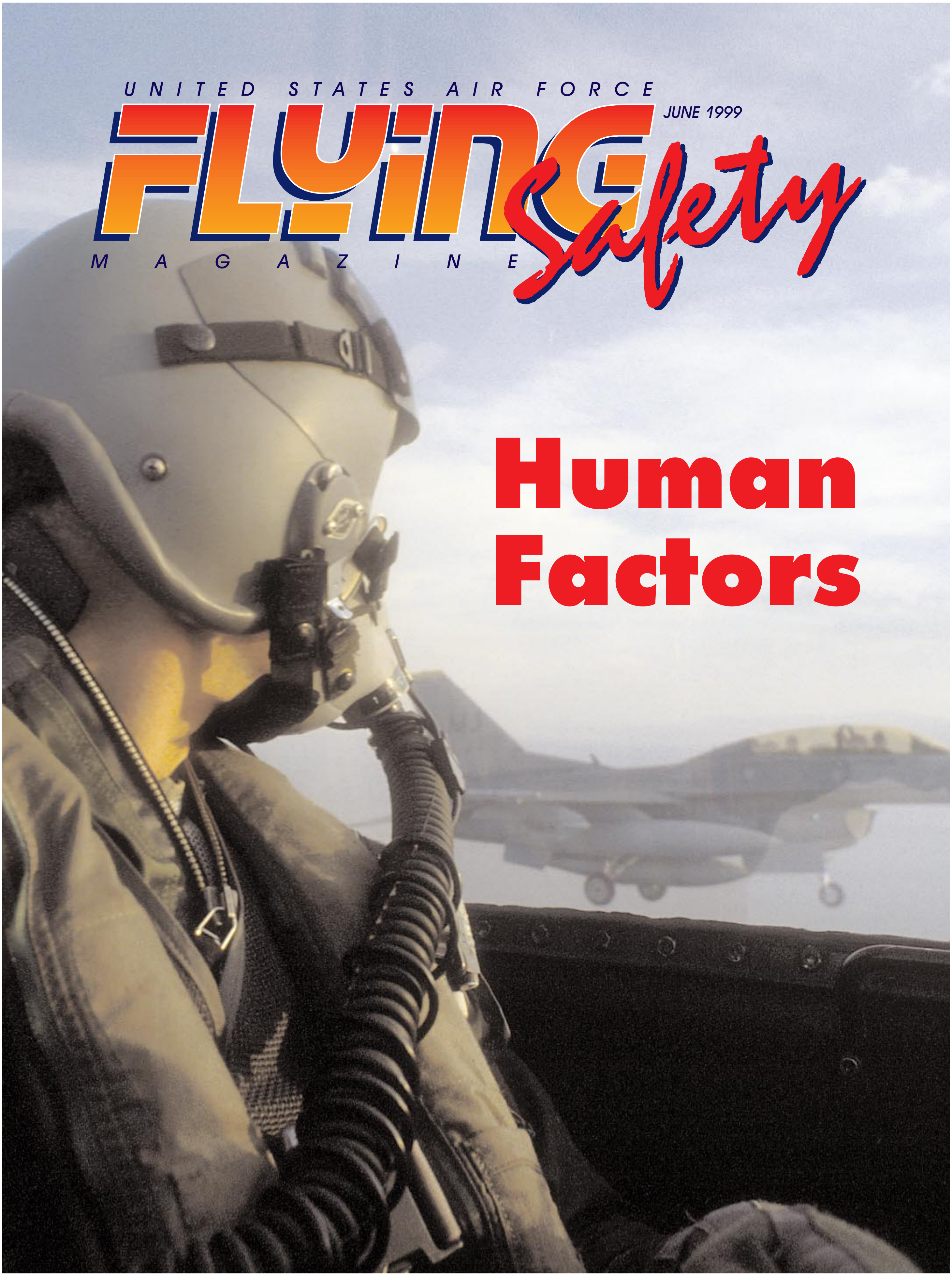
UNITED STATES AIR FORCE
FLYING Safety
MAGAZINE
JUNE 1999



Human Factors

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FSM notams

WHERE THERE'S SMOKE…

Courtesy ASRS *Callback*, Feb 99

A special report issued by the Flight Safety Foundation in 1994 noted that "aircraft fires are rare, but their prospect is terrifying." When such events do occur, crew and passengers often have only moments to escape toxic fumes and acrid smoke. (FSF *Cabin Crew Safety*, Vol 28, No. 6 and Vol. 29, No. 1).

Some of the more common causes of in-flight smoke and fumes reported to ASRS are hydraulic fluid leaks in air-conditioning packs and electrical shorts in cockpit instrumentation. But several ASRS reports describe highly unusual incidents involving in-flight smoke and suspected fire. We begin with a first officer whose thirst had nearly unquenchable consequences.

While in level cruise at 11,000 feet, I was enjoying a drink of water from a clear, plastic water bottle that I normally carry with me on flights. Suddenly, the captain and I smelled smoke in the cockpit. About a second later, I felt an intense burning pain on my left leg. When I looked down, I found the smoke to be coming from my pants leg.

The cause of this unusual occurrence also became immediately evident—the clear water bottle that I had resting between my legs had magnified the sunlight coming through the side window! The beam was concentrated…on my left leg near the bottle.

At least if a fire had actually been allowed to develop, the emergency procedure would have been quite simple: (1) pull open spout; (2) squirt!

This event has caused me to think of the possible consequences of leaving a water bottle or other clear plastic or glass object on a pilot's seat or console in an unattended aircraft parked outside in the sun.

Other pilots may wish to follow our reporter's lead and consider adopting personal procedures to prevent such "pants on fire" experiences.

Food for thought here. While we can't vouch for the truth of this occurrance, we can say that two things are undeniably true. One, bottled water containers are found everywhere. And two, stranger things than the author describes have happened. —Editor ■

Temporal Distortions and the Ejection Decision

In an emergency, you may have less time than you think.

LT COL DOUGLAS M. CARSON
Directorate of Aerospace Safety
Flying Safety, Mar 82

Why do so many highly trained aviators lose situational awareness in critical emergencies, and what can we do about it? To answer this question we have to take a look at what happens to an individual who is under stress.

It would probably be the understatement of the Twentieth Century to say that an aviator who is suddenly faced with an ejection decision has been placed in a condition of acute stress. Most discussions of stress deal with the long-term effects—high blood pressure, ulcers, heart attacks, etc. Let's take a look at what happens to the body in the short-term (acute) phase.

In the course of evolution, animals have developed an amazing mechanism to defend themselves against all kinds of assaults. This defense mechanism is the "fight or flight" response, an involuntary alarm reaction to conditions of acute stress.

When the brain perceives a threat (stress), it reacts by exciting the hypothalamus. The hypothalamus, in turn, stimulates the pituitary glands to inject adrenocortiotrophic hormone (ACTH) into the blood. ACTH signals the adrenals to immediately secrete two substances—cortisone and adrenaline. Cortisone's effects are generally of a long-term nature, but adrenaline has immediate effects. The emergency discharge of adrenaline (a stimulant) increases the pulse rate and blood pressure. Perspiration increases. Sugar levels of the blood are raised to provide additional energy. The muscles tighten in preparation for immediate use, physical strength is dramatically increased, and the threshold of pain raised. The body is now prepared to fight or flee.

The discharge of hormones also triggers the entire nervous system which becomes alarmed in preparation for combat. This brings us to the little-discussed phenomenon I call TEMPORAL DISTORTIONS, which is the key subject of this whole article.

Before we go any farther, let's get a working definition of this term. *A temporal distortion is a temporary false perception which slows the apparent passage of time.* When an individual experiences a temporal distortion, time expands and events appear to happen in slow motion. This can occur automatically under conditions of acute stress, but it can also be artificially induced by certain drugs such as marijuana.

The exact physiological process isn't precisely understood. It seems that the brain instantly becomes intensely alert, increases its efficiency, and begins to process information at an accelerated rate. Regardless of the actual physiological process, the phenomenon is real, and the result is that time appears to slow down. This is part of a remarkable defense mechanism which has evolved over millions of years. It's obviously been successful in the environment in which it evolved, by virtue of the fact we're here today. (Individuals who inherited this characteristic survived.)

The following examples of successful ejections can help show how often temporal distortions occur under acute stress and how dramatic the change in time perception can be. A hypothetical case will then illustrate how a temporal distortion can kill.

These examples contain the actual comments made by the surviving crewmembers. Bear in mind that since temporal distortions had not been recognized by the USAF, comments about this phenomenon were unsolicited—they were provided by individuals who felt the subject was important enough to mention.

• The first mishap was a midair collision between two F-4s. The WSO of one aircraft made these comments: "Ejection was initiated with min time decision (.5 - 1 sec) by me. As a unified movement, I pulled the handle and threw my head back (I practiced all ejections in simulators that way so that action was automatic). Between pulling handle and canopy separation, I was aware of being enveloped in a fireball. Time distorted, and I was acutely aware that the canopy had not yet separated."

• This mishap was also an F-4. Again, the comments were extracted from the WSO's narrative.

"Emergency was left wing folding on takeoff. As soon as we were airborne, the aircraft started a roll to the left. I delayed ejection until I felt the aircraft would hit in a clear area. Time had expanded greatly, so it felt like several minutes before it was time to get out. Still no feelings of excitement. Waiting to eject felt no different than waiting to change the INS to the next turn point. I assumed the ejection posture and pulled the lower handle. Again there was time expansion. The canopy leaving, the seat going up the rail, and the aircraft disappearing below me seemed to take several minutes.

"Because of altitude, I had elected not to perform the four-line jettison, but it seemed to be taking forever to come down. Since I was coming down on the parking ramp, I wanted to see where I was going and what I was going to hit. Only a few seconds later, my feet hit the ground, and I felt a pain in my left ankle. I tried to release my shoulder harness but got only the left one. After what seemed a very long time, I managed to release my harness and came to an immediate stop. Just as immediate, I was surrounded by people asking how I was, and the one and one-half minute ordeal that took 10 minutes was over."

• This is still another F-4. The aircraft departed controlled flight at 2,000 feet above the terrain. Ejection was initiated at 1,200 feet AGL. Here are the aircraft commander's initial comments from his narrative: "In retrospect, my perception of time is the most interesting aspect of the incident. After warning the WSO that recovery from our unusual attitude was doubtful and then putting all of my attention into aircraft control again, it seemed like minutes from the emergency's onset until our ejection. It was actually very few seconds."

In addition to these examples, other escape system reports included numerous indirect references to inaccurate time estimations. Two pilots reported parachute rides of 10 to 15 minutes after ejection. The computed descent time in one case was 7 minutes and 5 1/2 minutes in the second case. Several F-4 pilots mentioned a long-time delay from the time the backseat left the aircraft until the front seat fired. The first female to use an escape system was a student pilot who ejected from a jet trainer following an engine fire and loss of control. After parachute deployment, she stated, "I sailed for about three to four minutes, down to a farmhouse front yard on one of the main roads back to the base." However, ejection was initiated at approximately 2,000 feet AGL, so the parachute descent time was actually closer to 90 seconds!

continued on next page

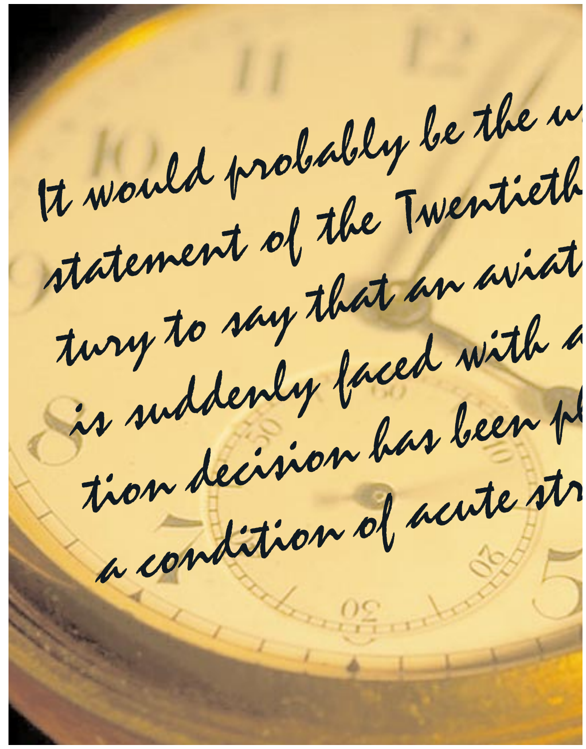
Our brains, like computers, take in information, process it, and make a decision. That decision is translated into a course of action. If some of the information is erroneous, the decision could be a bad one, and the resulting course of action, particularly in the case of an aviator, may be a fatal one.

I can personally attest to the fact that a temporal distortion can occur under stress, and its effect can be dramatic. While performing a functional check flight on an F-4, I experienced an engine bay fire. We took off only about 1 minute before I got a fire light, so I immediately declared an emergency and turned back to the airport. During the descent, level off, and base turn, everything was unhurried. The WSO and I completed the emergency checklist items. Total elapsed time to this point was $4\frac{1}{2}$ minutes.

After rolling out on base leg, the situation and my perception of time changed dramatically. The landing gear and flaps would not extend, both fire lights and both overheat lights abruptly illuminated, two hydraulic systems went to zero, and aircraft control started to deteriorate. I told the WSO the aircraft was becoming uncontrollable, and we would have to get out. I used what little control we had left to point the aircraft toward a clear area. As soon as the aircraft was pointed away from the city, I told my backseater to bail out and grabbed my lower ejection handle. I felt that the flight time from the base turn to the ejection point was longer than the flight time up to the base turn. A radar plot later indicated it was only 54 seconds.

The entire ejection sequence from pulling the handle to parachute deployment appeared to take at least 30 seconds. (It was actually 6 or 7 seconds.) I heard the rear canopy pop, was aware of a delay, and then heard the double bang as the rear seat departed the aircraft. It seemed to take several seconds before anything else happened. I looked at the instrument panel, confirmed both fire lights and overheat lights were still illuminated, noted the aircraft heading, altitude, attitude, airspeed, and engine instrument readings. I was totally amazed that the ejection sequence was taking so long and I was thankful the aircraft wasn't in a dive. The front canopy finally departed with a loud pop. I was surprised there was no apparent windblast, and I still had time to think "Okay, here it comes!" The explosive charge fired, and the aircraft appeared to drop away. Then the seat rocket motor ignited, and I blacked out momentarily from the acceleration. The only thing I was totally unprepared for was the noise. (It is loud!) The seat slowly pitched forward and started to roll to the right. For the first time, I was aware of windblast. The drogue gun finally fired, and a short time later the chute deployed with a "whump."

I saw my backseater in his parachute and then directed my attention to our crewless



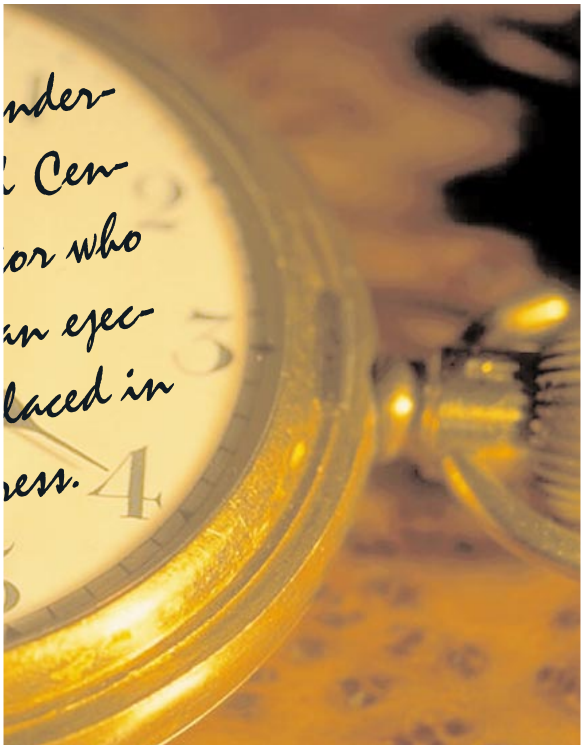
In the course of evolution, animals have developed an amazing mechanism to defend themselves against all kinds of assaults. This defense mechanism is the fight or flight response, an involuntary alarm reaction to conditions of acute stress.

aircraft. It appeared to be moving in slow motion as it approached the ground about a mile away. The thought that went through my mind was pure disbelief—it was impossible for the aircraft to fly that slowly! I watched the airplane impact in an empty field and start to break up. The fireball boiled up at about the same rate as a nuclear explosion.

At this point, I was so sure that I wasn't going anywhere I actually looked up to see if my chute was hung up on something! It seemed to take 5 or 6 minutes to reach the ground, even though the descent actually took about $1\frac{1}{2}$ minutes.

My perception of the ejection sequence was that it took as long to happen as it took you to read my description of it. The point is: *Under acute stress, you cannot trust your sense of time!*

These temporal distortions, like spatial disorientations, are particularly dangerous because they are insidious. We tend to believe our perceptions. Our brains, like computers, take in information, process it, and make a decision. That decision is translated into a course of action. If some of the information is erroneous, the decision could be a bad one, and the resulting course of action, particularly in the case of an aviator, may be a fatal one. To illustrate this point, let me put



you in the following hypothetical situation.

You've just completed two engagements on a Defensive Basic Fighter Maneuver mission, and things couldn't have gone better if you'd written the script yourself. There's plenty of fuel left for one more engagement, so you're inbound and eagerly looking forward to making the humiliation complete for the other guys. Your wingman makes a quick call, "Lead, break right! Two bandits four o'clock high!" You make the break and get a tally. A quick look shows they're committed nose low and really smoking. (Hot dog! Pull just a bit and they'll overshoot. Then a quick reverse and we'll have 'em.)

Suddenly your nose slices to the left, and you start an uncommanded roll as the nose descends through the horizon. Instinctively, you shove the stick forward to unload the aircraft. A cold flash shoots through your body, and your mouth instantly feels dry. The aircraft is nose low and rotating to the left. (Is this a rolling departure, or am I in a spin?) A quick glance at the altimeter shows that you're passing 10,000 feet. (This is getting serious!)

The adrenaline is really pumping now, and everything is slowing down. (Hey, the rotation rate is decreasing. It's about time. I'm starting to get a little low.)

"Lead, bail out!"

"Stand by, two—I've just about got it!" (I think I've just about got it. Everything's slowing down.)

"You're too low! Bail out now!"

(Why doesn't this stupid bird respond? Everything is so sluggish. Holy cow, there's the ground! I don't believe it—I really gotta get out of this thing!) You grab the handle and pull. (What's wrong? Why is it taking so long? There goes the canopy! Why doesn't the seat fire? OOF! What a kick! I'm still in the seat, and here comes the ground. What's taking the chute so long! If it doesn't open soon, I'm not going to make it…).

It's tragic, but hundreds of aviators over the years probably had similar final thoughts. On top of that, they watched themselves die in slow motion. Don't let it happen to you!

Temporal distortions haven't been treated seriously in the past. Now there's ample evidence which seems to indicate they may be responsible for delayed ejection attempts. It's time to stop thinking of this phenomenon as a mildly interesting curiosity and start treating it seriously. It's a killer and has to be recognized as such.

Okay, so much for that. Now, what can you do? Here are some suggestions which might help you if you find yourself faced with an ejection decision.

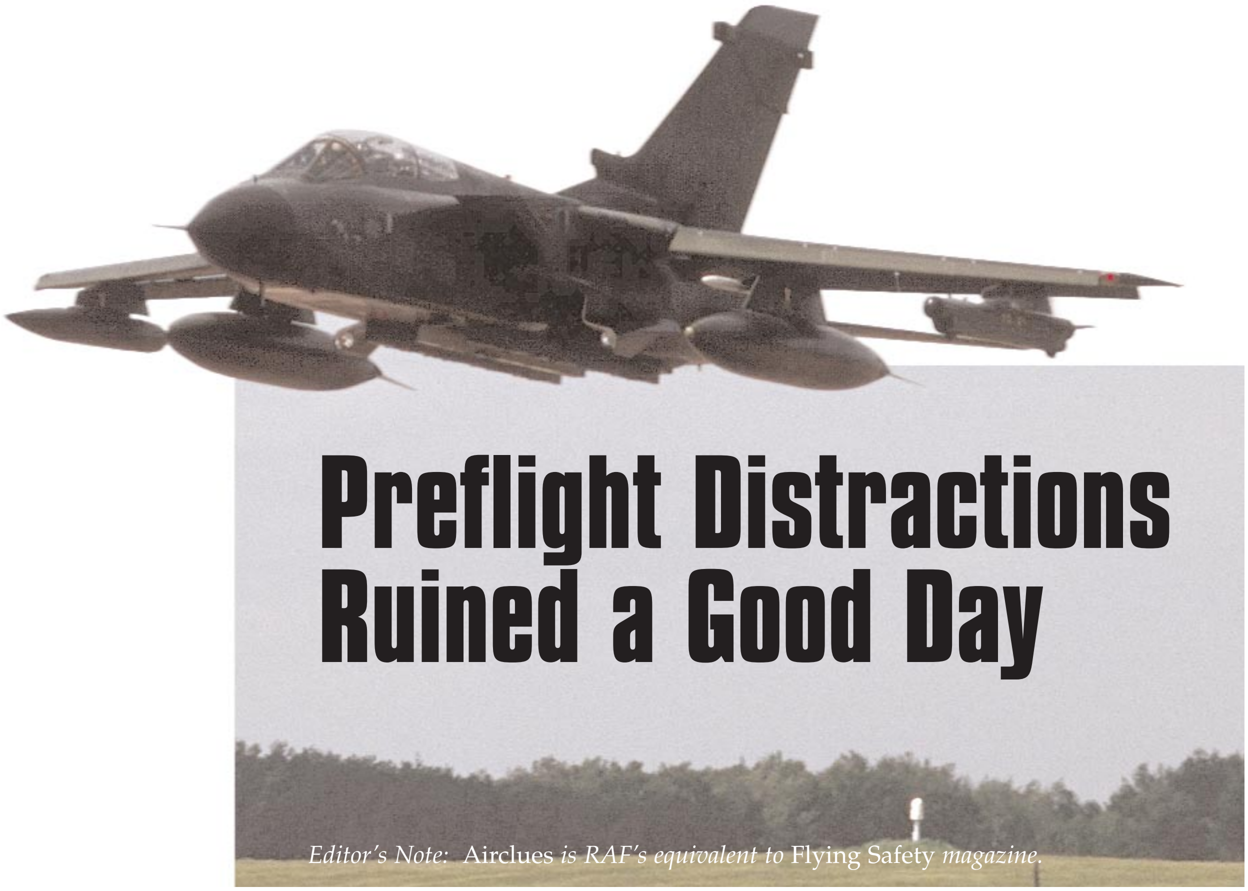
▼**Recognize the problem.** If you read this article, you made a start. Realize this can happen to you when you're under acute stress.

▼**Make the ejection decision on the ground.** The ejection decision is not an easy one. Believe me, it's the most difficult decision I've ever had to make. Don't wait until you're faced with an immediate decision. Plan your course of action in advance, and if the time comes, stick to your plan.

▼**Believe your instruments, not your senses.** Treat a temporal distortion like a spatial disorientation. Remember, those ejection altitudes for controlled and out-of-control conditions are minimum recommended altitudes. Once you recognize the aircraft is gone, for whatever reason, write it off and get out! You've made the decision; now execute it immediately. Don't waste those few precious seconds. ✈

(Editor's Note: This article was originally published in the March 1982 issue of Flying Safety. *Although we have removed some dated information, the phenomenon of temporal distortion in times of stress remains a potentially serious problem.)*

When the brain perceives a threat (stress), it reacts by exciting the hypothalamus. The hypothalamus, in turn, stimulates the pituitary glands to inject adrenocorticotrophic hormone (ACTH) into the blood.



Preflight Distractions Ruined a Good Day

Editor's Note: Airclues *is RAF's equivalent to* Flying Safety *magazine.*

Courtesy AIRCLUES, Winter 1998

After takeoff, on undercarriage up selection, the nosewheel indication stayed at red. We asked lead for a visual inspection and started to action the FRC (Flight Reference Card) drills.

The task was simple: No. 2 of a pair of Tornado GR1s was returning to base from an air day in Corsica, staging through Marham. We arrived at Met in good time to discover that, although Marham was usable, there was no legal diversion available given our planned fuel at Marham. We then considered using Dijon, where the weather was fit, only to be told that the airfield was closed. At this stage, I went to the flightline to refuel both aircraft prior to departure.

During the subsequent brief, I pointed out that the weather at the booked diversion was not legal. Some hurried phone calls, and we were eventually booked in to Landivisiau (northwest France). The transit towards Landivisiau was uneventful until about 150 miles out when we were told that Landivisiau (which had given us a prior permission number!) was, in fact, shut, and we had to divert to Lorient.

On arrival at Lorient, all was well until we started refueling the second (my) aircraft. Although fuel would flow happily into the rear/right group, it did not want to enter the front/left group. Normally this problem can be cured by simply moving some cockpit switches; however, on this occasion, this was to no avail, and we started to look for other solutions.

Time was now pressing as we were aware that base would be closing at 1700 local, and we still had a long transit to complete. I tried recycling all the refuel-associated switches whilst my navigator, assisted by the lead navigator, started to check the circuit breakers. In order to access some of these CBs, my navigator opened panel 302VE in the nosewheel bay. None of the CBs had popped, and with my switch recycling unsuccessful, I went to Ops and telephoned the engineers at base. The specialist there had two useful suggestions, both of which required external power to be applied to the aircraft. Having been assured by the French handlers that they had a suitable power set, I returned to the pan to find both aircraft packed and ready to go, except for the fuel problem. The second suggestion from base worked, and having signed for the refuel and turnaround, I stowed the aircraft servicing record (F700), did a walkaround, and strapped in.

After takeoff, on undercarriage up selection, the nosewheel indication stayed at red. We asked lead for a visual inspection and started to action the FRC (Flight Reference Card) drills. The visual inspection showed all legs up and doors closed, and we were just about to action the FRC drill, which allowed a recycle of the undercarriage.

At this point, the alarm bells in my head, which should have sounded far sooner, went off. I asked my navigator if he remembered closing panel 302VE, to which he replied with words to the effect of, "Oh gosh, no!" Recycling the gear suddenly seemed a less sensible option, so we lowered the gear, burned off some fuel, and landed back at Lorient with lead waving us a metaphorical good-bye on the radio.

Diagnosis of the direct cause of the incident was easy. The panel was open, and the cover was "creased" where the nosewheel bay door mechanism had fouled on it, preventing the final microswitch from closing and causing the red light. Ultimate blame was also easy to apportion. I was captain, I signed for the jet, and I did the walkaround!

However, how did it happen, when three aircrew, all with over 1,000 hours on the jet, were aware, to some degree, that the panel had been opened? So why was it never closed, and why did I not spot it on the walkaround?

The panel is difficult to open, being held in place by four catches and two safety pins, none of which are easy to close. The pins are notorious for delivering painful cuts to unwary fingers. This design problem certainly influenced my navigator's decision to leave the panel open, just in case the engineers told us to pull and reset some other CBs. The temporal pressure probably made my walkaround less thorough than it could have been, but several other factors also played their part.

First, the panel is painted black on both sides. When open, it hangs flat against the right-hand side of the nosewheel bay and is not visible from outside or conspicuous when the nosewheel bay is examined. Second, it was a very bright, sunny day. The nosewheel bay is dark, and my eyes were therefore not adapted to the shadows of the area. Third, external power was connected to the jet, which made the bay very noisy and certainly discouraged any loitering in the area.

Finally, I had looked inside a nosewheel bay over a thousand times and had never seen this panel undone. I may have reached the stage where I was looking, but not seeing, or seeing what I expected to see, not what was there.

I believe there are several lessons here, apart from the obvious "Do your checks properly."

◆If you open a panel, remove a filler cap, or undo anything that does not want to stay undone, then close/refit it immediately when you have finished working in the area. It may cost a little time, but it can save embarrassment.

◆Examine your own working practices occasionally. What are you really looking for when you do a check? I learned several years ago to positively count out loud pins and greens when doing checks. I now have stored away what that panel looks like when open and how to spot it.

◆The old lesson still applies—beware of distractions and external pressures.

Finally, one for the engineers: This is by no means the first time this incident has occurred, and I doubt it will be the last. Can the panel not be modified to make it more conspicuous when open? Simply painting the inside red as we do for external panels would help. However, a better solution would be to attach a 30-60 cm flag to the inside of the panel. When closed, the flag would lie flat inside the panel, but when open, the flag would hang down below the level of the nosewheel undercarriage doors. Thus, the flag would be visible from outside, which would make an open panel more conspicuous and increase the number of people with a chance to spot the error. I believe this modification would decrease the risk of this incident being repeated. ✈

The Squadron Commander Comments:

The pilot volunteered to complete this report and has been extremely forthright and candid on the circumstances leading up to this incident. This is not the first time, to my knowledge, that an incident such as this has happened, and I believe that his recommendation has merit.

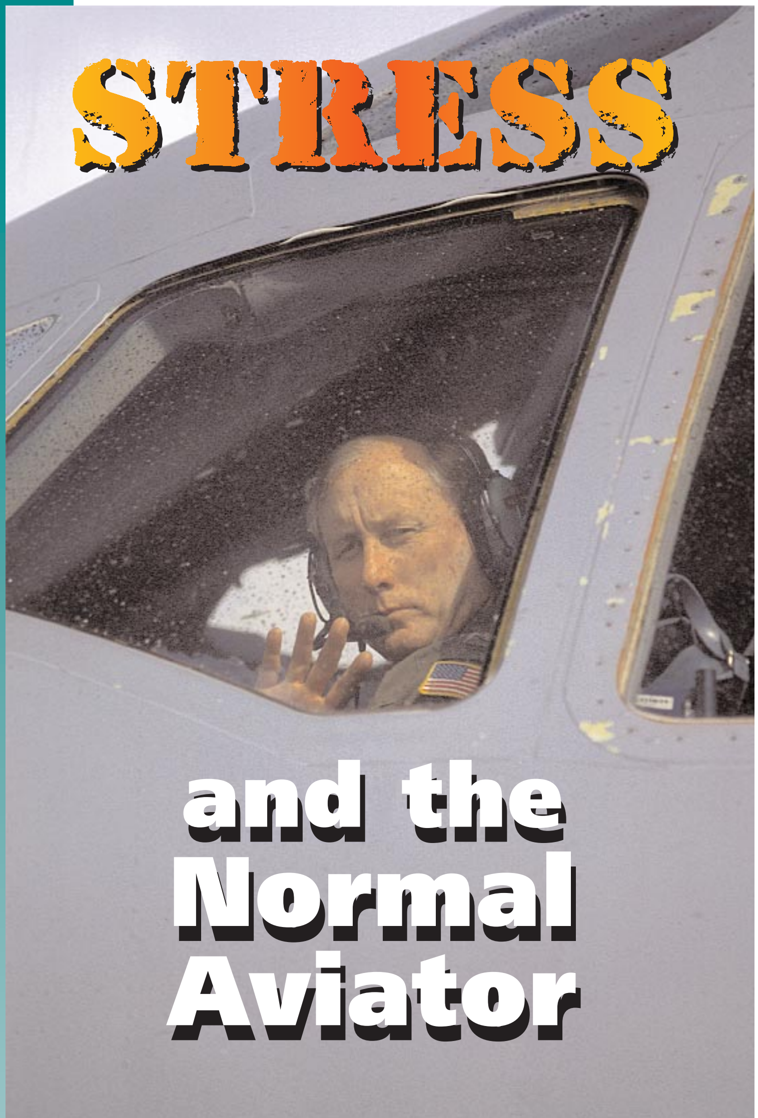
The Station Commander Comments:

I commend this pilot for his honesty in raising this report. There are lessons here for all of us and some practical suggestions which must be followed up.

Wing Commander Spry (Editor, AIR-CLUES Magazine) Says:

The pilot's suggestion has been passed on to the Tornado Support Authority for consideration.

At this point, the alarm bells in my head, which should have sounded far sooner, went off. I asked my navigator if he remembered closing panel 302VE, to which he replied with words to the effect of, "Oh gosh, no!"



STRESS and the Normal Aviator

Surprisingly, almost half of all Class A flight mishap reports since FY91 make mention of some psychosocial stressor involving one or more of the crew.

LT COL JAY C. NEUBAUER, MC, SFS
HQ AFSC/SEFL

The stresses and strains of life come in all sizes and levels of complexity. What do I need to get done today? I've got to remember to stop by the store on the way home tonight. I've got to sit down with my family and prepare for the upcoming TDY. I've got an appointment with the lawyer today about the divorce settlement. How are we going to pay for medical bills after our daughter's (son's) surgery?

We can all relate to the occasional (or maybe frequent) desire to leave it all behind, move to a South Sea island, and work at getting a tan. Each of us deals with some level of stress daily, and our reaction to that stress affects how we perform both on the ground and in the air.

Surprisingly, almost half of all Class A flight mishap reports since FY91 make mention of some psychosocial stressor involving one or more of the crew. In 15 percent it was considered a contributor. The 44 percent of mishaps with documented stressors may be just an indication of how much we all take on in today's society, or, worse, it may suggest that those dealing with personal problems may be more likely to have a mishap.

There are really two parts to the issue of stress management: how much stress there is, and how each individual deals with that stress. It's not surprising that military aviators carry a lot of stress but manage the stress so it doesn't have an obvious effect on work performance. Where others might "fall apart" or be distressed by a single stressor such as illness, financial loss, or a fight with a significant other, aircrew tend to compartmentalize well. In other words, aviators can put the problem(s) in the back of their minds for later when they have time to pull the issue up and think about it. The compartmentalization allows the aviator to concentrate on the task at hand, i.e., flying, without the continual "I should have done…" popping into their head.

Unfortunately, each flier has an amount of stress or a specific issue stressful enough to overpower the ability to compartmentalize. In other words, we each have a specific tolerance to stress. That tolerance changes over time (i.e., what you could handle last year may not be what you can handle this year) and changes from event to event. As the tolerance threshold is passed, the ability to keep things locked in the back of the brain begins to fail. This is when performance starts to break down, and mistakes are made. The more complex the task or job, the more mistakes are made and the higher the risk of a mishap.

So, "What can I do about it?" you ask. The obvious fix would be to limit stress and know your limits. Unfortunately, most fliers are hard-driving, goal-driven overachievers and take on a lot of stress as a routine. In addition, any goal-driven overachiever tends to be a pretty poor judge of when things are starting to affect performance. Therefore, it is incumbent on each of us to watch out for the other. Here are some obvious signs of stress easily noted in others.

1. Irritability—Short-tempered, reacts to small annoyances/inconveniences

2. Anger and hostility out of the norm or out of character
3. Distracted/Preoccupied—Hard to maintain attention, misses information, slow to pick up on information and its significance
4. Distancing from friends/squadron mates—Becoming the loner, loss of interest in usual activities
5. Change in personality—Routinely acts differently, e.g., easy-going to uptight, happy to sullen
6. Increased use of alcohol, tobacco products—Increased regular use, excessive for individual
7. Increased frequency of illness—From frequent colds to significant headaches and gastrointestinal upset
8. Sleep disturbances—Insomnia, inability to get to sleep, inability to stay asleep, difficulty getting up
9. Change in appetite—Potentially manifested by weight loss or significant weight gain

These warning signs are by no means absolute, but they are warning signs suggesting something is wrong. Any of these signs taken individually may mean nothing. But if there are stressors present, these are dangerous characteristics telling squadron mates the compartmentalization is leaking, and normal coping methods aren't working. Several of these signs are also indications of depression, i.e., stress and inability to cope may well lead to mild depression or worse.

Although there are very few mishaps where personal stressors were considered the cause of a mishap, it's very likely the stressors may have been subtle contributors. Unfortunately, the connection is often difficult to prove and, therefore, the association is not made or documented.

Why mention stress management if it's not a direct contributor to mishaps? Because another human factor, ***attention management,*** is a frequent cause of mishaps. Last year, 45 percent of our Class A mishaps had attention management as a significant factor. The year before, it was almost 40 percent. In fact, year after year, attention management is in the top three human factors associated with Class A flight mishaps.

When personal issues start to leak out, one of the first things to go is the ability to focus the needed attention on a given critical task. Inattention, distraction, and channelized attention draw the attention away from the critical task. At the wrong second, they can literally lead to disaster.

Again, the warning signs above are significant in the right context and warrant, at least, some further query.

Just something to think about? No, not while you're flying. ✈

When personal issues start to leak out, one of the first things to go is the ability to focus the needed attention on a given critical task. Inattention, distraction, and channelized attention draw the attention away from the critical task. At the wrong second, they can literally lead to disaster.

Lead Violinist for the London Symphony Orchestra

Courtesy AIRCLUES, Winter 1998

Have you ever seen the film *Distractions*? If you haven't, but you re reading this article, spare the time to get the video from your FSO. It's as relevant now as it was when it was made in the eighties (probably more so), and I recommend it to anyone remotely connected with our business.

So, what happened?

One fine day I walked for my jet, greeted my liney (start-up crew), and began my walkaround (external check). Having completed over half of it, and by now standing under the port wing, I realized that I hadn't really checked anything properly. I had just gone through the motions. I started the process again and explained to my liney what I was doing. This ate into precious time, but—not to worry—there was still some in reserve. I climbed up the ladder to the cockpit. Strangely, I felt as if my legs were made of lead. Some more checks, this time of the ejection seats, a glance at the navigation system to see that all was well with the alignment, and then it was time to strap in.

I chatted with my liney as he handed me my shoulder straps (looking back, if he had told me that his mother had died I would have probably said, "Oh, that's good"), and after showing him the seat pan pin, I was ready to get my office into shape. My hands were soon flashing around the cockpit as they were used to doing, but something was wrong—they seemed totally detached, as if they were someone else's.

By now I had one engine turning and burning, and my right hand was making the sign to start No. 2. But, as if coming round from a deep trance, the conscious side of my mind began to take stock of the untidy state of the office. Checks had been missed, and things which should have been turned on earlier were still off, and I couldn't remember what I had just checked. I sat there for a moment to collect my thoughts, and a cold finger of doubt started to tap me on the shoulder. Logic dictated that I sort it out, and so I began the process of switching things on that should be on and rechecking the systems that had been omitted or forgotten.

A look at my watch told me that I had better get a move on because time was running out and there was still much to be done before the formation check-in time, which was looming. More hands flashing around now, but again, my mind seemed to be elsewhere. That finger of doubt was now prodding me in the back.

I think my pulse was racing as I tried in vain to get my mind to catch up with what my hands were trying to do. I felt very odd. At some point I rehearsed in my mind what we were about to go off and do. We were going to the tanker, I was No. 3 of 4, then we were going to the range to do some fairly nonroutine and demanding weaponry. The leader was not yet qualified as such, and, therefore, I was the formation supervisor and ultimately responsible for the sortie (a common occurrence at the time).

I started No. 2 and did some more checks, but again, my hands seemed to belong to someone else. And then it dawned on me. I was about as capable of flying this trip as I was of playing lead violin with the London Symphony Orchestra—I was a shambles. Pride raised its dangerous head at this point, as did thoughts of setting an example as a "can-do" professional and, while these and other thoughts were spinning around in my overloaded head, the leader called us in.

"Three standby," was my initial response. This gave me thinking time. Finally, an awareness of everything I'd learnt about flight safety and supervision, as well as thoughts of self-preservation, and the vision of my mangled body being fished out of the Wash, started to win the mental battle against pride. I came to a decision.

"Three is unserviceable," I said to the leader.

"Okay three, are you going for the spare?" (My pride was really hurting now.)

"No, I'm unserviceable, not the aircraft."

Looking back now, I thank my lucky stars that I uttered those few painful words. I gave my liney the engine cut signal. There were still decisions to be made. The remaining formation was not legally constituted without me in it. (The loser plan had, reasonably, included me getting airborne in any event; if necessary, I would have been able to take one of the other aircraft in our formation if mine and the spare had both broken.) Having solved the main problem (*me*), I devised a workable and legal plan for the others to fly without me, briefed the leader accordingly, and off they went.

I honestly believe I stopped an accident from happening.

I shut all the systems down and climbed out. A great wave of fatigue hit me. I was exhausted. I was also worried. What was wrong with me? After debriefing the engineers, I walked back to the squadron and phoned the senior medical officer. I was put through to him immediately (excellent), and after a brief chat, he said that he would see me straightaway. After I told him what I had done, he said that this was one of the best moments in his career so far—a pilot had just grounded himself!

He also told me that he and his colleagues had noted how awful I'd been looking lately (the docs there took time to be involved with the squadrons and kept an eye on people—excellent). His diagnosis was that I was mentally exhausted, and he prescribed that I should disappear on leave for at least 3 weeks. A great idea, but I was due to go on the advance party to the States in the next few days where we were soon to take part in a major exercise (the jets we were going to use were already out there with another squadron). We reached a compromise: I would go on leave for a couple of days. He was due to go on the advance party with me, and he would review my fitness to fly when we were out there.

I flew (and led) the first sortie of the exercise in the States. Pride had been restored. Leading by example had been reestablished, and a possible statistic had been avoided. Well done, all of us.

But what had led up to all of this, and why couldn't someone else have taken some of the workload?

First, let's look at who was supervising me. The answer is…me! So where were all the other players in the chain?

- The station commander was handing over to his replacement.
- The squadron commander was handing over to his replacement (who, obviously, was not yet qualified).
- Two weeks before, the executive flight commander had been posted (I was now the exec, and, therefore, the deputy squadron commander and, for the next few weeks, effectively the squadron commander).
- We had a brand-new flight commander who was still finding his feet—progressing well, but not yet qualified.
- The remaining flight commander was fairly new, but was struggling. He was on review, was unqualified to supervise in the air, and added to our supervisory workload.
- My excellent deputies were busy trying to cope with the usual problems, including a lack of experienced/qualified pilots caused by the above.

Other factors which affected the squadron (and me):

- A few months earlier, the squadron had finished a long deployment to Bosnia on ops.
- One month earlier, we hosted the squadron exchange.
- We had some aircraft with new avionics, so we were converting to the new type and were flying a mixed fleet.
- Assets were short because of an aircraft fleet fatigue problem, which necessitated "horse trading" with the other squadrons.
- I was the station logistics information

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A couple of years ago, I was a flight commander in the squadron featured in that film, and at one time I thought that I was reenacting the part of the ill-fated main character. My story concerns supervision and asks the question, "Who supervises the supervisor?" Don t skip this article if you are on a ground tour at Group or Innsworth because there are lessons here for you, too.

After I told the senior medical officer what I had done, he said that this was one of the best moments in his career so far. A pilot had just grounded himself!

technology strategy (LITS) pilot representative and was having to spend a lot of time at LITS meetings (we were the lead squadron for implementation).

- I was sent at short notice overseas by the station commander for a LITS visit as I was the only flight commander who knew anything about it.
- I returned from the overseas LITS visit. My girlfriend left me. (She would rather have a relationship with someone she could see once in a while.)
- We deployed overseas on the squadron exchange.
- I was recalled at short notice by Group to give a briefing to aircrew on LITS.
- I flew in the VJ Day flypast over London (Saturday evening).
- I led a VJ Day flypast over Bury St Edmunds (Sunday).
- I flew on the Monday, and Tuesday night for currency.
- **Wednesday - GROUNDED.**

Overall, you could say that the supervisory system worked, in that I grounded myself.

Also, I was experienced, I had a good track record, and I had attended all the excellent courses on supervision, etc. However, I think that it was too close for comfort in a peacetime environment.

But there's the rub. It wasn't strictly peacetime (Bosnia, etc.), but we were not at war either—just trying to adjust to a period somewhere in between, as is the case for many now when you look around our air force. To my mind, the operational deployments were not in themselves a problem. Sure, there were the added risks (the ones we all accept when we take the Queen's shilling—and quite rightly so), but the problems are caused by simply the time spent away.

Domestic pressures apart, the periods away create a narrow time frame into which everything else must be squeezed. Most important of all is the need to train in all those aspects which operational flying denies you, and those aspects are normally the core elements (low flying, range work, currency, workups, etc.). Often, further overseas training periods will be required to gain the maximum benefit from the flying hours.

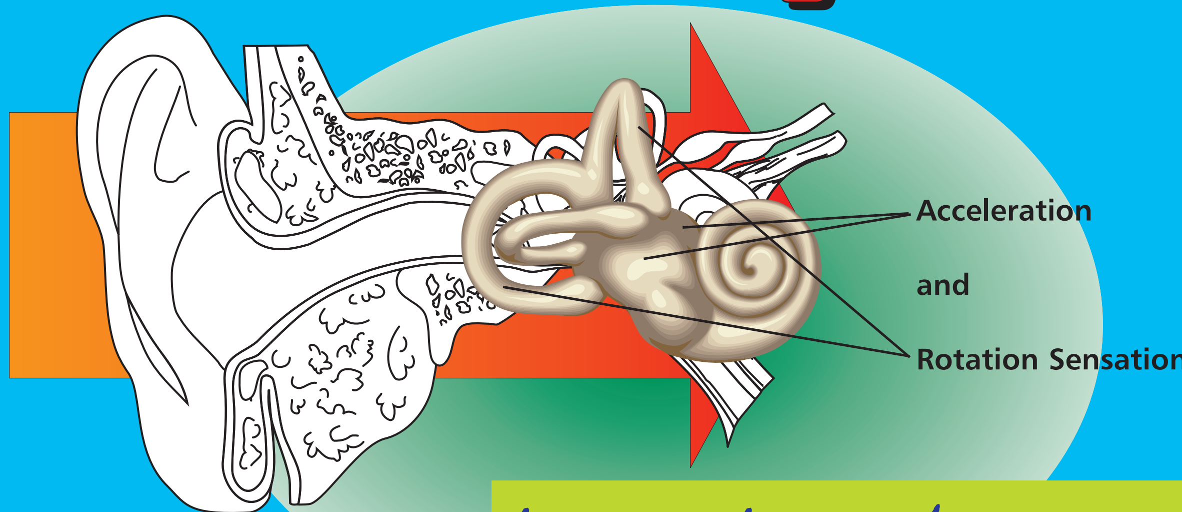
Back at home base, probably with other squadrons away, visits, leave, courses, and secondary duties, etc., are these days more of a problem to accommodate. Also, the posters have a small window of opportunity to get their difficult tasks done, which results in there being more new people to train at the same time.

"Well, we know all of this," I hear you say. But let's face facts. Make sure that everyone in the organization is in the picture, and try to manage the situation better than we have before.

Finally, if you're out there doing one of the best jobs going, trying to maintain our reputation as one of the finest air forces in the world, with a lot of factors making that more and more difficult to achieve, remember that you won't be thanked for drilling a large hole in the ground. ✈

Hidden Hangover

Alcohol and Your Inner Ear



Lessons Learned: There are two ways to get smart. One is through experience—we call this "the hard way." The other is to learn through others' experiences. The second method is much easier on our machines and bodies.

LT HEIDI SQUIER, MSC
Courtesy *Approach*, Jul 98

It's 0100 at the O Club. A hail and farewell has continued into the night, but our aviator knows he will not brief his flight until 1400 the next day. "More than 12 hours bottle to brief," he thinks, as he declines a beer and orders a glass of water. He gets a room at the BOQ so he doesn't have to drive. After checking in, he forces down more water and falls asleep.

By 1400 the next day, our hero feels fine. The water he drank did the trick of hydrating away his hangover symptoms. He arrives for his brief apparently in good shape. His flight goes fine—until he enters IMC. Before he can transition to instruments, he becomes aware of a sickening, spinning sensation. His copilot takes the controls and lands. However, our aviator is confused, as well as nauseated.

"These symptoms can't have anything to do with last night," he thinks. "It's been more than 12 hours since my last drink. NATOPS and 3710 both say I can fly."

He can—but should he?

His problem is in his vestibular apparatus, which lies buried within the inner ear and has tiny hair cells that stick into a jelly-like fluid. When the aviator turns or accelerates, this fluid moves opposite the direction of his motion, deflecting the hair cells and telling him which end is up. These hair cells are great inventions but are not intended to function without input from his eyes, ears, and brain. If any of these other components are impaired, a mismatch occurs, and he feels sick.

Alcohol displaces part of the fluid in the inner ear, making the tiny hair cells hypersensitive to any movement, almost as if they were sunburned. When you go out drinking and later lie down in a quiet room and close your eyes, you shut several other components out of the equilibrium system. The hypersensitive cells then make it seem like the room is spinning.

How does alcohol affect you in flight? It can take 24 to 48 hours for the alcohol in your inner ear to dissipate, despite a 0.0 BAC. It may still be there when you fly into clouds. Since the hair cells are still "sunburned," the false sensation could disorient you. In the case of this pilot, he waited to transition to instruments and thus cut his eyes out of the equation.

The bottle-to-brief rule was developed for good reasons and has worked for a long time. But there is another good rule of thumb for aircrew: If you're not sure of your ability to fly safely on the morning after, sit down and put your head between your knees. Rapidly sit up. If you get dizzy or feel sick, you might still have alcohol on board, buried within your inner ear. Remember how it feels to "spin," and decide whether to take that chance in the cockpit. ✈

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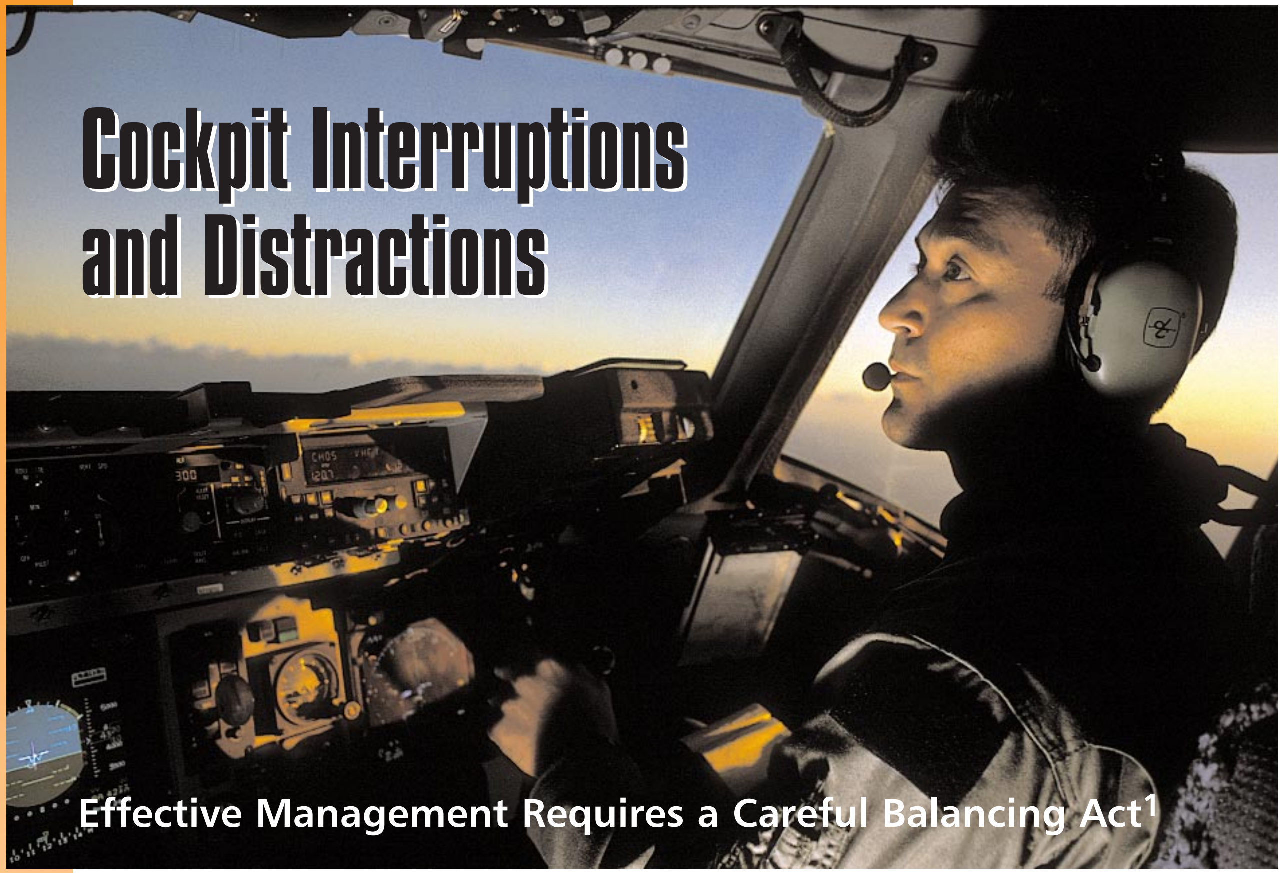
Cockpit Interruptions and Distractions



Effective Management Requires a Careful Balancing Act[1]

USAF Photo by SSgt Tana R. Hamilton

Most pilots are familiar with the December 1972 L-1011 crash that occurred when the crew became preoccupied with a landing gear light malfunction and failed to notice someone had inadvertently bumped off the autopilot.

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Courtesy ASRS, No. 10, Dec 98

Managing several tasks concurrently is an everyday part of cockpit operations. For the most part, crews handle concurrent task demands efficiently, yet crew preoccupation with one task to the detriment of other tasks is one of the more common forms of error in the cockpit. Most pilots are familiar with the December 1972 L-1011 crash that occurred when the crew became preoccupied with a landing gear light malfunction and failed to notice someone had inadvertently bumped off the autopilot. More recently, a DC-9 landed gear up…when the crew, preoccupied with an unstabilized approach, failed to recognize that the gear wasn't down because they hadn't switched the hydraulic pumps to high.

NASA has begun a research project to study why crews are vulnerable to these sorts of errors. As part of this project, we reviewed NTSB reports of accidents attributed to crew error. We concluded that nearly half of these accidents involved lapses of attention associated with interruptions, distractions, or preoccupation with one task to the exclusion of another task.

We have also analyzed 107 Aviation Safety Reporting System (ASRS) reports involving competing tasks; we present here some of our conclusions from this review. The 107 ASRS reports involved 21 different types of routine tasks crews neglected at a critical moment while attending to another task. Sixty-nine percent of the neglected tasks involved either failure to monitor the current status or position of the aircraft or failure to monitor the actions of the pilot who was flying or taxiing.

Thirty-four different types of competing activities distracted or preoccupied the pilots. Ninety percent of these activities fell into one of four broad categories: (1) communication (e.g., discussion among crew or radio communication), (2) head-down work (e.g., programming the FMS or reviewing approach plates), (3) searching for VMC traffic, or (4) responding to abnormal situations.

We will discuss examples from each category and suggest preventive actions crews can take to reduce their vulnerability to these and similar situations. Our suggestions are not perfect fixes, but we hope they will be useful. It's likely that research will ultimately provide more powerful solutions.

Category 1
Communication

- "Copilot was a new hire and new in type; first line flight out of training IOE. Copilot was hand-flying the aircraft on CIVET arrival to LAX. I was talking to him about the arrival and overloaded him. As we approached 12,000 feet (our next assigned altitude), he didn't level off, even under direction from me. We descended 400 feet low before he could recover. I didn't realize that the speed brakes were extended, which contributed to the slow altitude recover." (#360761)

In this example, the captain was attempting to help the new first officer, but the combination of flying the airplane and listening to the captain was too much for the new pilot. Tellingly, the act of talking distracted the captain himself from adequately monitoring the status of the aircraft.

Thirty-one of these incidents involved altitude deviations or failure to make a crossing restriction.[3] In 17 of these 31 incidents (and 68 of the total 107 incidents), the crews reported being distracted by some form of communication, most commonly discussion between the pilots, or between a pilot and a flight attendant. Most, although not all, of these discussions were pertinent to the flight. However, in many cases the discussion could have been deferred. We later discuss how crews can schedule activities to reduce their vulnerability to distraction.

Research studies have shown that crews who communicate well tend to perform better overall than those who do not. But conversation has a potential downside because it demands a substantial amount of attention to interpret what the other person is saying, to generate appropriate responses, to hold those responses in memory until it's one's own time to speak, and then to utter those responses. One might assume that it's easy to suspend conversation whenever other tasks must be performed. However, the danger is that the crew may become preoccupied with the conversation and may not notice cues that should alert them to perform other tasks. (The accompanying sidebar explores the nature of interference between competing tasks.) Special care is required to avoid distraction when others enter the cockpit, because they may not recognize when the pilots are silently involved in monitoring, visual search, or problem-solving.

Category 2
Head-Down Work

- "…Snowing at YYZ. Taxiing to runway 6R for departure. Instructions were taxi to taxiway B, to taxiway D, to runway 6R…as first officer, I was busy with checklists [and] new takeoff data. When I looked up, we weren't on taxiway D but taxiway W…ATC said stop…." (#397607)

In a review of airline accidents attributed primarily to crew error over a 12-year period,[4] the NTSB concluded that failure to monitor and/or challenge the pilot flying contributed to 31 of the 37 accidents. In 35 of the ASRS incidents we studied, the pilot not flying reported that preoccupation with other duties prevented monitoring the other pilot closely enough to catch, in time, an error being made in flying or taxiing. In 13 of these 35 incidents (and 22 of the total 107 incidents), the pilot not flying was preoccupied with some form of head-down work, most commonly paperwork or programming the FMS.

Monitoring the pilot who is flying or taxiing is a particularly challenging responsibility for several reasons. Much of the time the

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Special care is required to avoid distraction when others enter the cockpit, because they may not recognize when the pilots are silently involved in monitoring, visual search, or problem-solving.

USAF Photo by TSgt Marvin Krause

monitoring pilot has other tasks to perform. Monitoring the other pilot is much more complex than monitoring altitude capture because the other pilot is performing a range of activities that vary in content and time course. Thus, it's sometimes difficult for the monitoring pilot to integrate other activities with monitoring because he or she cannot entirely anticipate the actions of the other pilot. Furthermore, serious errors by the pilot who is flying or taxiing don't happen frequently, so it's very tempting for the pilot who isn't flying to let monitoring wane in periods of high workload.

Periods of head-down activity, such as programming the FMS, are especially vulnerable because the monitoring pilot's eyes are diverted from other tasks. Also, activities such as programming, doing paperwork, or reviewing approach plates, demand such high levels of attention that attempting to perform these tasks simultaneously with other tasks substantially increases the risk of error in one task or the other (see sidebar). Some FMC entries involving one or two keystrokes can be performed quickly and may be interleaved with other cockpit tasks. However, attempting to perform longer programming tasks, such as adding waypoints or inserting approaches during busy segments of flight, can be problematic. It's not possible for the pilot not flying to reliably monitor the pilot flying or the aircraft status during longer programming tasks, and it's difficult to suspend the programming in midstream without losing one's place.

Periods of head-down activity, such as programming the FMS, are especially vulnerable because the monitoring pilot's eyes are diverted from other tasks.

Category 3
Searching for VMC Traffic

USAF Photo by SSgt Andrew N. Dunaway, II

- "PRADO 5 Departure. Cleared to climb (and) received TCAS TA (which) upgraded to an RA, monitor vertical speed. While searching for the traffic, we went past the NIKKL intersection…for the turn to the TRM transition. We had discussed the departure before takeoff; special procedures, combined with many step climb altitudes in a short/time/distance, made this a more demanding departure than most. Next time on difficult departures I will use autopilot sooner…will try to be more vigilant in dense traffic areas." (#403598)

In 16 incidents, crews failed to turn as directed by ATC on the SID or STAR they were following. The crews reported various activities competing for their attention; in three cases the activity was searching for traffic called out by ATC or TCAS. Altogether, crews reported searching for traffic as a competing activity in 11 of the 107 incidents. Searching for traffic takes the pilot's eyes away from monitoring aircraft position and status and also demands substantial mental attention. If the conflict is close, the urgency may further narrow the focus of attention.

One of the insidious traps of interruptions is that their effects sometimes linger after the interruption. For example, descending through 4,500 feet, a crew might be instructed to report passing through 3,000 feet. They might then respond to and quickly resolve a traffic alert, but forget the instruction to report by the time they reach 3,000 feet. In this hypothetical example, searching for traffic preempts the reporting instruction from the crew's conscious awareness. The instruction presumably is still stored in memory in an inactive form, and if reminded, the crew probably will recognize that they were given the instruction. However, lacking such a reminder, and being preoccupied with other activities, they don't remember to contact ATC as they pass through 3,000 feet.

Category 4
Responding to Abnormal Situations

- "Large areas of thunderstorms; we had to deviate considerably. Several (equipment malfunctions) in short period…then cabin pressure started climbing slowly in cruise (FL290). Troubleshooting…to no avail. Requested immediate descent. Descending through FL180, both crewmembers forgot to reset altimeters, putting us 300 feet low at FL130. To prevent this from occurring again during any abnormal, I will: (1) delegate tasks; have one person focus on flying the airplane while the other troubleshoots, and state clearly who will do what, (2) strictly adhere to company procedures." (#404306)

In 13 incidents, crews failed to reset their altimeters when passing through the transition altitude (18,000 feet MSL in the United States and Canada). It's especially easy to forget to reset altimeters if this action isn't linked in pilots' minds to other actions. (For this reason, some pilots make resetting altimeters part of a cluster of action items they routinely perform together, e.g., making a passenger announcement and turning on the seat belt sign. Some companies make resetting altimeters part of the descent checklist.) In principle, the problem is similar to that of monitoring for altitude level-off, except more vulnerable to error. In air carrier operations, the crew is normally aided with altitude level-off by altitude alerting devices and by the formal procedure of making a thousand-foot call, confirmed by both pilots, before reaching the assigned altitude.

Two of the crews reporting to ASRS thought that they forgot to reset their altimeters because they were preoccupied with an abnormal situation. Altogether, abnormals were a factor in 19 of the 107 incidents. Ironically, it seems that one of the biggest hazards of "abnormals" is becoming distracted from other cockpit duties. Abnormals easily preempt crews' attention for several reasons. Recognizing the cockpit warning indicators, identifying the nature of the problem, and choosing the correct procedure require considerable attention. Crews have much less opportunity to practice abnormal procedures than normal procedures, so choosing and running the appropriate checklists require more effort and greater concentration of mental resources than running normal checklists. Also, in situations perceived to be urgent or threatening, the normal human response is to narrow the focus of attention, which unfortunately tends to diminish mental flexibility and reduce ability to analyze and resolve nonroutine situations.

Strategies for Reducing Vulnerability to Interruptions and Distractions

We suggest several lines of defense against the types of crew errors described above. These aren't perfect, but in combination they should, in our opinion, reduce crews' vulnerability to error.

1. **Recognize that conversation is a powerful distracter.**
   Unless a conversation is extremely urgent, it should be suspended momentarily as the aircraft approaches an altitude or route transition, such as altitude level-off or a SID turn. In high workload situations, conversation should be kept brief and to the point. Even in low workload situations, crews should suspend discussion frequently to scan the status of the aircraft and their situation. This requires considerable discipline because it goes against the natural flow of conversation, which usually is fluid and continuous.
2. **Recognize that head-down tasks greatly reduce one's ability to monitor the other pilot and the status of the aircraft.**
   If possible, reschedule head-down tasks to low workload periods. Announce that you are going head-down. In some situations, it may be useful to go to a lower level of automation to avoid having one crewmember remain head-down too long. For example, if ATC requests a speed change when cockpit workload is high, the crew may set the speed in the Mode Control Panel instead of the FMS. An FMS entry might be made later, when workload permits. Also, some airlines have a policy that FMS entries should be commanded by the pilot flying and implemented by the pilot not flying. This approach minimizes the amount of attention the pilot flying must divert from monitoring the aircraft.
3. **Schedule/reschedule activities to minimize conflicts, especially during critical junctures.**
   When approaching or crossing an active runway, both pilots should suspend all activities that aren't related to taxiing, such as FMS programming and company radio calls, until the aircraft has either stopped

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It s not possible for the pilot not flying to reliably monitor the pilot flying or the aircraft status during longer programming tasks, and it's difficult to suspend the programming in midstream without losing one's place.

USAF Photo by SrA Jeffery Allen

short of the runway or safely crossed it. Crews can reduce their workload during descent by performing some tasks while still at cruise; for example, obtaining ATIS, briefing the anticipated instrument approach, and inserting the approach into the FMS (for aircraft so equipped). Also, it may be useful for companies to review their operating practices for optimal placement of procedural items. For instance, could some items on the Before Takeoff Checklist be moved to the Before Start Checklist, since the latter is performed during a period that usually has lower workload?

4. **When two tasks must be performed concurrently, set up a scan and avoid letting attention linger too long on either task.** In some situations, pilots must perform two tasks concurrently; for example, searching for traffic while flying the airplane. With practice, pilots can develop the habit of not letting their attention linger long on one task, but rather switch attention back and forth every few seconds between tasks. This is somewhat analogous to an instrument scan, and like an instrument scan it requires discipline and practice, for our natural tendency is to fixate on one task until it's complete. Pilots should be aware that some tasks, such as building an approach in the FMC, don't lend themselves to time-sharing with other tasks without an increased chance of error.

5. **Treat interruptions as red flags.** Knowing that we're all vulnerable to preoccupation with interruptive tasks can help reduce that vulnerability. Many pilots, when interrupted while running a checklist, place a thumb on the last item performed to remind them that the checklist was suspended. It may be possible to use similar techniques for other interrupted cockpit tasks. One of us has developed a personal technique using the mnemonic "Interruptions Always Distract" for a three-step process: (1) **I**dentify the Interruption when it occurs, (2) **A**sk, "What was I doing before I was interrupted?" immediately after the interruption, (3) **D**ecide what action to take to get back on track. Perhaps another mnemonic for this could be ***Identify/Ask/Decide***.

6. **Explicitly assign pilot flying and pilot not flying responsibilities, especially in abnormal situations**. The pilot flying should be dedicated to monitoring and controlling the aircraft. The pilot flying must firmly fix in mind that he or she must concentrate on the primary responsibility of flying the airplane. This approach doesn't prevent each pilot from having to perform concurrent tasks at times, but it does ensure that someone is flying the airplane, and it guards against both pilots getting pulled into trying to solve problems. ✈

The pilot flying should be dedicated to monitoring and controlling the aircraft. The pilot flying must firmly fix in mind that he or she must concentrate on the primary responsibility of flying the airplane.

Photo by SSgt Andrew N. Dunaway, II

End Notes

1. We thank ASRS staff members who assisted in this study: Dr. Rowena Morrison and Mr. Vince Mellone helped design the search strategy for reports; Mr. Bob Wright screened reports; Capt Bill Richards made callbacks to reporters and consulted with NASA on selected incidents; Capt Charles Drew reviewed the paper; and Dr. Rowena Morrison reviewed and edited the paper.
2. Capt Sumwalt is employed by a major U.S. air carrier and has served as an ASRS research consultant since 1993. He has also published a number of articles on pilot error and human factors issues in professional aviation publications.
3. The relative frequencies of different types of neglected activity reported probably don't reflect the relative frequencies actually occurring in line operations. Pilots may be more likely to report incidents observable to ATC (for example, altitude deviations), than to report incidents not observable outside the cockpit (for example, omitting a checklist item).
4. National Transportation Safety Board (1994). A review of flightcrew-involved major accidents of U.S. air carriers, 1978 through 1990. Safety study NTSB/SS-94-01. Washington, D.C.: NTSB.

Task Management

■ Why do activities as routine as conversation sometimes interfere with monitoring or controlling the aircraft? Cognitive research indicates that people are able to perform two tasks concurrently only in limited circumstances, even if they are skillful in performing each task separately.

Broadly speaking, humans have two cognitive systems with which they perform tasks: One involves conscious control, the other is an automatic system that operates largely outside of conscious control.* The conscious system is slow and effortful, and it basically performs one operation at a time, in sequence. Learning a new task typically requires conscious processing, which is why learning to drive a car or fly an airplane at first seems overwhelming—the multiple demands of the task exceed conscious capacity. Automated cognitive processes develop as we acquire skill. These processes are specific to each task, they operate rapidly and fluidly, and they require little effort or attention.

Many real-world tasks require a mixture of automatic and conscious processing. A skillful driver in a familiar car on a familiar road can perform largely on automatic, leaving enough conscious capacity to carry on a conversation. However, if the automatic system is allowed to operate without any conscious supervision, it's vulnerable to certain types of error, especially a type of error called habit capture. For example, if we intend to take a different route home from work, we are prone to miss our turnoff and continue our habitual route if we don't consciously supervise our driving. Also, if we encounter a section of road that's difficult to navigate, we find that we cannot continue the conversation without risking errors in the driving, the conversation, or both. This is because the automatic processes aren't adequate to handle the unpredictable aspects of the driving task.

Conscious control is required in four situations: (1) when the task is novel; (2) when the task is perceived to be critical, difficult, or dangerous; (3) when an automatic process must be overridden to prevent habit capture, or (4) to choose among competing activities. The required mixture of automatic and conscious processing varies among tasks, and the mixture may vary with the moment-to-moment demands of a given task. Conversation, for example, generally requires a substantial amount of conscious processing because it involves novelty. We don't know what the other person is going to say, and we have to formulate unique responses appropriate to the discussion. In contrast, an experienced pilot can manually fly a familiar aircraft in a largely automatic fashion. However, certain subtasks embedded in the act of flying manually require conscious attention. For example, leveling off at an assigned altitude requires consciously monitoring the altimeter to read the numbers and to match the current altitude with the assigned altitude the pilot is holding in memory.

The framework outlined above allows some general conclusions about the circumstances under which two tasks may be performed concurrently. A task requiring a high degree of conscious processing, FMS programming, for example, cannot be performed concurrently with other tasks without risking error. Two tasks that are largely automated can be performed together reliably if they are regularly practiced in conjunction; for example, flying the aircraft manually and intercepting the localizer. We're less certain how well individuals can combine two tasks, each of which involves a mixture of conscious and automatic processing; for example, searching for traffic while monitoring for altitude capture. We suspect that pilots can learn to integrate two tasks of this sort and achieve reliable performance, but only if they regularly practice the two tasks in conjunction. This, however, is speculation and requires experimental research for validation. ■

*Norman, D. J. and Shallice, T. (1986). Attention to action: willed and automatic control of behavior. In R. J. Deardin, G. E. Schwartz, and D. Shapiro (Eds), Consciousness and Self-Regulation, Advances in Research and Theory (pp 1-18). New York: Plenum.

Official USAF Photo

Human Factors Councils:
A Best Practice Tool for Risk Management

How many squadron buds really hang around the bar with the older guys and tell stories like we used to? Many people are busy, have families, or are just eager to get out of the squadron after another deployment.

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Chief, Air Force Aviation Psychology
HQ AFSC/SEFL

As dedicated *Flying Safety* readers remember, November's *Flying Safety* contained an article by Dr. (Lt Col) Jay Neubauer, Chief of Life Sciences at the Safety Center, on Human Factors Councils (a.k.a. HFCs). While our Navy sister service implemented this quarterly aircrew review process by regulation in 1997, the Air Force conducts no similar "whole person" perspective review of our fliers. The November article was meant to spark interest and feedback in both directions. Those not in favor raised manning and workload concerns (although let me assure you, there's a lot MORE work associated with a human factors Class A mishap). Some felt HFCs present an outright threat and violation of personal privacy.

Yes, a "good" squadron commander knows his people, their family circumstances, level of proficiency, and career aspirations. In this case, the HFC might duplicate an everyday part of squadron business. Yet with today's deployments, ops tempo, less-experienced rated community, personnel issues, other "management" tasks, and larger squadrons (maintainers included), many well-intentioned commanders find their cup filled to the brim with other administrative responsibilities. This is why the ORM process replaced armchair "common sense" retrospectives. How many squadron buds really hang around the bar with the older guys and tell stories like we used to? Many people are busy, have families, or are just eager to get out of the squadron after another deployment.

Commenting in favor of HFCs, many saw the process intended as a tool for commanders' use to get the "big picture" and make informed decisions. One squadron, the 55th Nighthawks from Hurlburt Field, became our "test site" for the HFC. The 55th Special Operations Squadron (the "Blackhawks") flies the MH-60G. And by the way, deactivation looms for this unit in October with the mission being absorbed by other AFSOC assets (deactivation obviously brings its own set of stressors). Innovative efforts of the 55th's Flight Safety Officer and the AFSOC chain of command resulted in an HFC program with unexpectedly positive results. The 55th HFC members modified questions and the process to meet the squadron's needs based on their crew makeup and mission. The following comments from the 55th's key leaders show the benefits of this process.

Let's start with the flight surgeon, since we medical folks typically believe in these types of things:

◆ "HF Councils allow key leadership to be aware of 'where a crewmember's head is' in a nonpunitive forum. Close friends, coworkers, and lower level supervisors may notice subtle changes that could affect a crewmember that the leadership may be blindsided on. In addition, the Squadron Medical Element (SME)/flight surgeon could make the leadership aware of health items for the individual or his family members that could affect him mentally or on lengthy deployments. The SME/flight surgeon would have to work within the principles of doctor-patient confidentiality, however. If handled properly, the HFC may be a very effective 'combat multiplier' for the squadron."

How about the flight commander? Like the story of the zookeepers describing the elephant, each person has his (or her) hands on a different part. You might have the trunk, or the ear, while someone else is dealing with a foot. HFCs provide a process for getting the bigger picture:

◆ "As for my inputs from the HFC…each squadron member needs to be discussed. This will alleviate the possibility of passing someone by and forgetting about a possible problem area that needs to be discussed. Also, this method would allow for discussion of support personnel that may be having some of the same problems. Their problems may not have an impact on flying, but they will possibly filter over into the area of morale, and that can have an impact on unit flying.

"The first HFC was almost painfully long, except we were discussing problem areas, and that made the time fly by. We ended up not having enough time to really go into enough detail on each element. A squadron commander may not have the time for a 2-hour council, but that is where the flight commanders must get involved. This will lessen the burden on the commander. Backbriefs of the commander may be a more viable option for the times he is unable to be available for the entire meeting.

"Subsequent HFCs should not take as long since they will be discussing the period between each meeting. This will help control the amount of information brought out. (We covered problems from 8 to 10 months earlier. This info would be in the minutes if it were a factor.) I expect the next HFC will be complete within an hour and still be able to get out the information needed to evaluate the human factors that affect the individual."

Speaking of support, we are more aware that the consequences of our "nonoperators'" behaviors can have as great an impact as the one actually controlling the aircraft. The comments from two flight NCOICs support this idea:

◆"Here's my take on the Council: I thought what we did was very productive. For the initial meeting, the things that we talked about in detail were adequate. I don't think that we need to go into that much detail each and every meeting. I also believe that a quarterly meeting is more than adequate. During the recurring meetings, I believe we should identify only the situations that warrant discussing. If the situation is serious enough, then an immediate meeting might be appropriate. I also think that if we identify an individual who is 'at risk,' this should be left as an open item and discussed at the next council."

◆"I thought the meeting was excellent. Being a new supervisor and new to the squadron, I learned a lot about the past and present history of my guys. It's good info to know not only as a flight NCOIC, but as a crew dog as well. I think it's great for the senior leadership to be aware of any problems our people may be having so we can keep an extra eye out. The 30-/60-/90-day flight time is a good tool to see who may be being over- or underworked. That could result in a morale problem or even complacency if somebody is not pulling their own weight. Overall, I found it to be very informational, and I'm looking forward to our next meeting."

And lastly, with bold added, the combined comments of the two people with the ultimate responsibility for making proper individual and environmental decisions —crew, mission, weather, equipment decisions—the squadron commander and DO:

• "I don't think crew resource management is as critical anywhere else in the Air Force as it is in the special ops helicopter business. Having a completely functioning crew, one that is not focused on outside influences, is a key to mission success in a low-level tactical environment. The HF Council acts as a risk management tool for squadron leadership to bring to our attention problems out of the ordinary that our squadron mates may be facing. Be it financial, relationships, emotional, etc., e.g., squadron member's spouse may be having serious medical problems. Obviously that individual is not focused on flying; he/she is focused on the spouse and dealing with the situation. The information flow of these types of situations to decision-makers is **key to effective risk management.** The HF Council gives us that link to both relay and receive these facts."

The bottom line—HFCs:

- Don't take that much time, and if they prevent a mishap, they actually SAVE time.
- Can be modified (frequency, HFC members, paperwork) to meet your squadron's needs.
- Could be a platform to incorporate other mandated reviews, i.e., Training Review Boards.
- Personal information can be handled appropriately.
- Represent a powerful risk management tool.
- Might save someone's life—maybe even your own.

Any FSO or others interested in the HFC process? Could HFCs work for you or your squadron? We'd be happy to send you the information and will work with you to implement the program at YOUR base. Any accident we help prevent is one less we have to investigate, review, and add to the data base. ✈

Speaking of support, we are more aware that the consequences of our non-operators behaviors can have as great an impact as the one actually controlling the aircraft.

THE UNREPORTED INCIDENT

"Lessons learned" aren't learned if nobody hears about them.

USAF Photo by SSgt Andrew N. Dunaway, II

CAPT CHRIS L. WHEELER
Airfield Operations Flight Commander
Spangdahlem Air Base, Germany

It was a typical early morning in Germany. Darkness and a low cloud ceiling combined to make landing at our base tricky at best. The German-led approach control facility handed off the C-5 Heavy Galaxy aircraft to our Ground Controlled Approach at about 12 miles from the base, at 4,000 feet MSL. The controller initiated radar and radio contact with the C-5 and cleared him for the instrument approach. At about 9 miles from the airport, the arrival controller was preparing to hand the aircraft off to the radar final controller, but noticed the aircraft was already at 3,000 feet MSL. A faster descent than normal, but not abnormal. The arrival controller elected to keep the aircraft on frequency, just in case.

In just over a mile, at about 8 miles from the base, the controller noticed the aircraft was already approaching 2,000 feet MSL. At Spangdahlem, this is only 500 feet above the ground. Not a good altitude for a descending C-5. The controller initiated "too low for safe approach" procedures with the aircrew. Not receiving an immediate acknowledgment from the aircrew, the controller directed an immediate climbing breakout off the approach. The aircraft responded, made a climbing turnout, was re-cleared for the approach, and landed without incident.

I was in my office when I got a phone call from our base safety office. It was Flight Safety asking a question about a C-5 Hazardous Air Traffic Report (HATR) incident involving problems with our instrument landing systems. I thought to myself, "We don't have a C-5 here today. What is he talking about?" After doing some quick research, what I found out surprised me. The incident described happened over 2 months prior to my receiving this phone call!

After interviewing the controllers, I was able to piece together the scenario. I was lucky because this C-5 was the last one to land at our base, and the situation remained in the minds of the controllers. After forwarding applicable information back to the Flight Safety Office, I began to ask myself some other questions, which essentially resulted in this article. Was there something wrong with the instrument landing system? Did the controller issue an incorrect descent altitude? Was the instrument procedure in the flight information publications correct? Unfortunately, due to the delay in hearing about this incident, I was not able to fully answer those questions, among others.

When incidents go unreported, aircrews are put at risk. Data can be lost and incidents go unnoticed by management. This is detrimental for several reasons.

- If the incident was the result of controller error, air traffic management must be made aware to determine the extent of the error and take necessary actions.
- If the incident was the result of faulty equipment, late reporting endangers all other aircrews utilizing the same instrument approach landing aid.
- All air traffic control communications are recorded. Unless air traffic management receives notification of an incident, these tape recordings are recycled every 15 days, overwriting all previous information. Delays in reporting air traffic-related incidents could result in the loss of vital information that is pertinent to any incident investigation.

Finally, a quick advertisement for the USAF HATR Program. AFI 91-202, Attachment 3, *The USAF Mishap Prevention Program*, states that HATRs must be filed with the base Flight Safety Office within 24 hours of the event. If the incident occurs during flight, the reports should be submitted to the nearest USAF base Safety Office after landing. This timeline is vital due to the reasons mentioned above. The primary purpose behind the HATR program is mishap prevention, so the worst kind of incident report is the report that doesn't get filed!

Getting immediate feedback from aircrews is vital to ensuring a safe flying environment. Even if a HATR is not filed, getting a message to air traffic management concerning problems with controllers, procedures, or equipment is critical. Most, if not all, Airfield Operations and Air Traffic Managers welcome feedback, good or bad. If you, as a pilot or aircrew member, experience something not quite right or downright abnormal, contact your base safety officer or go directly to the air traffic control chief controller or flight commander. The important thing to remember is: Inform someone as soon as possible! The lives you are protecting are yours and your fellow aviators. ✈

Who Is Watching You?

J. T. RAGMAN

"I am more nervous about this flight than any other flight or check ride I've had during 10 years as an Air Force pilot," I told my dad during a phone conversation in 1989. "This flight" was my first unsupervised flight as an airline flight engineer.

During the course of my 1989 phone call, I explained to my father that in all my days as an Air Force pilot an entire crew had been watching my every action and every inaction. First, an aircraft commander, and later a copilot, had been watching; and always a flight engineer, navigator, and loadmaster.

An an airline flight engineer, sitting sideways 6 to 8 feet aft of the pilot and copilot on the flight deck of a Boeing 747, no one would be watching me.

Frankly, that concerned me—not out of any fear that I might be "incompetent" in my duties. Rather, my fear stemmed from the knowledge that I was human and that humans make errors, therefore, I would make errors. Indeed, fellow crewmembers had caught my errors on each and every flight as an Air Force front-seater, a fact for which I was, and remain, most grateful. Who would catch my errors as an airline flight engineer?

Crew Resource Management (CRM) has been with us for many years. However, whether by design, by default, or through misinterpretation, much of the CRM focus has appeared to target the *pilot's* need for crew inputs and the crew's need to monitor and challenge *pilot* actions, inactions, decisions, and judgments.

Most pilots are grateful for the added safety margin CRM has brought to flight operations. Clearly, pilots can crash airplanes, and unfortunately, we will continue to do so. We need to be watched. Not so clear is the realization that inaccurate navigation (the navigator), faulty fuel management (the flight engineer), and improper load configurations (the loadmaster) can, and have also crashed airplanes. Not once, not twice, but time and again.

How did I handle that first flight as an airline flight engineer from Honolulu to Sydney? Oddly enough, much the same way I had handled every flight as an Air Force aircraft commander. I acknowledged my humanity, the possibility of error, and I asked for help.

If I was crossfeeding fuel, I asked the front-seaters to monitor my crossfeed and fuel balance with an occasional glance over my panel. If the takeoff and landing computations were particularly tight or complex, I asked a front-seater to walk through the calculations with me. If I was in manual pressurization, I verbalized prior to my actions and solicited front-seat concurrence. Following the initialization of the three INS units, I requested front-seat confirmation of my present position entries prior to engine start. And on and on and on.

I no longer sit sideways on a Boeing 747. I am now an airline and Air Force Reserve front-seater. However, the perspective I gained while sitting sideways is with me every time I fly, whether it's for the airline or the Air Force.

Crew Resource Management is not a "pilot thing" or an "aircraft commander thing"—it's a "crewmember thing."

Front-seaters: You know you're human, you know you make errors, so you solicit crew support. Indeed, you might go so far as to deem it every crewmember's duty to monitor and challenge your performance. Bravo! However, there is a flip side to the coin. Recognize that each of your fellow crewmembers is likewise human and likewise prone to error. Recognize you too have a duty to monitor and challenge their performance. Scan your flight engineer's panel. Know your systems and procedures well enough to make sense of your panel scan. Share your flight engineer's performance computation workload in the tight scenarios. Review your navigator's INS preflight and fuel computations. Monitor his/her en route fuel burns and all en route course changes. Back him/her up with raw data navigation. Know the Form 365F top to bottom, inside and out. Know enough to ask your loadmaster the right questions at the right time. Take the lessons of CRM and direct them toward your fellow crewmembers. Back them up. Let them know you are there.

Navigators, flight engineers, loadmasters: Do you recall your first unsupervised flight? Did you make a similar phone call? Did you miss your instructor or training partner? Were you struck with just a hint of the jitters?

Embrace that recollection—humility is healthy. You too are human, you too are prone to err. Crew Resource Management is not a "pilot thing." Where the textbook might direct the aircraft commander to solicit inputs, **you** solicit inputs. If CRM directs the crew to monitor the pilot, ask the crew to monitor you as well. On any given day, on any given flight, you may save the day—not by monitoring another, *but by asking another to monitor you.*

Pilots don't have a monopoly on error. Flight safety textbooks are filled with examples in which a navigator, flight engineer, or loadmaster killed a crew. Who is watching you? ✈

("J. T. Ragman" is the pen name of a C-130 pilot in the Air Force Reserve. He's also a Boeing 757 pilot and Human Factors instructor for a major airline. Editor)

USAF Flight and Flight-Related Class A Mishaps FY99

This FY (Oct 98 - Apr 99)	Last FY (Oct 97 - Mar 98)
20 Class A Mishaps	10 Class A Mishaps
7 Fatalities	4 Fatalities
15 Aircraft Destroyed	8 Aircraft Destroyed

6 Oct — An airman suffered a serious back injury during a helicopter training exercise.

21 Oct ♣ An F-15E crashed during a SATN training mission killing both crewmembers.

22 Oct ♣ Two F-16Cs collided shortly after departure. One F-16 was destroyed and the other F-16 recovered uneventfully.

29 Oct — A C-9A's No. 2 engine failed and caught fire shortly after a touch-and-go.

9 Nov ♣ An F-16CG crashed during a day BFM training sortie, killing the pilot.

17 Nov ♣ An F-16C experienced engine failure and crashed during a day training sortie.

19 Nov ♣ An F-16CJ experienced loss of thrust shortly after takeoff and crashed.

4 Dec ♣ An F-16D experienced engine failure 25 minutes into flight and crashed.

15 Dec ♣ An F-16C on a day training sortie experienced loss of thrust on RTB and crashed.

29 Dec — An OA-10A's No. 1 engine throttle cable failed during flight. The pilot had difficulty landing, the aircraft departed the prepared surface, and all three gear collapsed.

7 Jan ♣ An F-16DG experienced an engine malfunction shortly after gear retraction and crashed.

13 Jan ♣ A KC-135E crashed northwest of the departure end of the runway. All four crewmembers were fatally injured.

20 Jan ♣ An OA-10A entered an uncommanded, nose-low attitude. Unable to return the aircraft to controlled flight, the pilot ejected, and the aircraft was destroyed.

21 Jan ♣ An F-16CJ conducting low-level tactical navigation struck trees on a ridgeline. The engine failed, and the aircraft was destroyed on impact with the ground.

28 Jan ♣♣ Two F-15Cs were flying a Dissimilar Tactical Intercept Training sortie against a three-ship of F-16Cs. The two F-15s collided during the first intercept and were destroyed.

3 Feb ♣ An F-16C on a training mission had an engine malfunction. The pilot ejected after an in-flight fire developed, and the aircraft was destroyed on impact with the ground.

24 Feb ♣ An RQ-1A UAV crashed and was destroyed. (Non-rate producer)

17 Mar A U-2S sustained significant engine damage.

18 Mar An F-16C suffered major damage on landing.

26 Mar ♣ An F-16CG crashed during a day training sortie.

29 Mar ♣ A Global Hawk UAV crashed and was destroyed. (Non-rate producer)

30 Mar A U-2S suffered major damage on landing.

7 Apr ♣ A KC-135R sustained major fuselage damage. (Ground Mishap—Non-rate producer)

- ❑ These Class A mishap descriptions have been sanitized to protect privilege.
- ❑ A "Class A Mishap" is defined as one where there is loss of life, injury resulting in permanent total disability, and/or property damage/loss exceeding $1 million dollars.
- ❑ "♣" denotes a destroyed aircraft.
- ❑ Unless otherwise stated, all crewmembers successfully ejected/egressed from their aircraft. Current as of 13 Apr 99.
- ❑ Flight, ground, and weapons safety statistics are updated daily and may be viewed at the following web address by ".gov" and ".mil" users: http://www-afsc.saia.af.mil/AFSC/RDBMS/Flight/stats/index.html. ✈

Maintenanc

Predator and Prey

The driver of the air stairs truck needed to make a stop at debrief, so he drove to the hangar where debrief was located and parked the vehicle pointing toward the hangar.

After placing the gearshift in "Park," he exited the truck—with the motor still running—and entered debrief. Soon after he entered the hangar, the air stairs truck started moving backward at a leisurely pace. And like a patient predator in search of prey, it rolled slowly in reverse nearly 500 feet (!), in a shallow arcing turn, until it found the prey it was looking for: an aircraft.

Just as the driver was exiting debrief to return to his truck, he heard a crash and turned to see the air stairs truck stopped in front of a KC-135. He returned to the hangar to let his supervisor know about the collision, then ran to the truck, opened the door, and turned off the ignition. That's when he noticed the gearshift was in-between "Park" and "Reverse."

As you would expect, the aircraft was the big loser in this collision. The air stairs truck sustained negligible damage. But the stairs had sliced across the forward portion of the aircraft radome, destroying it and the APN-59 radar antenna under it, causing $12,000 damage. Fortunately, a stabilizing beam on the stairs struck the antenna mount bracket, preventing the truck from finding more "prey."

AFMAN 24-306, Manual for the Wheeled Vehicle Driver, requires the ignition be turned off, the transmission be placed in "Park" (automatics) or "Reverse" (manuals), and the parking brake be set when the driver leaves the vehicle. This mishap is a good illustration why leaving running vehicles unattended is verboten.

I Know You Heard What You Thought I Said, But What I Really Said Was…

The mishap flight was an F-16 two-ship scheduled to fly a three-part mission in the local area. Forty minutes into the second leg of the sortie, the pilot noted an engine "Lube Low" fault. The pilot followed checklist procedures, confirmed it wasn't a false indication, and expedited a return to the home drome, where landing was uneventful. After shutdown, maintainers determined that oil quantity was about 8 half-pints—31 half-pints less than the required minimum—and engine failure had been imminent.

It all started a few days before the mishap flight, when swings found the lube and scavenge pump differential pressure indicator (dpi) had popped. The chip detector was checked and it was clean. After removing the lube and scavenge pump filter and filter bowl, maintainers observed that the engine oil that had been drained into a bucket was saturated with "gold fuzz." The Pro Super noted in his log that the particles might be brass (good call) and had the NDI lab burn a sample of the gold fuzz-saturated oil. Analysis confirmed that abnormally high amounts of copper and zinc—the elements that make up brass—were indeed present. Per T.O. 33-1-37-3, the Joint Oil Analysis Program (JOAP) Manual, the most likely source for brass contamination in F110-GE-100/129-series engines is fuel boost pump bearings. And that's when the process broke down. Due to an unlikely (and incredibly unlucky) series of communication errors, this information didn't reach the flightline.

As a result, over the next several days, flightline maintainers R&R'd the lube and scavenge pump filter, drained and flushed the system, R&R'd the lube and scavenge pump, R&R'd the hydraulic pump, and drained and flushed the system again. After completing all of these actions, the flightline had the NDI lab burn another JOAP sample. It was normal, and NDI reported that the oil was now "clean." Unfortunately, the NDI lab didn't know that the only part which would introduce appreciable quantities of brass into the oil system had not been changed. And that's how an unlikely series of communication errors nearly resulted in a Class A mishap.

How good are your coordination procedures and communication processes?

ce Matters

Safety Crosstell: Aircraft Wash Hazards

The Wash Rack poses lots of well-known hazards to skin and eyes, but here are a couple more that you may not have thought about before now. Maintainers were washing a C-130 in an enclosed hangar and applying an authorized cleaning compound, using both pressurized washing equipment and manual washing techniques. An hour or so into the wash, one of the wash crew members started experiencing vision problems, facial numbness, and difficulty in breathing. When the other members of the wash crew noticed his disorientation, they got him out of the work area. That's when they realized they were experiencing some of the same symptoms too, only to a lesser degree. The stricken member was taken to a nearby hospital, where he was treated and released.

Exposure to the cleaning solution was fingered as the culprit. A written report stated that continued exposure might have led to "…unconsciousness, central nervous system effects, asphyxiation, and death." So, how did this brush with near-death occur? Investigation uncovered a number of practices that, alone or together, were responsible.

- At the Wash Rack, SOP was to partially fill a bucket with the cleaning compound—a thick, gel-type liquid—and then add hot water (estimated temp: 200 degrees) to make it easier to use. It made the solution easier to work with, but it was also contrary to Materiel Safety Data Sheet (MSDS) warnings which stated heating would release hazardous vapors.
- The MSDS stated the compound should only be applied using a "coarse" spray, since "misting" the cleaner—as happened when the wash crew used their pressurized cleaning equipment—created further likelihood of inadvertent chemical agent inhalation.
- It wasn't uncommon for Wash Rack personnel to finish an aircraft wash and then wear their cleaning compound-saturated clothing for the rest of the duty day. The MSDS cited continued contact with contaminated clothing as a hazard and dictated a change to clean, uncontaminated clothing.
- During the public health survey, Wash Rack personnel were observed eating and drinking in the work area while an aircraft was being cleaned, further increasing the possibility for ingesting harmful chemicals.

These Wash Rack personnel didn't willfully disregard MSDS-identified hazards. Investigation revealed none of them had received workplace-specific Hazard Communication (HAZCOM) Training. HAZCOM Training would have included a review of applicable MSDSs for the chemicals used around the Wash Rack and alerted personnel to hazards posed by them.

How effective is the Hazard Communication Program in your workcenter? Ensure your folks are aware of workplace hazards, and help them protect themselves from unreasonable exposure. How? Contact the base Bioenvironmental Engineering Flight (BEF). The BEF is the office of primary responsibility for overseeing the base chemical hazards surveillance program. BEF personnel are thoroughly familiar with AFOSH and federal OSHA standards, and they can perform occupational health surveys in your workcenter, identify and evaluate hazardous chemicals used in work processes, and recommend ways for controlling the hazards. "Chemical Hazards in the Workplace: Are You Protected?" appeared in the August 1998 issue of Flying Safety magazine (available on the WWW), and it spotlights how the BEF can assist in making your workcenter safer.

(Thanks to TSgt G. C. Malinowski for putting out the initial alert/crosstell on some aircraft wash practices that could have had fatal consequences. TSgt Malinowski is the Ground Safety NCO for the 352d Special Operations Group. If you have specific questions about this crosstell, you may e-mail him at: gerhard.malinowski@mildenhall.af.mil) ✈

ULTRAVIOLET RADIATION AND PUBLIC HEALTH

DRS. RICHARD J. VETTER,
KEITH H. DINGER,
MARVIN GOLDMAN,
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OTTO G. RAABE
Adopted: July 1998
Courtesy HPS *Newsletter, Nov 98*

One in five people will be diagnosed with skin cancer sometime in his/her lifetime. Nearly 1 million new skin cancers are diagnosed each year in the United States, and more than 40,000 of these cases are melanoma. Annually, nearly 10,000 people die of skin cancer, including over 7,000 from melanoma. Many of these cancers can be prevented by reducing exposure to ultraviolet radiation.

Most human exposure to ultraviolet (UV) radiation comes from the sun. Light rays from the sun are comprised of several different bands including UVA, UVB, and UVC.

UVA constitutes the majority of the ultraviolet light that reaches the earth's surface. UVA has little effect on the skin, but it can trigger phototoxic or photoallergic reactions associated with certain medications, or illnesses such as lupus.

UVB makes up only 10 percent of the ultraviolet light that reaches the earth's surface, but it is nearly 1,000 times more efficient than UVA in causing a suntan and associated skin damage. UVB causes burning and damage to the skin, including increased risk of skin cancer.

UVC, used in germicidal lamps, causes almost no damage because of its low penetration of the skin.

The atmosphere, especially the ozone layer, filters ultraviolet light and is most effective in the early morning and late afternoon. Ultraviolet penetration is greatest between the hours of 10 a.m. and 4 p.m.

UVB intensity increases about 3 percent for every thousand feet in elevation and, like light, is reflected variously from most objects. Sand may reflect about one-third of the UVB, and snow, ice, and water may reflect up to 100 percent. Ironically, water vapor neither absorbs nor reflects very much UVB; consequently, cloudy days offer no protection from UVB.

The primary source of artificially produced UVB is tanning booths. The American Academy of Dermatology estimates that 1 million Americans visit tanning salons every day and that the average 15- to 30-minute visit is equivalent to an entire day at the beach. The tanning bed light can burn both skin and eyes and can increase the risk of skin cancer. Public health experts and medical professionals continue to warn people that even moderate use of tanning beds may cause skin cancer, including melanoma. The Food and Drug Administration and the Centers for Disease Control and Prevention encourage people to avoid use of tanning beds and sun lamps.

The Health Physics Society* advocates that the public be provided adequate information to understand the potential risks from ultraviolet radiation and to make decisions that decrease their risk of skin cancer. The Society supports and urges public agencies, including local agencies, to take a more active role in educating the public on these risks and in methods to reduce risk. To assist the public, health officials, and the media, the Society offers the following recommendations to reduce the risk of cancer from exposure to ultraviolet radiation:

1. Avoid the use of tanning beds or sun lamps. Unless directed by a physician, people should not use tanning equipment. Such equipment offers no health benefit and significantly increases the risk of skin cancer.

2. Protect yourself from the sun. To reduce exposure to harmful UVB radiation, people should practice the following:

- Minimize exposure to the sun between 10 a.m. and 4 p.m. when the sun's rays are strongest. If your shadow is shorter than you are, seek shade.
- Apply a broad-spectrum sunscreen that protects against UVA and UVB and has a Sun Protection Factor (SPF) of at least 15.
- Reapply sunscreen every 2 hours, even on cloudy days. Reapply after swimming or perspiring.
- Wear a wide-brimmed hat and sunglasses.
- Avoid reflective surfaces. ✈

*The Health Physics Society is a nonprofit scientific professional organization whose mission is to promote the practice of radiation safety. Since its formation in 1956, the Society has grown to more than 6,800 scientists, physicians, engineers, lawyers, and other professionals representing academia, industry, government, national laboratories, trade unions, and other organizations. Society activities include encouraging research in radiation science, developing standards, and disseminating radiation safety information. Society members are involved in understanding, evaluating, and controlling the potential risks from radiation relative to the benefits. Official Position Statements are prepared and adopted in accordance with standard policies and procedures of the Society. The Society may be contacted at 1313 Dolley Madison Blvd., Suite 402, McLean VA 22101; phone: 703-790-1745; fax: 703-790-2672.

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THE Well Done AWARD

Presented for outstanding airmanship and professional performance during a hazardous situation and for a significant contribution to the United States Air Force Mishap Prevention Program.

MAJOR MARK A. RONCO

303d Fighter Squadron
Whiteman AFB, Missouri

■ Maj Mark A. Ronco had just raised his gear after takeoff for a night mission when his A-10A was struck without warning by five large waterfowl. The sound from the impact was masked by radio transmissions. One bird passed through the right engine, causing severe damage. Another bird penetrated the right gear pod nose and severed both the pitot and static lines, causing loss of airspeed and altimeter indications. Since the birds were not visible in the darkness, Maj Ronco's first indication of a problem was heavy aircraft vibration. He continued his climb, called a knock-it-off, and directed his wingman to close for a check. Maj Ronco directed the wingman to use night vision goggles to inspect his aircraft, but the wingman was unable to see any external damage. Engine indications were within normal parameters. Since the vibration appeared to be coming from the right side of the aircraft, Maj Ronco carefully retarded the right throttle to idle, which reduced the engine vibration to a more tolerable level. Despite the fact that he was flying in total darkness, in a single-engine configuration with no airspeed, altitude, or VVI, with the root cause of his malfunctions completely unknown, Maj Ronco was able to maintain aircraft control and establish a wide downwind pattern. He attempted to further analyze his condition, but there were no procedures in the emergency checklist which matched his unusual combination of symptoms. Consultation between Maj Ronco, the SOF, and an experienced FCF pilot confirmed that his condition lay well outside normal A-10 failure modes. With no other options apparent, Maj Ronco directed his wingman to a chase position and set up for a long straight-in final.

Utilizing single-engine procedures, with the wingman continuously advising him of airspeed, altitude, and descent rate, Maj Ronco executed a flawless approach and landing. Maj Ronco's outstanding airmanship, flawless self-discipline, and superior flying skills in the face of a dual aircraft malfunction outside normal guidelines, averted the loss of valuable combat resource and precluded the potential for severe damage or injury to persons and property in the surrounding community. ✈

Hello?

"Hello, out there— Are you reading us?"

If your organization has moved, closed, consolidated—whatever—we need to know! Please tell your PDO to contact us. You may also notify us directly by phone, fax, email, carrier pigeon—whatever works! We're running out of space here in the office because of returned magazines and getting on the bad side of the base fire marshal. These mags belong to you, so please let us know where you are—or aren't!

By the way, we've also made a change. We are now known as Headquarters Air Force Safety Center/SEMM, but our mission remains the same.

Let us hear from you.

Write: HQ AFSC/SEMM
Attn: Dorothy Schul
9700 "G" Avenue S.E., Ste 283A
Kirtland AFB NM 87117-5670

Phone: Commercial (505) 846-1983, DSN 246-1983
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