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Aviation Safety

Vortex

Learn from the mistakes of others; you'll not live long enough to make them all yourself . . . **Issue 2/2003**

Perchance to Dream…

Fatigue. Everyone knows that it is bad, but excessive fatigue is often worn as a badge of honour—as if to show how hard we're working, instead of how dangerous we have become. Regulations attempt to govern it through duty times and mandatory rest periods, but the arguments as to their effectiveness continue.

The helicopter industry in Canada sees fatigue from many sources. We have ambulance pilots working 12-hour day and night shifts, spending endless hours waiting for the phone to ring. In the summer, VFR pilots routinely fly 10 or more hours on seismic, logging, or forest fires—often for weeks on end. Spray pilots fly only at dawn and dusk (frequently after a long ride to the spray block) with terrible sleep schedules that involve a few hours at night and a few more during the day. Maintenance is routinely performed at night, when the machines are not flying, and late-night or early-morning run-ups are common. Pilots in Arctic camps may sit for days in bad weather, only to see it clear at 2 a.m., and be expected to go flying.

If there is one thing we know about fatigue, it is that it leads to human error, and the consequences are seen everywhere. In June 2001, just north of Albury, Australia, a convoy of six tractor-trailers was involved in an accident that scattered wreckage over several hundred metres and closed the highway for hours. The convoy was "slipstreaming," a common practice in motor racing and trucking, which involves the lead vehicle effectively towing those behind in its wake. The Transport Workers Union claimed the practice was used to save fuel, and even to keep the vehicles going if the driver fell asleep. It was just one example, they said, of the measures drivers had taken to meet unrealistic deadlines.

There are other high-profile examples of accidents in which fatigue played a starring role:

- The managers who authorized the launch prior

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to the *Challenger* explosion in 1986 had had little sleep the night before.

- The pilot-in-command of the Cessna 177B Cardinal in which he, seven-year-old Jessica Dubroff and her father were killed, suffered fatigue that seems to have impaired his judgment; he departed into weather that had convinced a Beech 1900 captain to delay his flight.
- The officer in charge of the *Exxon Valdez* was acutely sleep-deprived when she ran aground off Alaska in 1989.
- The nuclear accidents at Chernobyl and Three Mile Island, and the deadly chemical spill at Bhopal, India, all involved serious errors of judgment by tired operators.

In studies throughout the Western world, statistical data has proven that an incident rate spike occurs predictably during **all** night activities. This means your chances of having an accident in the wee hours may be greatly increased, due to degraded performance. In aviation occurrences, the initial investigations often reveal a puzzling lack of judgment by otherwise competent aviators.

It seems logical that to combat fatigue, we need sleep—but sleep is something we know little about. Until recently, the theory was that we slept to give the body and mind a good rest; but that has come under question. We now know that the brain is highly active for some of the time we spend snoring, and that we actually use almost as much energy when asleep as we do when awake and resting. There are two different types of sleep, known as REM (*rapid eye movement*—this is when we dream, and the brain activity is similar to when we're awake), and non-REM. Various theories claim that REM sleep plays a part in brain development, maintenance, learning and memory. Babies spend much more time in REM sleep than adults—it starts to decline as we reach our mid-forties, and becomes minimal in later years.

We may not know exactly why we need to sleep, but it is clear that we cannot function properly without it. Sleep-deprivation experiments show that people become progressively less effective as they become increasingly tired. Preventing people from sleeping has been widely used as a form of torture that leaves the victims increasingly miserable, confused and suggestible, and may even kill them.

Long-term sleep deprivation studies have been performed on our little friends, the laboratory rats, by Professor Allan Rechtschaffen, Ph.D., the director of the Sleep Research Laboratory at the University of Chicago. Dr. Rechtschaffen and his colleagues constantly deprived an otherwise cheery group of rats of all sleep, and demonstrated a 100% mortality rate within two or three weeks. The rats became increasingly debilitated, developed skin lesions, edema and stomach ulcers. They lost weight despite eating more than usual, suffered a drop in body temperature of 6°C, and eventually died. In an interesting twist, if the rats were allowed some non-REM sleep but no REM sleep, they lasted twice as long but still died eventually, after a period of sexual hyperactivity. A control group of rats that were permitted limited amounts of both REM and non-REM sleep, survived.

It's not clear by what mechanism the rats died, but some of their symptoms pointed to a failure of their immune systems. This is supported by research that has shown a link between diminished immune response and lack of sleep, but other studies seem to have shown the opposite. The jury's still out on that one. Dr. Rechtschaffen has also drawn a link between overeating and sleep deprivation, as a result of these experiments.

We have all felt the onset of serious fatigue. When the body is ready to sleep, not even the threat of grave and immediate danger will stop it—I have personally dozed off while driving a car, flying a helicopter, and riding a motorcycle, as I'm sure most of you have. When Charles Lindbergh made the first solo non-stop flight across the Atlantic in 1927, he discovered that staying alert for 33 1/2 hours in the air proved agonizingly difficult. He wrote this passage in his journal, after completing only 9 hours of flight:

"My eyes feel dry and hard as stones. The lids pull down with pounds of weight against the muscles. Everything is uniform blackness, except for the exhaust's flash on passing mist and the glowing dials in my cockpit, so different from all other lights…My world and my life are compressed within these fabric walls....My mind clicks on and off. I try letting one eyelid close at a time while I prop the other with my will. But the effect is too much, sleep is winning, my whole body argues dully that nothing, nothing life can attain is quite so desirable as sleep. My mind is losing resolution and control."

To combat fatigue, we must take a multi-faceted approach that involves the individual and the organization. On a personal level, we can strive to attain sufficient sleep, and be sure that it is of good quality. Sleep deprivation can be the result of everyday factors such as work patterns, jetlag, lifestyle, having young children, the use of alcohol, tobacco, drugs, etc. Relief can often come from dark, quiet, and comfortable sleeping quarters, exercise, a healthy diet, and following a disciplined schedule.

From an organizational standpoint, tasks or assignments where the risk of fatigue is high (shift work, late shifts, long periods away, high-flying contracts, etc.) should be recognized and identified. Certain tasks could be re-scheduled to a different part of the day, when the employee is more alert. Company policies must be pro-active in combating fatigue, and managers should learn to recognize signs that an employee needs a break. Tired employees, left on jobs because there is no replacement, seems to be common in our industry, but we all know this is an accident waiting to happen.

Some things to be aware of when trying to prevent fatigue:

Time continuously awake: It is ironic that the practice of extending a duty day can increase productivity when used sparingly but can result in a decrease in productivity if used excessively.

Cont. on p. 4

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DID YOU KNOW?

by Mike Laughlin, Transport Canada, Commercial and Business Aviation, Operational Standards

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CBAACs can be viewed and downloaded from our website at: http://www.tc.gc.ca/CivilAviation/commerce/circulars/menu.htm

Send us Your Stories for "Tips and Tails"

In the spirit of sharing our experiences, we would like to print more of your personal aviation experiences for the benefit of others. We therefore encourage you to send us your stories, no matter how incredible they may seem! As usual we offer anonymity on request.

Send your stories in by e-mail (preferred) to vardyb@tc.gc.ca, by fax at 613 991-4280, or by mail at:

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Now Available–Icing for General Aviation Pilots

OK, so maybe it's not prime icing season in much of our great land, but thanks to the folks at the NASA Glenn Research Center, the training video *Icing for General Aviation Pilots* is now available. You can get your copy free of charge from your regional System Safety office.

While this production doesn't speak directly to the helicopter community, the strategy followed in one of the scenarios is ***avoidance***, which is the only tactic for the vast majority of us. I'm sure each and every pilot will learn something from this well-made and insightful video.

Stay tuned for our joint venture with NASA Glenn on rotorcraft icing products, and don't forget to send in your ice encounter stories (see Vortex 1/2003).

IN THIS ISSUE

Page

Perchance to Dream… *Cont. from p. 2*

In one study by Professor Drew Dawson and colleagues at The Centre For Sleep Research in Adelaide, Australia, it was found that performance impairment after 17 hours awake was equivalent to a blood alcohol concentration of 0.05 percent (for which most provinces now suspend a driving licence for 24 hours). However, this study does not suggest people are unable to complete *any* tasks successfully when they have been awake for an extended period. Simple, over-learned tasks are relatively unaffected by fatigue. This is not the case however, with tasks requiring reasoning or judgment. Performance on these tasks will be impaired and additional fatigue-proofing may be necessary if this performance decrement is to be managed safely.

Time of day: The consistency and effectiveness with which a task is completed during a day shift is higher than during a night shift. In addition, fatigue recovery during a night off-duty period is considerably more efficient than recovery during a day off-duty period. These differences occur because the body's internal clock follows a 24-hour cycle and controls many functions including temperature regulation, performance capability and mood (Figure 1). This cycle includes two periods during the day when alertness is at a maximum (roughly 08:00–11:00 and 20:00–23:00) and two periods during the day when sleepiness is the greatest (03:00–06:00 and 15:00–17:00). As is the case with length of time continuously awake, additional defences may be required if tasks undertaken during circadian low periods (especially between 03:00 and 06:00) are to be completed to the required standard. Similarly, allowances must be made if off-duty time coincides with a period of maximum alertness.

Fatigue prior to duty: Individuals need about seven to eight hours of sleep in order to cope with ordinary demands of everyday life. To the extent that this need has not been met (perhaps as a result of early morning starts, out of phase attempts to sleep, poor sleeping conditions, administrative requirements or poor sleep discipline) individuals will be suffering from acute fatigue. Consequently their performance, especially on tasks requiring reasoning and judgment, will deteriorate as their on-duty time increases. While it's true there are individual variations and some tasks can be successfully completed by individuals who have had less than their required sleep, these are the exception.

Sleep Debt or Cumulative Fatigue: Unfortunately, the body cannot store sleep. Although the loss of a small amount of sleep on a single night may not have a significant effect on performance, sleep *loss* is cumulative—and should it continue for several nights, it will build into a sleep debt. For example, the loss of one hour of sleep for a single night will be undetectable, after the loss of a second hour on the second night the individual will feel its effects, after the third night the effects of sleep loss on performance will be noticeable to an external observer. To manage the fact that it is not always possible for individuals to get all the sleep they need every night, they must be offered periodic opportunities to recover this sleep loss. Research has established that two nights of unrestricted sleep are usually sufficient to recover from even a relatively severe sleep debt. Therefore, to prevent the

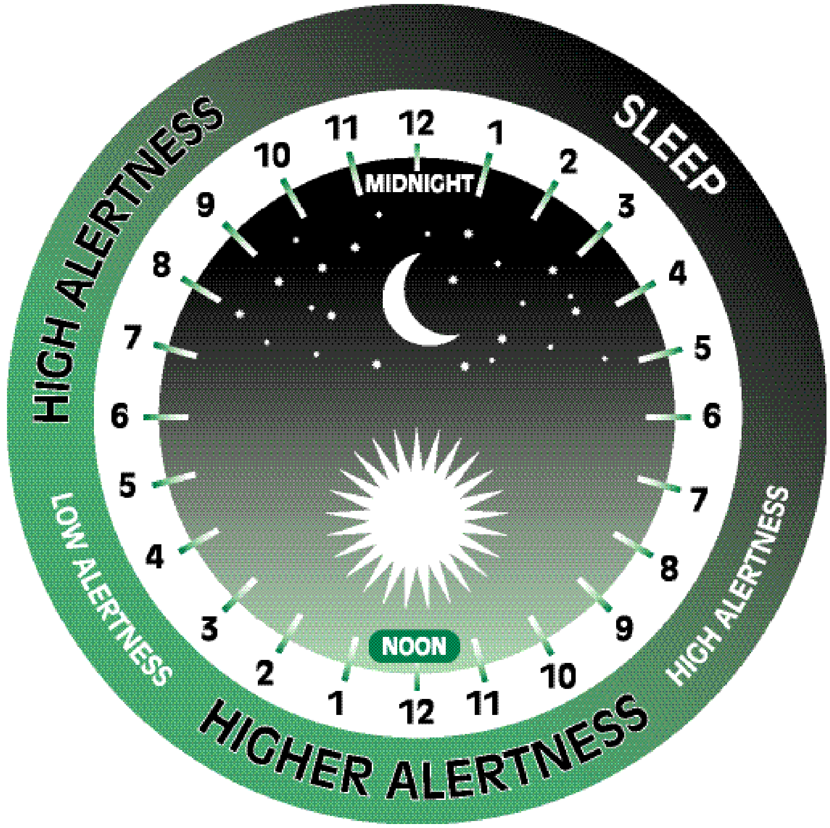

Figure 1: Flight Safety Australia

Cats—The World's Best Sleepers!

accumulation of excessive sleep debt, everyone should be provided with the opportunity for recovery sleep.

So far, we've discussed fatigue from quasi-voluntary factors, but much sleep deprivation is involuntary. Physiological problems such as chronic stress, illness, or pain, can deprive the body of sleep, as can sleep disorders like night terrors, sleepwalking, narcolepsy, or sleep apnoea. If you suspect you may have a physiological problem or sleep disorder, seek qualified help.

Some of these problems can go unrecognized or untreated because the sufferer may not know that they are sleep-deprived. People with sleep apnoea, for instance, literally stop breathing for short periods during sleep, but may never realize they have a disorder. As sufferers sleep, the soft tissue in the throat relaxes and obstructs the upper airways, causing them to snore loudly and eventually to stop breathing, which causes the brain to rouse and demand oxygen. This arousal interrupts the deep-sleep cycle, and may occur more than a hundred times in a night, without the sleeper's awareness. As a result, the victim can be chronically fatigued, even though they spent a considerable time asleep. It is estimated that this condition afflicts four percent of the population, usually overweight, middle-aged men (so, does that make us helicopter pilots a high-risk category?).

Whether its cause is physiological or environmental, excessive fatigue does not belong in the cockpit, around the helicopter, or in the maintenance hangar. Be vigilant of yourself and your colleagues for signs of fatigue around your operation. Try to encourage a personal and company culture that recognizes and reacts to fatigue issues. Get to know the relationship between fatigue and drugs like caffeine, alcohol, and prescription and non-prescription medicines. Be aware of the risks associated with shift work and extended hours. Strive to get optimal rest, both physically and mentally, when off duty. Eating well, staying hydrated (see *Vortex* 3/2002), and maintaining a healthy lifestyle will all help prevent chronic fatigue. And by all means, take a nap if you need one!

Thanks to Civil Aviation Safety Authority, Australia, *Flight Safety Australia*, article "Dead Tired", July-August 2001 www.casa.gov.au

Sliding Doors Alert

The following is a reprint of a Special Airworthiness Information Bulletin (SAIB) from the United States Federal Aviation Administration (FAA). I thought it was worth sharing with Vortex readers. Thanks to Matthew Rigsby, Continued Operational Safety (COS), FAA, Rotorcraft Directorate, Standards Staff, Fort Worth, Texas—Ed.

This is information only. Recommendations are not mandatory.

Introduction

This Special Airworthiness Information Bulletin (SAIB) advises pilots, operators, and passengers of rotorcraft equipped with sliding doors of the **possibility of the sliding door becoming unusable or "jammed" during a survivable accident**.

Background

During a recent rotorcraft accident, a sliding door became unusable due to fuselage deformation and an aft baggage door opening during the impact sequence. This condition prevented a passenger from using the sliding door as a point of egress. The crewmember advised the passenger to use an alternate egress point and the passenger safely exited the aircraft.

The sliding door was not equipped with an emergency egress "pop-out" window. Although the rotorcraft met all of the requirements for egress under FAR part 27.807, the **passenger was still unable to exit the aircraft using the nearest exit, the sliding door**.

Although there were no fatalities in this accident, during the accident debrief with the NTSB Investigator, the investigative team concluded that under other circumstances, a fatality could have resulted due to a jammed door and the confusion normally experienced after an accident.

Recommendations

In order to reduce the probability of a fatality resulting from a jammed sliding door, we strongly urge pilots and operators of rotorcraft equipped with sliding doors to accomplish the following recommended procedures.

1. ***AVOID COMPLACENCY*** in pre-flight briefing to passengers on egress during an emergency situation. Brief passengers before every flight!
2. Review the operators' pre-flight passenger briefing procedures and plans to insure passengers are made aware of alternate exits in the event of a sliding door impingement or jam. If "Sliding Door Jammed" is not currently a scenario briefed to passengers, add the scenario to your egress procedures.
3. In aircraft equipped with a sliding door that does not have emergency "push-out" windows, advise passengers that in an emergency, **they can kick out, or break the plastic window of the sliding door**, if there is no other means of exiting.
4. If the aircraft sliding door is equipped with emergency "push-out" window(s), you should ensure they are properly identified and marked in the aircraft. We recommend you call out window egress in your pre-flight briefing.

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We post SAIBs on the internet at www.airweb.faa.gov

The Importance of Situational Factors in Aviation Safety (or, Situations and How to Control Them)

by Adam Hunt
Canadian Owners and Pilots Association (COPA)

In Issue 3/2002 of Vortex*, in an article entitled* How Much Fuel Do We Need, *I made mention of research that indicates a focus on personality factors is ineffective and that* ***situations*** *overwhelm personality variables. A presentation given by Mr. Adam Hunt at the 2001 Canadian Aviation Safety Seminar in Ottawa spoke about this topic, and he has been kind enough to adapt it for* Vortex. *Adam flew military and commercial helicopters for 18 years, logging 3 600 helicopter hours, mostly on Bell 212s and 205s. He graduated in psychology from the University of Manitoba in 1998 and currently works for the Canadian Owners and Pilots Association in Ottawa—Ed.*

This article is based on a talk originally presented at the 2001 Canadian Aviation Safety Seminar in Ottawa. The aim is to discuss how Western society views accidents and to present a different way of looking at accidents based on research done in the last 50 years. As part of this article I will discuss how this information can help us reduce accidents, and how it interfaces with Safety Management Systems (SMS). I will also look at how all of this is useful in establishing a "culture of safety."

The basis of the piece is grounded in research done by:

Peter Platenius Ph.D. and Gerald Wilde Ph.D., Queen's University;

David Huntzinger Ph.D., Director of Safety, Southwest Airlines;

Stanley Milgram Ph.D., Yale University; and

Lee Ross, Ph.D.

So, why place all this emphasis on research? What is wrong with using personal experience or common sense? Those are very good questions! The main reason is because personal experience and common sense can be misleading. Let me present some examples.

If you take antibiotics for a cold and it goes away in a week, you may conclude, "antibiotics cure colds." However, research shows that, on average, colds pass in the same amount of time whether you take antibiotics or not. Therefore, what your experience is showing you is misleading.

What about using "common sense?" Many companies and individuals prefer to use a "common sense approach" to aviation safety, rather than a research-based one, but what is this common sense? By common sense, most people seem to mean "something everyone has." This implies that common sense is something that you are born with, rather than something you learn. However, insisting that people are born knowing how to prevent aircraft accidents does not make sense. Or is common sense somehow an inherent part of an individual's personality? The case of the Critically Ill Emergency Room Patient, and the follow-up study provide some useful thoughts on the subject of so-called common sense.

The Critically Ill Emergency Room Patient study

This was a "ready made experiment," in that all the elements came together nicely to illustrate something without too much pre-planning. The scene was a large hospital emergency room. A patient was brought in by ambulance. He was very ill and the doctor on duty was not sure what was wrong. Naturally, the doctor ordered some tests and observation. After about 30 minutes, the patient died, and an autopsy found the cause of death to be a fairly rare disease. Many of the doctor's colleagues felt that they could have done better. They felt that the diagnosis was only "common sense"—upon reading the report they all said, "Of course, it was obvious." But was it? The implication was that the doctor on duty that day was incompetent, and that he had some personality flaw that let the patient die.

The hospital psychologists decided to conduct an impromptu study, since it was already set up for them. They decided to take the facts from this case to another hospital. There they presented it as a series of reports within the same amount of time as the doctor on duty had received them. All the doctors were unsure what to do other than observe and order more tests. At the time the patient would have died none had figured it out. After being given the diagnosis the reaction was the same: "Of course, it was obvious!" It actually *was* obvious…after you knew the answer!

So what does this prove? When you examine "common sense" you often find "hindsight bias" in operation. This is sometimes called "Monday morning quarterback syndrome," something that is obvious after all the facts are known. The best definition I have found of common sense is "What I think you should have done after you made a mistake…" I think that this shows some of the problems with a "common sense approach" to aviation safety—it is very effective after the accident has happened, but isn't very useful in preventing accidents.

What about the idea of a link between personality and aircraft accidents? Linking accidents to personality is tempting. It serves two identifiable purposes: It is easy to say things like, "He crashed because he was lazy." It also protects us; some people may think, "I'm not lazy so I am safe." It is very tempting to take this approach! In Western society we like to emphasize the value and strength of personality. After all, we love individual heroes and we hate those who let us down. Regardless of the situation, we expect individuals to triumph over adverse circumstances. But what does the research show? Does personality play a large role in accidents? Or is there something else that we should be looking at here?

The 1986 Transport Canada study

In 1986, Transport Canada funded a comprehensive study on just this subject, conducted by Peter

Platenius Ph.D. and Gerald Wilde Ph.D., both from the Department of Psychology at Queen's University in Kingston, Ontario. Upon completion, the Canadian Aviation Safety Board (CASB) published the research. The results were also reported in the January 1989 issue of the *Aviation, Space and Environmental Medicine* journal. The study was a retrospective self-report which did have some inherent limitations. It was conducted by mailing out a survey to 12 701 licenced pilots in Canada. The survey included 302 questions and actually achieved a 12% return rate, which is pretty good for this type of survey. The main aim was to look for links between many different personality factors and having a history of aircraft accidents. Specifically, it was looking for a "macho personality syndrome" in aircraft accidents.

Results

The study could not find any stable correlations between personality variables and accident history. It also found no evidence of a "macho personality syndrome." In fact the researchers could find no evidence of "macho personality" in any individual accident in the Canadian accident database.

The question is, was this a surprise? Not to the psychologists involved! The "Good Samaritan" experiment had actually predicted the results of the 1986 Transport Canada study. This was an experiment performed on seminary students at a U.S. college back in the 1970s.

The *Good Samaritan* experiment

In this experiment students studying to become church ministers were told to prepare a sermon on the subject of *The Good Samaritan* (for those who aren't familiar with that, it is a bible story about the value of helping injured people while traveling). Some students were told to rush over to another building—where they were to present their sermon—because they were late. Others were told that they had lots of time to go over to the other building to present their sermon. All students encountered an injured person lying by the path on the way to the next building.

Whether the students stopped to help or not was predicted by whether they were in a hurry or not. Very few of those who were told that they were late stopped to provide assistance, in contrast, almost all of those who were **not** in a hurry stopped to help. This showed that the person's behaviour was predicted by whether they were in a hurry, not by personality variables. As you can see, there was some irony in the design of this experiment!

The 1986 Transport Canada study was not given wide distribution, which is actually too bad. The lack of distribution was probably because it failed to find what Transport Canada and aviation industry managers were hoping for—a personality test that could be given to pilots to see who would have an accident! Personality is usually defined as "enduring traits that change little with time." If personality were responsible for accidents, then we could do little to change those people who would have accidents. We could just give them a test and not hire them. The fact that the research didn't come to this conclusion was important, even if it wasn't the desired result—but was this a "good thing" or a "bad thing?"

The researchers who conducted the study weren't surprised at all by the study's findings. Decades of research done since the Second World War have shown similar results. The classic experiments in this area were conducted by Stanley Milgram at Yale University, starting in 1965. They are an interesting story and very relevant to this whole subject.

Milgram's experiments

It was only 20 years after the end of the Second World War. Stanley Milgram was deeply troubled by the plight of the Jewish people during the War. He was especially troubled by the 6 million Jews who died in Hitler's *Final Solution.* There were hundreds of thousands of people involved in the German concentration camps working as guards, doctors and other staff. How could so many people be involved in such a horrible crime? That was what bothered Stanley Milgram. "Was it something about those Germans?" That was a question that many people asked after the Second World War. Or was something else going on that caused so many people to be involved?

At the Nuremberg Trials after the War, many former death camp staff claimed as their defence that they were, "only following orders." The judiciary at Nuremberg mostly rejected this defence. It troubled Milgram a lot. Were the judges right? Did hundreds of thousands of people have a personality defect? Being a research psychologist, he designed an experiment to find out.

Two volunteers arrived at the psychology lab at Yale University. They were told that they would be participating in a pioneering experiment on the "effects of punishment on learning." They drew lots to see who would be the "teacher" and who would be the "learner." One of the two volunteers was a confederate of the experimenter (of course); he always got to be the "learner." The "teacher" was given a sample electric shock and then seated at a control panel. The confederate was strapped into a chair and electrodes were attached to his wrist. The control panel had a shock generator with voltages labeled 15V, 30V, 45V, all the way up to 450V, with the last level labeled "XXX." It looked pretty ominous.

The teacher was instructed to read sets of word pairs to the learner. If the learner got one answer wrong he got a shock at 15V. Subsequent errors were punished with increasing shocks, at 15V intervals.

At the start, the confederate "learner" complained about "heart troubles" and remarked that he was participating because he needed the money. As the experiment continued, the learner proved to be a poor student and received increasing shocks. The only other person present was the researcher—a man in a white lab coat, with a clipboard. He was a real "authority figure," with a stern demeanor. He always coached the teacher but did not interfere. The researcher used four verbal "prods": "Please continue," "The experiment requires that you continue," "It is absolutely essential that you continue," "You have no other choice; you *must* go on."

How far would you go if you were the "teacher?"

Before he did the experiment, Milgram described the procedure to 110 individual psychiatrists, college students and middle class adults. The majority of people in all three groups said that they would disobey by 135V and none expected to go over 300V. Milgram thought they might be exhibiting a "self-serving bias" so he asked them how far they thought other people would go. No one expected any other person to go to the "XXX" level of shock. The group of psychiatrists guessed that only 1 person in 1 000 would go to the "XXX" level of shock. It should be pointed out that the confederate "learner" only acted as if he were getting shocks! In the first experiment run he protested increasingly as the voltage was increased, and mentioned his "bad heart."

The first experiment consisted of 40 male subjects, aged 20–50. Twenty-five of them (63%) went right to the last level. All who went to the 450V level went on to the "XXX" level and continued giving shocks at that level until the researcher called the experiment off even if the "learner" feigned being unconscious.

Milgram thought that perhaps the "learner" wasn't complaining loudly enough, so subsequent experiments had the "learner" complain more strongly. This made little difference in the results.

The Milgram experiments were duplicated dozens of times with similar results.

"Teachers" in the experiment included doctors, lawyers, priests, housewives and pilots, among other professions. Over 1 000 people were employed as "teachers" by the time the experiments wound up in the 1970s. The results shocked the world at the time, and the whole story was made into a movie called *The Tenth Level,* starring William Shatner.

What does all this have to do with aircraft accidents?

The experiments showed the importance of "situations" in how people react and what the outcome is. Personality variables were poor predictors of what voltage-level people would go to. People of "high moral character" (priests and doctors) didn't perform better than those from more ordinary backgrounds. IQ was also a poor predictor of who would go to the last level, which helps to explain why IQ doesn't predict who will have aircraft accidents either. In Milgram's experiments, personality factors overall were poor predictors of how far someone would go. These included IQ, profession and personality types. The overwhelming factor was the man in the white lab coat insisting that the experiment continue. In other words it was the situation alone that best predicted how far people would go.

Milgram was so surprised at his results that he became a strong advocate of questioning authority, instead of obeying orders. Milgram's work became one of the cornerstones of the resistance to the Vietnam War at the time.

The Fundamental Attribution Error

In 1977, researcher Lee Ross found that most people, particularly in Western society, overestimate the effect of personality and greatly underestimate the effects of situation. He called this effect the *Fundamental Attribution Error*.

The exception to this effect is when we talk about ourselves—then we tend to be more realistic about the effects of the situation. For example, when I am late for work it is because "traffic was heavy" (situation). When a co-worker is late for work it is because "they are lazy" (personality).

Why do we do this? When we look out on a scene, we see a person and we see surroundings. The person draws our eyes and becomes the centre of the scene. We assume that anything that is happening is because of the person we see and not the surroundings. When dealing with our own situations we see just the situation, as we can't usually see ourselves. The situation dominates our view and so we assume that it is causing the effects we see. This effect is found in all cultures around world and contributes to the high rate of attributing aircraft accidents to "Pilot Error."

Aviation research

David Huntzinger identified many strong situational effects in his 1994 paper with the very long title: *The Motivating Factors And Perceptions Of Risk Associated With Intentional Rule Breaking Among Aviators*. His study consisted of interviewing recreational and professional pilots about times when they intentionally broke rules.

He asked them to describe incidents where they broke aviation rules on purpose and where they were tempted to, but didn't. During the study he discovered that dilemmas play a big part in aviation accidents and incidents. These dilemmas are caused by ourselves as pilots; other people, such as passengers or other pilots; and especially company management.

Sample management dilemmas

Helicopter example 1:

Rule: Comply with all the CARs, including the requirements of the Airworthiness Manual, to record all defects.

Company policy (can be 'unofficial,' but understood as policy): Never ground a helicopter in the bush, unless you have the time, parts and the AME there.

Situation: You are without an AME in the bush at a camp and your Bell 206 develops a high frequency vibration. What do you do?

Helicopter example 2:

Rule: All pilots must comply with the Company Ops Manual and the CARs with regard to low visibility operations. The limit is a minimum visibility of $\frac{1}{2}$ mi.

Company policy: Get the job done, and keep the customer happy.

Situation: The weather has been bad for three days, and the client is getting impatient that you haven't shown up on the job. What do you do?

Private pilot example

You are a college student and have been visiting your out-of-town girlfriend for the weekend, using a rental Cessna 150 to get there. You leave on time to get back before dark on Sunday evening, since you don't have a night rating. Unforecast increased headwinds slow you down enroute, and it is obvious that you will not make it home before dark. Being a poor college student you have no cash or credit card. Do you fly on, and land at an unlit airport in the dark, when you have no night rating? Or do you land at the halfway point in daylight, sleep in the plane (recall you have no money for a hotel!), miss your Monday morning classes and incur an extra day's rental penalty for bringing the plane home late? Remember, you have no money!

This was a real-life example. In this case, the pilot flew home in the dark and landed at an unlit airport. He didn't get caught or have an accident, but he was lucky.

In all these cases the *situation* dominates the problem, not personality variables. Does this mean that accident prevention is hopeless?

Dealing with dilemmas

In the case of our college student, he created his own predicament without external pressure. In hindsight it is easy to see how he could have avoided the dilemma or controlled the situation! However, most commercial flying dilemmas involve more than one person or peripheral factor, and Milgram's experiments emphasize the need for us to:

- Identify who is wearing the "white lab coat."
- Determine who is being pressured to take action.
- Understand that personality is a small factor in these cases, and that "situation overwhelms personality."

So, we should strive to recognize and deal with dilemmas before they cause accidents. Introduce a culture of safety that works from a basis of identifying and controlling situational risk factors, not just when it is easy to do so!

We must identify factors that can cause dilemmas between safety and performance, such as:

- Profit sharing arrangements;
- Payment by the mile, load, passenger, or ton delivered; and,
- Payment by the flying hour.

These all motivate pilots to fly when they shouldn't, or at least "give it a try."

As a manager in commercial aviation, make sure you are paying for what you want. If you want a safe operation, then pay for safe decision-making. If you want production, regardless of accidents, then pay for flying hours, passengers delivered or freight delivered. People will generally do what they are paid to do!

In private aviation, always leave yourself options. Always have an alternate for fuel, accommodation and food. Always leave yourself an "out" for time, such as airplane rental agreements that will not pressure you into bad decisions or a boss who will give you a Monday morning as vacation time if needed, so you don't have to push the weather to get back to work. Always leave yourself financial options—carry credit cards, cheques, bank cards or even cash, so you don't pressure yourself to do things due to lack of money.

What about SMS?

Transport Canada's new SMS approach to "safety as a culture" is well adapted to include an emphasis on situational factors. It doesn't require laying the entire problem of safety on individual personalities. It gives the opportunity for organizations to better control their situations, through risk management. That's good business.

Conclusions

So what have we learned from all this? We have seen that decades of research have shown us that a focus on personality factors is ineffective in preventing accidents, and that situations overwhelm personality variables. That is actually "the good news"—situations can be controlled, while personalities are very resistant to change.

More information about COPA can be found at www.copanational.org

Cockpit Ergonomics

Webster defines 'ergonomics' as, "*an applied science concerned with the characteristics of people that need to be considered in designing and arranging things that they use in order that people and things will interact most effectively and safely*" That's a very long and drawn out way of saying it's the science of how we interact with stuff. In helicopters, this can include:

1. the location of switches and gauges;
2. control travel vs. control effect, i.e. that the average pilot doesn't need to be a contortionist to achieve full control authority; and
3. the location of emergency equipment, etc.

The term 'ergonomics' is widely used to describe comfort issues as well, but that won't be the focus here.

Of course, in a small cockpit, creating an effective work environment can be a challenge. In addition, we find hundreds of uses for helicopters that necessitate the installation of specialized equipment—we add longlines, carousel hooks, emergency floats, survey equipment, spray gear, search lights, satellite phones, stretchers, water buckets, hoists, or special navigation equipment. At times, the job requires the removal of parts of the aircraft, such as doors or seats. These changes sometimes require additional switches, or changes to the basic helicopter layout, which, if not carefully considered, can land us in trouble.

A Bell 206L was coming to the end of the first leg of a 10-hour ferry trip to the company's main base for some minor maintenance prior to heading off for a summer contract in a remote corner of nowhere. The first fuel stop was another company base at a small airport, where the pilot could help himself to fuel and be quickly on his way—as usual, there was pressure to get to destination *yesterday*. It was a beautiful spring day, but the winds were quite strong and gusty, making for an uncomfortable ride. The pilot found himself wishing he could call it a day and wait for the gale to die down, but he knew that would be hard to explain. To make matters worse, the Long

Ranger was equipped with fixed floats, and every gust threw the helicopter around like it was strapped to the back of some cranky old meteorological rodeo bull. Finally, the airport was in sight, and the pilot began his approach to the company fuel area.

Being the intrepid aviator that he was (me), he intended to land with the fuel pump on the range extender side, so he wouldn't have as far to pull the fuel hose—after all, seconds count in these situations. During the pedal turn in the strong wind, the helicopter began to drift to the right, toward the pumps, and the pilot was surprised to find insufficient left cyclic to arrest the drift. As the rotor came dangerously close to the light standard that hung over the pump, the pilot abruptly lowered collective and the helicopter landed hard on the right float, but was not damaged.

This particular Long Ranger, like others in the company's fleet, had a bracket installed on the cyclic that housed a cargo hook release on one side, and a water bucket release on the other. The bracket extended more than an inch on each side, making the cyclic in excess of 4 in. wide between the pilot's knees. This seriously reduced the available lateral cyclic travel, especially to the left, as the pilot's knee would be pressed against the collective. Snow pants (or pilots with big knees) would further increase the risk during sloped-ground or crosswind landings.

This problem is relatively easy to address, as after-market cyclic heads are available that contain provisions for extra switches, but some examples of potentially dangerous cockpit ergonomics are not as simple.

The recent accident of a Bell 206B that was engaged in spraying operations has been partially attributed to poor cockpit ergonomics. In its report, A01A0100, the Transportation Safety Board of Canada (TSB) finds that the helicopter experienced an unanticipated right yaw, also known as *loss of tail rotor effectiveness*(LTE) (see *Vortex* 1/2002), while attempting to take off at high gross weight from a staging area. As the aircraft rotated, the tail rotor struck a tree, the helicopter rolled over and was substantially damaged. During the LTE event, the pilot tried in vain to jettison the spray load, which would have shed considerable weight from the aircraft. According to the TSB report, "Had the pilot's attempt to dump the spray load been successful, it is likely that he would have been able to quickly regain control of the helicopter and avoid the tree strike."

The helicopter was equipped with an agricultural navigation (AgNav) system, for which a remote switch had been attached to the left side of the cyclic grip, by way of a bracket. The spray system control box, which is designed to be mounted on the left side of the cyclic, was mounted on the left side of the AgNav remote switch. The spray system control box incorporates an emergency dump switch, which is designed to be operated with the middle finger. With the AgNav bracket in place, the location of the dump switch was now considerably further from the pilot's reach than the design intended. The TSB found that "…only persons with large hands could operate the dump switch—although this was with the ring finger, not the middle finger—and still maintain a normal grip on the cyclic. An investigator with medium sized hands (the same size as the pilot's hands) had difficulty pressing the dump switch." When the AgNav switch bracket was removed, even those with small hands could easily access the dump switch and maintain a normal grip on the cyclic.

Photo: TSB

Of course, the spray system and AgNav cyclic installations would seriously impede the pilot in a right-slope landing or strong left crosswind, but during spray operations these conditions are unlikely. However, some operators leave cyclic and collective-mounted specialty equipment permanently installed when the aircraft is returned to 'normal' service—this exposes the aircraft to increased risk from reduced control travel or snagging in loose clothing.

In some cases, operators with mixed fleets use the same switch position for different functions—a practice that is especially common with cargo hook, remote hook, and force trim releases. This lack of standardization between aircraft of the same type has resulted in many dropped loads and lost water buckets over the years! It is also important to know that all modifications to the basic aircraft are regulated by Transport Canada Aircraft Certification, and ergonomics are considered as part of the evaluation process. Any request for a design change will not be approved if it jeopardizes the safety of the aircraft operation.

So, before you go flying, look around for potentially hazardous ergonomics in your aircraft, and take the time to acquaint yourself to the peculiarities of each machine. Be certain that any change to the ergonomics of your aircraft are either covered by a Supplemental Type Certificate (STC), or approved by the governing regulatory body, in this case, Transport Canada. Ensure all switches and emergency releases are accessible, and identify their function—could you activate them quickly under stress? Be certain that controls are free through their entire travel, and no possible obstructions are present. The position of small, seemingly insignificant items in two examples above, contributed to one accident and one serious wake-up call. Easily preventable, weren't they?

Tips and Tails

MEDEVAC Turns Dark and Snowy

I was a Captain on an EMS IFR twin. There were frequent snow showers giving reduced visibility down to 1/2 mi, and ceilings were hanging around the 500 ft mark. We received the call in the afternoon for a MEDEVAC flight to a location just over 100 mi. away. As usual, myself and the first officer proceeded to the hangar, and the medic went straight to the local hospital to prep the patient for transport. We checked the weather, which wasn't nice, but acceptable considering the flight was over mostly flat terrain, and we waited for the call. After an hour and a half, I started to worry as night would soon be a concern. I made a call to the hospital—it took some time to get a hold of our medic—but we were eventually told it was a 'go.' I made a few quick calculations in my head, and came to the conclusion that we could make our destination prior to nightfall. After an uneventful trip to the nearby hospital, the first officer headed into the building to check on the situation, as I sat at idle in the bird. Once again we were subjected to a lengthy delay as there were complications with the patient. Now I started to get worried, so I called the FSS to get the exact time for 'official night,' broke out the whiz-wheel to work out an accurate ETE, and did a bit of math. I also gave myself a buffer that was nowhere near sufficient. I passed along our cut-off time to the dispatcher and watched my clock. As the time approached, I called the dispatcher again to cancel the trip and to send out the first officer, but as we spoke, the door opened and out rolled a stretcher, medics, doctors and a few support staff. Now the acid started to flow into my stomach and I seriously considered the consequences of the decision I was to make, but I reassured myself that I had done the math and was thorough. My buffer was going out the window but I had thousands of hours of flogging around in crappy weather as a bush pilot and I forced myself to relax. Now the five min loading time was nearing fifteen min with further complications, and we would actually be arriving a tad after dark, but I could hardly turn things around now (something I told myself at the time), besides, there were plenty of lights in the city and I knew every power line and tower like the back of my hand.

So off we went into the storm. Half way into our trip, I realized with some disgust that 'official dark' is dark on a clear night—in a blizzard, well, let's just say it was dark a bit early. So now I find myself with a fresh, inexperienced first officer, three oblivious souls in the back, unable to climb due to heavy icing in cloud, smoking along at 500 ft completely on the dials. The first officer was furiously punching in known towers into our GPS (still new technology at the time) while I tried to reassure myself that we weren't picking up any ice, and that we were above the power lines. My biggest concern was how to deal with ATC once we got closer to the city. My options, as I saw them, were:

a) at the edge of the zone, pick up a clearance for an approach and hope we don't pick up too much ice (I didn't particularly like that one, though).
b) hope that when we got over some lights that I'd have enough reference to get to the ground and call for a land ambulance.
c) hope the weather was VFR.
d) wake up and not share this dream with anyone, ever.

In the end, as we neared the edge of the zone, the numerous lights gave us enough reference to find a place to land, but the visibility kept improving to the point where I'm sure the controllers almost believed us when we told them we had the airport visual.

As we sat over brews in the hotel bar that evening, I had a good chance to reflect on my stupidity. I kept pushing myself further and further into that trip. I had numerous opportunities to turn the flight down, and I knew that there would be no repercussions for doing so. Sure, some people would have been inconvenienced, and the road trip into the city would have been horrendous for the patient in the storm, but I would not have put anyone's life at risk—something I had surely done by continuing with the flight. My young first officer thought the entire trip was "the coolest" and no amount of second guessing myself that night would wipe the grin from his face. Luckily, he managed to scare himself enough over the years to become a safe pilot, but I could have eliminated a great deal of those scares by having the courage to turn down that trip. I came to the conclusion that the indigestion was not worth it, is never worth it, and I proceeded to set up some very strict limits for myself that would always assure a safe and boring trip.

Name withheld by request.


DON'T BE LIKE A
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CF AFS
AVOID
AIRSPACE
CONFLICTS
"Did you know that there is Restricted airspace around "all" forest fires for 5 nautical miles and at an altitude of 3,000 feet above ground(AGL)?"
"On fires with heavy aircraft activity, Forest Protection may have a NOTAM in place which is greater in dimension and altitude to ensure the safety of the aircraft working over and around the fire."
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