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CHRONIC STRESS AS A FACTOR IN AIRCRAFT MISHAPS

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Thirty four years ago, when I started Navy flight training, there was no such thing as pilot stress. The macho thing was that stress didn't bother you. Stress was for sissies. We were told by our flight surgeons that aviators compartmentalize their stress, keeping marital problems at home, office problems at the office, etc. In fact we were selected, in part, because of this talent. Unfortunately, this leads to the selection of individuals who are not very introspective, and not very aware of what's actually happening to them, physiologically.

In the late 1960s, I worked for a Navy flight surgeon at the Naval Aviation Safety Center, Captain Frank Austin. Frank recently resigned as Federal Air Surgeon. During the Vietnam war, in 1966, he took part in a study, (ref. 1) conducted by Drs. James Roman, Walt Jones and Harry Older of NASA, of the stress of combat on Navy pilots. They took a number of physiological measures of pilot stress - heart rate, respiration and so on. They actually instrumented aircraft so that they could tape these responses in flight. After a flight, they also did chemical analyses of blood, urine samples and so on. What they found was that while these individuals were over the target with SAMS (surface to air missiles) being fired at them, their stress levels went up pretty high as one would expect. But when they got back to the carrier just before landing, they went right off the scale on these measures of stress. There is no stress like landing on an aircraft carrier, especially at night - not even being shot at by the enemy. But, the pilots were able to handle this type of acute stress better than the average person.

Naval aviators pride themselves on being at the "tip of the spear," of U. S. policy. Unlike the other services, they have to be ready and in place, near the battle zone, with their aircraft loaded with ammunition ready for trouble at any time. This means that they're in a constant state of readiness. They don't really feel they have time to talk about things like stress.

When you start looking at what these Navy personnel are doing, you can't really question that they are under conditions that produce chronic stress because we are talking about long family separations and severe living conditions. If any of you have ever been aboard an aircraft carrier you know what I am talking about. You are working in an environment of noise, temperature extremes, and vibration. There's really no rest. As for sleep, in many cases during the Vietnam war, "hot bunking" was practiced. Since there are accommodations for a fixed number of sailors, but more people than that were required to do the job, bunk sharing had to be employed. When a sailor was on duty and out of the bunk, his buddy was sleeping in it. He really had no place to go where he could relax. On board an aircraft carrier you are working, or you are sleeping, or you are eating a meal. Usually the meals are on-the-fly affairs, 15 minutes at the most. There's not a whole lot of rest. Work days are often 18 hours or

more. These conditions are conducive to chronic fatigue and stress in maintenance and aircraft handling deck crews.

A naval aviator's main duty is not just flying. He also has collateral duties. There is limited space aboard ship to put personnel, so every officer has to double up on jobs. In addition to being a pilot he also may be a maintenance officer, or an operations officer, or a training officer, or a safety officer. He may get so bogged down in his paper work that there's just no time to think about flying or to study flight manuals while at sea. There's a lot of uncertainty in the kinds of operations that may be assigned when a carrier air group is tasked to react to some kind of external threat. They may be at the point of returning home from a long sea period, when they're suddenly turned around and sent back. This seriously affects their family life. They find themselves involved in "blue water operations". That is, they are so far from land that, if anything happens, they can't go back and land somewhere on a land base. (At least not on friendly territory where you have prior arrangements to land.) So if anything happens and they can't get aboard the aircraft carrier they have to ditch at sea or eject from their jets. Many naval aircraft mishaps involve aircraft that take off and are never heard from again. Unfortunately, these mishaps can't be investigated to determine causes and correct them.

Also, there exists the potential for chronic stress that is caused by the heavy responsibility that's put on junior officers. The Navy utilizes independent duty detachments with fairly junior officers, especially in the helicopter community. They might be placed aboard a ship at sea that is not an aviation ship. It just has a very small platform built on the stern. Many times the commanding officers of these ships have no aviation background. They may want a crew to fly over and pick up some vitally needed supplies or take a wounded or sick man back to shore. It'll be a dark night, in freezing weather, and the deck will be rolling and pitching. A junior officer has a lot of pressure put on him to complete these kinds of missions. The same thing happens to Coast Guard aviators who are tasked with missions to rescue people under similar conditions.

The rotary wing community has been largely neglected when it comes to safety. Historically, the emphasis in human engineering design for safety has been on the more expensive fighter and attack aircraft. The individuals who are out there in small helicopter detachments, hovering over a very slippery deck at night in rough weather, have been overlooked.

But naval aviators are stress copers. They thrive on it. They're selected for this. In fact, they are stress seekers. You could call them type A personalities, people who have to be under pressure to really do good work. However, each has his own personal limitations. Stress coping is subject to individual differences. If you drew a curve showing their stress coping behavior, it would be a bell shaped curve. But, that curve would represent higher overall stress coping ability than that of the normal population. We may think that an individual aviator is doing well compared to the general population but we would have to compare him to the norm for his group to say he is coping well. Those who do not cope well represent a small percentage of our aviators, however.

We find that people who do not cope well with stress tend to fall into two categories. First there is the younger and the less experienced, immature individual as you would expect. These represent a substantial portion of the sailors who man the flight decks and do maintenance on the aircraft. Secondly, the type A personality frequently has trouble coping with stress. This description would fit a lot of our junior aviators. These two groups do not handle stress well.

I got into stress coping research because there was not widespread recognition in the Navy of stress as a mishap cause factor. Even Navy flight surgeons who are trained to do the human factors analysis on aircraft accidents were not recognizing stress when it was a factor in a mishap. Several years ago this was demonstrated during the investigation of an accident that involved an aircraft commander taking off in a transport aircraft who had an engine quit. The copilot, using good crew coordination procedures, tried to feather the bad engine. The aircraft commander reached up and knocked his copilot's hand away from the engine feather button, then proceeded to feather the good engine. They ditched into the sea and got out alive, but they lost a couple of passengers who drowned. The flight surgeon had written up his report declaring that there were no known psychological or sociological factors in the mishap. The Naval Safety Center's aircraft accident investigation team was sent to investigate. One of the team was in the officer's club bar at the base where the accident occurred. He started asking some questions and found out that the pilot was in the bar the night of the mishap. He finally had to leave when the bar closed at one a.m. He had an early flight at six a.m. and he had been drinking heavily. The reason for this was his wife had called him from the United States to tell him she was leaving with another man. This was the culmination of months of marital discord. Apparently everybody knew about it in his squadron. They just closed ranks and were tight-lipped about it during the investigation, to protect their buddy.

About that time I began talking with Captain Richard Rahe, a psychiatrist at the Naval Health Research Center in San Diego. He's now retired and teaching at the University of Nevada Medical School in Reno. I asked him if the life changes scale that he had determined was associated with health changes could also have some correlation with behavioral changes. Some of these health changes include accidental injuries. Certainly if life changes had such a profound effect on health there surely must be some effect on skilled performance. However, since his interest was only on health changes, Dr. Rahe encouraged me to investigate a relationship, if any, between life events and accidents.

You probably recall the study in which Dr. Rahe collaborated with Dr. Thomas Holmes of the University of Seattle. They had a large number of faculty members rank-order various life changes as to how much stress coping they felt would be required by each. They arbitrarily assigned the death of a spouse (the one that everyone agreed required the most stress coping) 100 points using an ordinal scale. Thus divorce was assigned 73 points and so on. In the Navy study, Captain Rahe added the cumulative points for people who reported these kinds of events within a year prior to going on a cruise on U.S. Navy ships from San Diego. There were over 2,000 men involved in this study. They weren't told why they were being asked these questions. During their cruise, of those who had accumulated between 150 to 200 points,

about a third reported to the sick bay with some kind of illness. If they had between 200 and 300 points, over half reported ill during the cruise. Of those with over 300 points almost 80% reported ill or with some kind of accidental injury (ref. 2).

Even though ordinal scales are not additive, they did demonstrate a relationship between cumulative life events and health changes. So I devised a questionnaire of my own. I found that a lot of these life change factors didn't work for me in discriminating aviators who had pilot factor mishaps (ref. 3). Again, there were too many individual differences, so I started looking beyond life changes to such things as stress coping. The questionnaire I used asked about pilot judgment and life difficulties as well as certain personality characteristics (ref. 4).

My questionnaire was adapted from Drs. Rahe and Holmes's list of life events, plus some biographical information and data on aviator performance. It was sent to flight surgeons who were on aircraft mishap boards. They were instructed to complete the questionnaire for the involved aviators. By talking to his family and friends, his superiors in the squadron, his peers, etc., the flight surgeon could get the answers without showing the aviator the questionnaire. Many times the pilot was deceased, so the information had to be obtained from the family. The pilot never saw the questionnaire, only the flight surgeon did. Unfortunately, it was an ex-post-facto study. This has led to a great deal of criticism of the study. At the time a mishap occurs we don't always know exactly what happened so we have an investigation. By the time the causal factors are determined, a year might have elapsed. But when the investigation was finished the questionnaire responses were divided into two groups. Over 700 of these questionnaires were completed. They were roughly divided into half between those with a pilot error factor assigned and those who had no role to play in the cause of the mishap. (Roughly half of major Navy aircraft accidents are determined to be caused by pilot error.) Those that were assigned pilot error by the aircraft mishap boards were compared with those who had no fault in the mishap.

The results are shown in table 1. Several of the factors are related to having problems with interpersonal relationships, i. e., having problems with peers, problems with superiors, etc. (ref. 5). I have recently collected data from people who have not been involved in a mishap by asking the flight surgeon to use the same questionnaire on an individual in the squadron who's the same rank and roughly the same experience as the mishap-involved aviator. I have not published these results yet, but I can say that those people who have not been involved in a mishap are not statistically different from the group that were not at fault in the mishaps they were involved in. Both of these groups are statistically different from the at fault group in certain areas in the same direction as the previous studies.

The study identified some of the symptoms of inadequate stress coping that are associated with a pilot factor aircraft mishap. These include difficulties with interpersonal relationships (i.e. peer troubles and problems with authority figures). The mishap itself is also a symptom of inadequate stress coping. When an individual is not coping, he may turn his frustrations inward and become self destructive or he may "act out", taking out his feelings on others or on objects around him. The aggressive

personality characteristics exhibited by most aviators lend themselves to "acting out". My results demonstrated that "acting out" behavior was present in the at fault mishap pilots at the time of the mishap (ref. 5).

Sloan and Cooper in Great Britain attempted a study to determine if my results were applicable to British airline pilots (ref. 6). They sent my questionnaire to mature airline captains (average age in their late forties) and asked them which characteristics they thought would be important in identifying accident prone pilots. "Acting out" symptoms were not among them. Since their methodology was so completely unrelated to mine, I find the results are not comparable. My subject population consisted of young (average age 29 years) aviators who had been involved in aircraft mishaps. They never saw a questionnaire. The data were collected by flight surgeons trained to investigate by asking questions of supervisors, family, friends and fellow aviators. Sloan and Cooper's subjects, on the other hand, were asked to make a subjective evaluation.

What would I recommend? I think that in spite of the fact that this study was of military aviators, a highly select group, there are still a lot of lessons to be learned for general and commercial aviation. I'd like to list for you some characteristics of what I feel are successful stress copers. These people have a higher degree of self-awareness and feelings of self-worth. They believe they can influence events or even change them. Change is seen as a challenge and an opportunity, rather than a threat. As for recommendations for coping with stress, I believe the traditional methods aviators employ, which usually involve alcohol consumption, are counterproductive, causing more problems than they alleviate. Instead rest, exercise and a proper diet should be encouraged. In other words, physical fitness is a better strategy for stress coping.

Also recommended is time management, the prioritization of life goals, more self awareness, stress avoidance and counseling by a flight surgeon or chaplain if needed. The idea that only sissies are affected by stress must be put to rest. The subtle and insidious effects of stress on pilot performance must be emphasized in pilot training programs. Stress and fatigue are hazards that must be dealt with in aviation to ensure safe flight operations.

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Table 1. Factors which discriminated between pilots who were at fault in an aircraft mishap and those who were not at fault using the Fisher-Irwin Exact Test (one-tailed). (N=737)

| Factor  | At Fault<br>(n=381) | Not at fault<br>(n=356) | Critical<br>Level<br>(1 sided) |
|---|---------------------|-------------------------|--------------------------------|
| Poor leader   | 43                  | 21                      | 0.0065**                       |
| Lacks maturity and stability                                    | 20                  | 9                       | 0.0425*                        |
| Financial problems  | 14                  | 5                       | 0.0418*                        |
| Recent marital engagement                                       | 17                  | 5                       | 0.0118*                        |
| Recent major career decision                                    | 77                  | 36                      | 0.0001**                       |
| Difficulty with inter-personal relationships                    | 26                  | 13                      | 0.03858*                       |
| Trouble with superiors  | 27                  | 5                       | 0.0001**                       |
| Trouble with peers  | 19                  | 7                       | 0.0203*                        |
| Recent personality change                                       | 13                  | 4                       | 0.0304                         |
| Excessive alcohol use or recently changed intake                | 8                   | 0                       | 0.0047**                       |
| No sense of own limitations                                     | 26                  | 11                      | 0.0131*                        |
| Incapable of quickly assessing potential troublesome situations | 31                  | 6                       | 0.0000**                       |

\*p<0.05 \*\*p<0.01