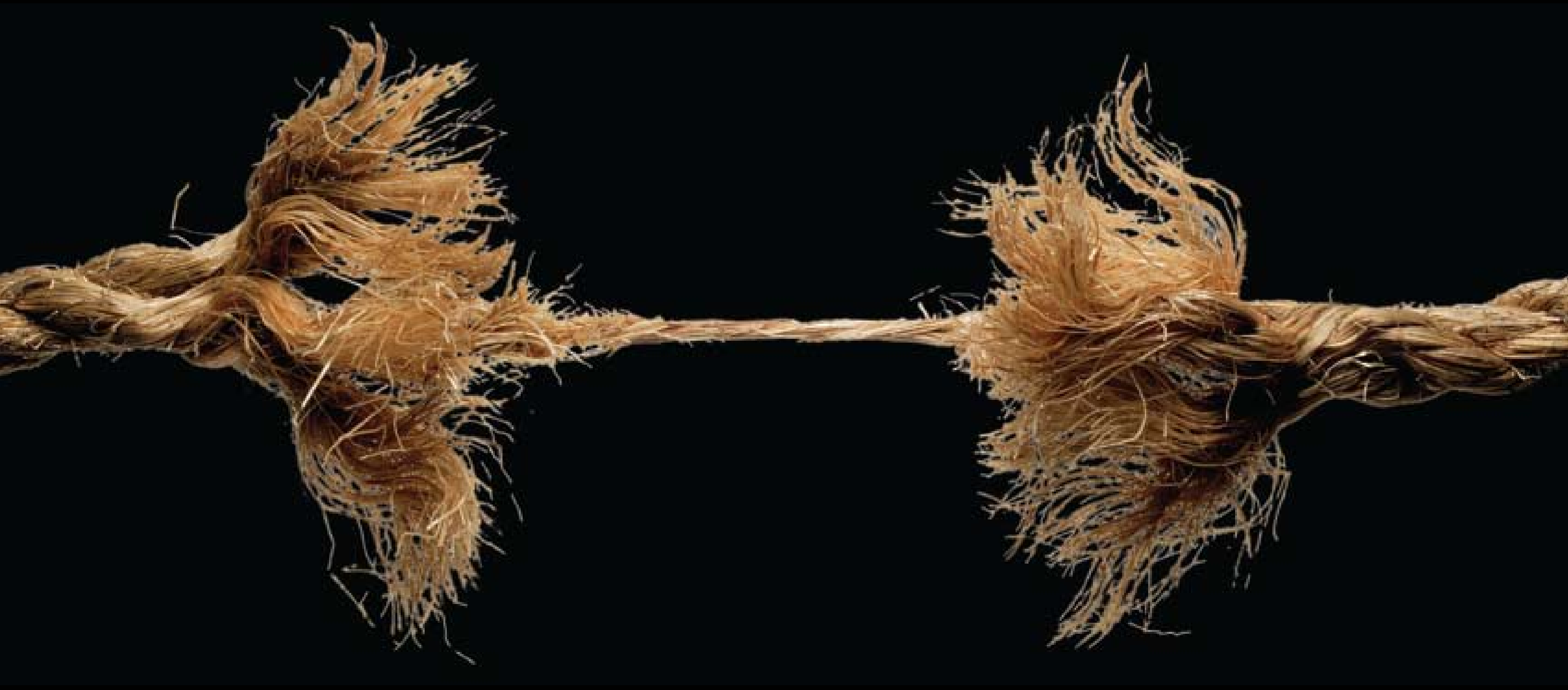
SECOND OF TWO PARTS

STRESSED OUT

BY CLARENCE E. RASH AND SHARON D. MANNING



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A range of physical and emotional factors can interfere with a pilot's cognitive process and degrade his decision-making skills.

Whenever pilots step onto a flight deck, they should ask themselves if they are fully capable of making the right decisions during the upcoming flight and taking the actions required in case of an emergency.

Decision making — the final step in the cognitive process[1] — is a factor in 30 to 40 percent of all commercial and general aviation aircraft accidents.[2,3] Any physical, physiological or emotional factor that degrades any portion of the cognitive process ultimately will degrade decision-making skills. When considered in the context of their effect on cognitive function in the operational flight environment, these factors often are referred to as "stressors."[4]

'Wear and Tear'

The term "stressor" is derived from "stress," a concept first identified in the early 20th century by Austrian endocrinologist Hans Selye. He identified what he believed was a consistent pattern of mind-body reactions that he called "the nonspecific response of the body to any demand."[5] He later referred to this pattern as the "rate of wear and tear on the body."

The definition of stress is necessarily broad: Stress is a normal, nonspecific physical, psychological and physiological response of the body to any demand placed upon it.

Prolonged stress may affect cognition — the process of perception, attention, memory, knowledge, problem solving and decision making — just as it affects emotions and behavior. This is a serious issue for pilots, because problems with judgment, attention or concentration present a great risk to the aircraft and the people in it. For example, under high-stress conditions, there is a tendency to oversimplify problem solving and decision making and to ignore important, relevant information —to "take the easy way out."

Many individuals under high-stress conditions tend to forget learned procedures and skills and revert to old habits that may not be appropriate. For example, they apply the techniques and knowledge acquired during previous training in other aircraft types.

Another stress-related cognitive error is perceptual tunneling — in which a pilot or an entire aircrew under high stress becomes focused on one stimulus, such as a warning signal, and neglects to attend to other important tasks or information.

Perceptual tunneling was at the heart of the Dec. 29, 1972, crash of an Eastern Air Lines Lockheed L-1011 in the Florida Everglades. The three-member flight crew declared a missed approach because they had no indication that the nose landing gear had extended, and then became so engrossed in identifying the problem with the position light system that they failed until seconds before the crash to notice that their airplane was no longer in level flight at 2,000 ft.[6]

In addition to affecting memory, judgment and attention, stress also can decrease hand-eye coordination and muscle control.

It is important to control stress by identifying and managing potential stressors. Stressors often are categorized as either external or internal.[7]

External stressors originate outside the individual and may be divided further into environmental and psychosocial subcategories (Table 1). In aviation, examples of environmental stressors are adverse flight conditions, cabin temperature extremes, glare or insufficient lighting, high noise levels and altitude effects. Psychosocial stressors relate to events or conditions that are linked to individual and family social characteristics, positions and roles, and include workplace conflict, a feeling of a lack of support from coworkers, and family-related stressors such as spousal conflict, problems with children, and illness or death of a relative.

Internal stressors originate within the individual and typically are considered to be within the individual's control. They may be divided into physiological and cognitive subcategories. Physiological stressors include poor diet, tobacco use, muscular fatigue, sleep

Classifying Stressors

External		Internal	
Environmental	**Psychosocial**	**Physiological**	**Cognitive**
Poor flight conditions	Workplace conflicts	Poor diet (Nutrition)	Lack of information
Extreme heat or cold	Family conflicts	Tobacco	Information overload
High noise level	Insufficient flight time	Muscular fatigue	Mental fatigue
Excessive vibration	Low job satisfaction	Sleep deprivation	Fear
Altitude effects	Feeling of lack of support	Alcohol	Feeling of helplessness
Crowded space	Lack of control	High blood pressure	Boredom
Air pollution	Spousal conflict	Prescription or over-the-counter medications	High workload
Humidity extremes	Family illness or death	Caffeine	
	Unrealistic expectations	Decreased vision	
	Financial problems	Hearing loss	
	Loneliness	Diseases	
	Devalued self-worth	Hunger	
		Thirst (Dehydration)	

Source: Clarence E. Rash and Sharon D. Manning

Table 1

deprivation, alcohol use and hearing loss. Cognitive stressors include boredom, high workload, information overload, a lack of information and emotions such as fear and hopelessness.

Making Rules

A few of these stressors have long been recognized for their degrading effects on cognitive function and, therefore, on decision-making skills. For this reason, civil aviation regulatory bodies have established rules regarding some of the more obvious stressors, including alcohol consumption and drug use, and continue to wrestle with the best methods of handling others, such as fatigue.

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In the past, fatigue was addressed almost exclusively with rules limiting the number of hours worked in a given period. In recent years, however, specialists have begun to recognize other equally important contributors to fatigue such as inadequate sleep time, poor sleep quality, disruption of circadian rhythms, irregular work hours and the effects of commuting time.

Fatigue typically causes an increase in reaction time, a decrease in accuracy and a reduction in attention. Fatigued pilots may exhibit a tendency to overlook or misplace sequential task elements, such as leaving out items on a checklist, or become so preoccupied with a single task that they neglect more critical tasks.

Fatigue also impairs memory. Although long-term memory is reasonably well preserved in the presence of fatigue, short-term memory and cognitive processing capacity are greatly reduced.[8] Communication also is impaired by fatigue; speech may become less clear, and fatigued pilots may be prone to misunderstanding messages. Fatigue invariably degrades decision-making skills, sometimes resulting in incorrect responses to emergency situations.

Hidden Stressors

A host of other factors — often misunderstood or ignored — have more subtle effects on cognitive performance. These factors include inadequate nutrition and exercise; use of prescription and over-the-counter medications; dehydration; tobacco use; exposure to heat and cold; noise; and vibration. As a result of their exposure to these factors, pilots may not be at their best while flying. Consequently, in an emergency, pilots may be unable to respond with the necessary reaction time, hand-eye coordination, communication skills or decision-making ability.

Poor nutrition and lack of exercise are stressful and make it more difficult to deal with other stresses. A proper diet provides the body with the essential vitamins and minerals and helps maintain cognitive function.

Medication

Most civil aviation regulations prohibit flying while taking any medication that might affect pilot performance and flight safety. Medical conditions and medications — even those that present no problems on the ground — can have adverse side effects that may vary with altitude.

Many common over-the-counter medications can significantly impair cognition, judgment or sensory inputs. For example, some medicines for colds and allergies contain ingredients that can cause drowsiness, short-term memory loss and blurred vision. Pilots should ask aeromedical specialists about the appropriateness of medications for use during flight and read all labels carefully.

When researchers from the U.S. Federal Aviation Administration (FAA) Civil Aeromedical Institute (now the Civil Aerospace Medical Institute) examined pathology samples from 1,683 pilots killed in aviation accidents from 1994 to 1998, they found over-the-counter medications more frequently than any other drugs.[9] Over-the-counter drugs were found in 301 samples, and prescription drugs in 240.

Smoking

The use of tobacco is widespread, although numerous studies have demonstrated an association between smoking and cardiovascular disease, various cancers, pulmonary disease and other ailments.[10]

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As a stimulant, nicotine has been found to improve cognitive performance on attention and memory tasks,[11,12] and it appears to improve visual attention — both important in aviation.[13] Other studies have shown that nicotine may improve the ability to focus on auditory information and filter out background noise.[14,15]

However, other studies have found that:

- Cigarette smoking contributes to hypoxia — a problem that increases with altitude. Three cigarettes smoked at sea level increase the physiological altitude to between 5,000 and 8,000 ft. At altitude, complex tasks requiring decision making, use of mental strategies and memory retention can be more difficult than they are at sea level; for a pilot who is at an artificially high physiologic altitude because of smoking, the problem is compounded.[16]
- Smoking reduces visual acuity at night, and the effect increases with altitude. Night vision has been reported to decrease by 5 percent at 3,500 ft, by 20 percent at 10,000 ft and by 35 percent at 13,000 ft, if supplemental oxygen is not provided.[17]
- Cigarette smokers are nearly two times more likely than nonsmokers to experience hearing loss, especially at high frequencies.[18]
- The nicotine in cigarettes also is associated with transient dizziness and nausea, which can be aggravated by motion.[19]

Dehydration

Dehydration is a major contributor to fatigue and an accompanying decrease in mental and physical performance, and dehydrated pilots are at a higher risk than others for decompression sickness, spatial disorientation, visual illusions, airsickness and loss of situation awareness.[20]

Pilots with health problems and those in small aircraft without air conditioning are most susceptible, but the problem also can affect pilots who operate on the low-humidity flight decks of air carriers.

The first common indication of dehydration is thirst. By the time an individual senses thirst, however, he or she already is about 1.5 qt (1.6 L) low on water — or about 2 percent dehydrated — and more if he has been drinking caffeinated beverages or if he consumed alcohol the previous day. At a dehydration level of 3 percent, he may experience sleepiness, nausea, mental impairment, and mental and physical fatigue.

Psychosocial Stressors

Psychosocial stressors are those that involve relationships, career and finances, as well as the factors that influence these three areas, such as physical health. Psychosocial stress can be either positive — such as a promotion at work, marriage or the birth of a child — or negative — such as divorce or separation, death of a loved one or illness or injury to self or family. Good psychological health enhances pilot performance, and the presence of negative stressors affects performance. These stressors are distractions and can slow reaction times in assessments of critical situations and decision making.

While some stressors are well known to pilots, others go unrecognized. Civil aviation authorities and others have developed a number of personal checklists to aid pilots in evaluating themselves for stressors. For example, the FAA has developed an "I'm Safe" checklist for pilots to evaluate their readiness for flight (Table 2).[21]

'I'M SAFE' Checklist

Illness	Do I have symptoms of an illness?
Medication	Have I been taking prescription or over-the-counter drugs?
Stress	Am I under psychological pressure from the job?
Alcohol	Have I been drinking within eight hours? Within 24 hours?
Fatigue	Am I tired and not adequately rested?
Eating	Have I eaten enough of the proper foods to keep adequately nourished during the entire flight?

Source: U.S. Federal Aviation Administration; Clarence E. Rash and Sharon D. Manning

Table 2

The mnemonic stands for being unimpaired by illness, medication, stress, alcohol, fatigue or eating (inadequate nourishment).

Dozens of stressors — originating from a variety of environmental, psychosocial, physiological and cognitive sources — may degrade cognitive processes and jeopardize decision-making skills. Vigilance by pilots can help prevent these stressors from putting flight operations at risk.

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Notes

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