Warfighter Endurance Management

During Continuous Flight and Ground Operations

AN AIR FORCE
COUNTER – FATIGUE GUIDE

DEPARTMENT OF THE AIR FORCE
HEADQUARTERS UNITED STATES AIR FORCE
WASHINGTON DC

MEMORANDUM FOR AIR FORCE PROFESSIONALS

FROM: HQ USAF/SG
110 Luke Avenue, Room 400
Bolling AFB, DC 20032-7050

SUBJECT: Endurance Management

Our airmen are our most important asset and have a direct impact on combat effectiveness. Our Air Force is preeminent in the world and we maintain this high standard by optimizing the performance of each of our service members. Fatigue has always been an inherent part of sustained military operations. Fatigue has an adverse effect on every aspect of performance and has been cited in over 200 Class A aircraft mishaps and countless ground incidents. No single factor is more detrimental to the on- and off-duty performance and safety of our force.

This guide contains many practical guidelines to reduce unnecessary fatigue and maximize endurance. Supervisor involvement, proper scheduling and good sleep hygiene can ensure every Air Force member maintains their needed cutting edge alertness during sustained operations. We must take care of ourselves and our troops to successfully execute our mission. My medical professionals stand ready to support you with training and scheduling consultation. It is essential that all service members implement these proven performance-enhancing techniques, which can be a force multiplier during sustained operations.

GEORGE PEACH TAYLOR, JR.
Lieutenant General, USAF, MC, CFS
Surgeon General

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- "Performance Maintenance During Continuous Flight Operations," NAVMED P-6410, developed by the Naval Strike and Air Warfare Center (NSAWC), Naval Aerospace Medical Research Laboratory, and Naval Operational Medicine Institute.
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  - Capt. Dave Brown, MC, USN and CDR Kris M. Belland, MC, USN – NSAWC
  - Capt. C.O. Barker, MC, USN – Navy Bureau of Medicine and Surgery

- "Leader's Guide to Crew Endurance," from the US Army Aeromedical Research Laboratory and US Army Safety Center.
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Electronic copies of the above manuals are available at the COPE web page: http://wwwsam.brooks.af.mil/web/cope.htm.

For comments and suggestions on this manual please contact the editor, 2Lt Dan Wheeler at the COPE: USAFSAM.COPE@brooks.af.mil.

WARFIGTHER ENDURANCE MANAGEMENT During Continuous Flight Operations

A GUIDE FOR THE AIR FORCE COMMUNITY

Job Performance

IS FATIGUE A PROBLEM?

The Air Force's performance goal for all members is optimal job productivity with no or absolutely minimal, adverse impact on safety, health and general well-being. Aside from the stresses of combat there are inherent (both personal and job related) physiological and psychological stressors present in the workplace. Unpredictable settings, attention to detail and vigilance combined with sustained operations only further confound the picture. The outcome is normally some level of increased "fatigue," which can either subtlety or overtly impair situational alertness and ultimately job performance. Sleepiness is often a confounding factor here and may be just as debilitating as alcohol-induced intoxication (26). For example, after a night without sleep mental and motor skill performance degrades to that of an individual who is considered to be legally drunk, (i.e. blood alcohol content (BAC) of 0.10 %). Even 18 hours of wakefulness equates to BAC of 0.05 %!

While the militaries have continued to evaluate and embrace technologies to enhance or sustain mission performance, this has sometimes come at a cost to the *human weapon system.* Operation and maintenance of complex military equipment now requires highly trained and very alert service professionals. At the same time our Air Expeditionary Force concept of operations can translate to longer work periods, shorter transition times, and less opportunities for sleep and recovery, etc. The resultant impact is on individual levels of fatigue, intuitive decision-making, response time, judgment and overall alertness, which ultimately impacts job performance and mission success rates.

So just how big a concern is fatigue to the Air Force? Although it is a very important concern to our leaders, it is not always easy to quantify the effects of fatigue on our military missions. This is due to a variety of reasons: 1) there is no biologic test for fatigue like a BAC test, 2) lack of sleep and fatigue have varying effects depending on the person, and 3) fatigue associated impairments/accidents are normally underestimated or not reported. Alternatively, in the civilian community it is estimated that productivity losses associated with sleepiness alone run into the tens of billions of dollars, both in the workplace and on our highways. Moreover thousands of citizens are killed or injured due to unintended sleep. Perhaps, our best quantitative evidence on mission impact is aircrew mishap data, which is identified below:

- Fatigue was listed as present in 234 of the 1837 Class A rate-producing mishaps between the years FY 1972 – 2000 (AFSC).

    - Fatigue was rated as a causal factor in 18 mishaps
    - Fatigue was rated as a major contributing factor in 8 mishaps
    - Fatigue was rated as a minor contributing factor in 102 mishaps

- During an Air Force Pilot Retention study of a sample of Military Airlift Command pilots (USAF, 1987) pilots indicated the following problems with fatigue:

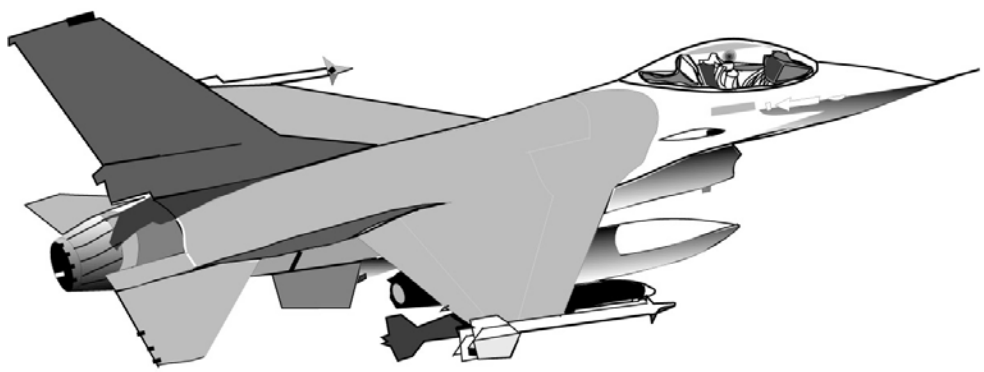
    - Horrible take off times. In a matter of a one-week trip, your wake-up time could vary from 0000hrs to 1700hrs, to 0300, and then they expect you to fly 16 hours. This does wonders for the circadian rhythm

    - Duty day is too long and its dangerous…Lucky statistics aside, we're the most dangerous flying outfit in the world with our zombie crewmembers. Where else do you alert at midnight, and then fly a 24-hour crew day?

- Fatigue was also emphasized in reports made by aircrews during an airlift operation in Somalia

Too often, aircrews were required to fly tactical type maneuvers on TDY arrival and departure without any training. This usually occurred at the 20 –24 hour point in the crew day. During departure, several crews reported making errors including flap over-speeds, missed checklist, and inadvertent descents—this is particularly noteworthy since these faulty maneuvers were performed at low levels and high speeds (300ft AGL and 300 KTS).

The bottom line is that fatigue and sleepiness are serious threats to our overall mission performance and personal safety. We must address our approach to “endurance management” or counter-fatigue measures, individually as well as a unit. Adequate personal sleep is the first prophylactic measure, as restorative sleep is a physiological and psychological need for everyone. Recognizing the symptoms of impending fatigue is just as important when it cannot be avoided. In this case appropriate “risk awareness and management” processes also need to be implemented. And lastly, working with your Flight Surgeon and Aerospace Physiologist or other mission specific strategies to counter fatigue may need to be pursued.



Basic Principles

THINGS TO KEEP IN MIND

Sleep is perhaps the easiest of our biological imperatives to satisfy. When denied sleep however, it becomes one of the most demanding and pervasive drives, eventually forcing us to succumb. In addition to the danger of incapacitating lapses into microsleep, the lack of sleep or consistently poor sleep results in increasingly slowed reaction time, error prone performance and irritability. Military personnel often face great potential for disrupted sleep. For example, crews are often required to work during the night, to cross multiple time zones and frequently face stressors that impair restorative sleep. In fact, fatigue may be the most threatening enemy that crews must face in the current military setting. Global Reach and Global Power are concepts that require traveling great distances for long hours in a cramped aircraft to cross multiple time zones. Ground crews and commanders similarly, must bear the added burden of longer hours and fewer personnel.

- Airmen are normally tired before sustained operations begin – preload.
- Sleep cannot be stored or built up prior to continuous or sustained operations, but preload can be reduced.
- Performance fluctuates over the day. Using cognitive fatigue modeling tools it can be predicted; it is not always intuitive.
- Sleep loss, circadian rhythm disruption and physical and mental work combine to produce fatigue.
- Fatigue is not due to lack of motivation or attitude, but undermines motivation and causes bad attitudes.
- Poor performance is the ultimate price of fatigue in continuous operations.
- We manage maintenance resources, fuel and weapons to maximize performance; we can also minimize operator's levels of fatigue to maximize performance.

Continuous And Sustained Operations

TWO TYPES OF ACTIVITIES THAT TIRE PERSONNEL

Operations that produce fatigue can be divided into two broad and sometimes overlapping categories:

Continuous Operations (CONOPS)

- Extend over 72 hours
- Not necessarily longer hours per individual
- Workers relieved at end of shift and return later
- Individual may work different hours which may conflict with the circadian rhythm
- Sleep may be intermittent, broken and unrestorative

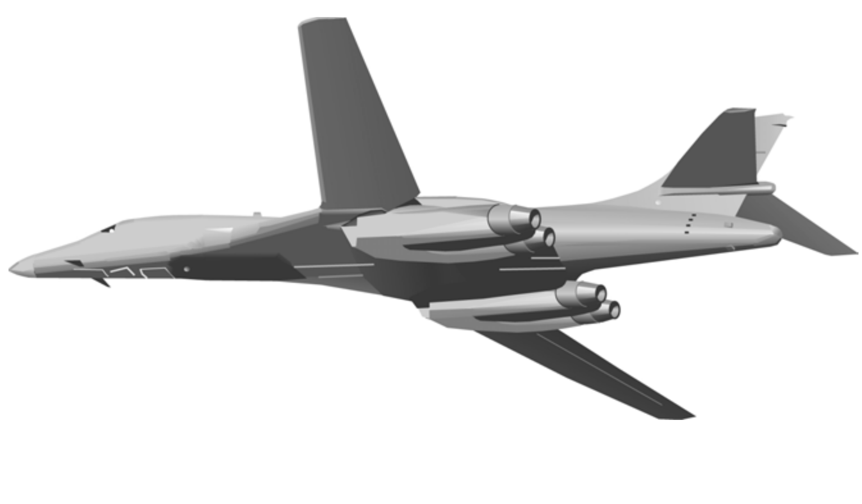
Sustained Operations (SUSOPS)

- Involve individual continuous performance longer than 72 hours
- Work is continued until a goal is reached
- Sleep deprivation is common
- Prevalent in ground warfare

Air Force members most commonly participate in sustained operations with periods of continuous operations. Unlike a ground war, aircraft availability and flight duration limit periods of duty. Back on base, however, planning, management responsibilities or lack of crew rest may generate significant fatigue after returning from the last mission. The conduct of war has changed. Previously limited by daylight, around-the-clock preparation or actual combat is now the norm.

Paratroopers at Normandy participated in a sustained operation which resulted in debilitating fatigue and a remarkable decrease in their ability to perform:

> They were dull-eyed, bodily worn and too tired to think connectedly. Even a 30-minute flop on the turf with the stars for a blanket would have doubled the power of this body and quickened the minds of its leaders to ideas, which they had blanked out. But no one thought to take that precaution. The United States Army is indifferent toward commonsense rules by which the energy of men may be conserved in combat.... Said Captain Patch of his people on the far right, 'They were so beat that they could not understand words even if an order was clearly expressed. I was too tired to talk straight. Nothing I heard made a firm impression on me. I spoke jerkily in phrases because I could not remember the thoughts which had preceded what I said.' (1)



Fatigue

EASY TO UNDERSTAND BUT DIFFICULT TO DEFINE

Fatigue is something everyone has experienced in varying degrees. Unfortunately, given its multi-faceted nature, a clear and concise definition remains elusive. Therefore, this guide discusses some of the qualities of fatigue as described by Krueger (8). The table to the right offers four working definitions applicable to the military setting.

Physical or physiological fatigue can be described as the temporary loss of the ability to respond due to repeated or continuous stimulation of the muscles (e.g., during strenuous exercise). Thus, anyone can suffer from physiological fatigue as a result of engaging in intense physical work. Some other causes of physiological fatigue include:

- Sleep loss
- Noisy or hot environments
- Inadequate nutrition and fluids
- Hypoxia
- Poor physical conditioning
- Sudden changes in work/rest schedules

Mental fatigue or boredom is the feeling of weariness that results from repetitive performance of nonphysical tasks. Troops can be affected after only a few minutes of performing monotonous work. Repetitive performance of even fairly complex tasks can result in mental fatigue. Mental fatigue can also be caused or made worse by anxiety, apprehension, and stress.

In general, fatigue is a subjective experience. The main effect of fatigue is a progressive withdrawal of attention. When people must continue working beyond the point at which they can effectively perform their tasks they experience a disinclination to continue work. Eventually, withdrawal is so insidious that operators may be unaware of it and unable to recover (27).

Characteristics of Fatigue

One characteristic of mental fatigue is "an aversion to effort." During prolonged difficult tasks Krueger describes how "...we often see fatigued workers suddenly stop their work, be it physical or cognitive, and vigorously participate in sporting activities, or computer games during 'break'."

Also seen are occasional periods of no response to stimulation but with normal functioning between. This has been described as the "lapse hypothesis" and while not fully understood, explains why vigilance and attention are early casualties of fatigue.

The subjective sense of fatigue is the first indicator that people are getting tired. **In a normally close-knit squadron interpersonal dynamics, in particular everyone's sense of humor may be the first thing to change.** This can be a useful hint for the commanding officer as a management tool.

TYPES OF FATIGUE

Working definitions which provide a starting point in the operational setting:

ACUTE

- Develops within 1 work period
- Complete recovery in 1 major sleep period

CIRCADIAN

- Oscillation of alertness within a period of 24 hrs

CUMULATIVE

- Developed over several work periods
- Results from interaction of work-rest schedule, circadian biology, and sleep deprivation
- Recovery requires more than a single sleep period
- AF Safety Center calls this "chronic" fatigue

CHRONIC

- May result from prolonged cumulative fatigue

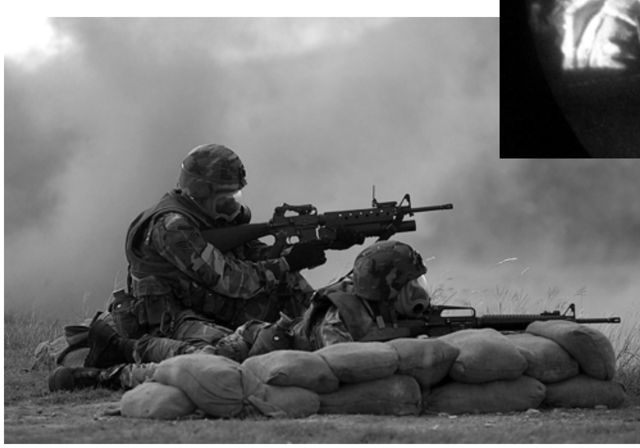
Other characteristics of fatigue include:

Impaired communication. Teams suffering from desynchronosis may have difficulty communicating critical mission, flight, or safety information.

- Conversation may become fragmented and contain repetitive phrases and ideas.
- Weariness makes verbal communication very difficult and tends to result in misinterpretation.
- Failed verbal communication can cause orders and warnings to be ignored.

Increased irritability. Irritability and impatience are commonly experienced in association with desynchronosis. While arguing may increase mental fatigue it does show crewmembers are still talking to each other, exchanging orders and messages. When bickering ceases, this may indicate mental exhaustion. This is particularly dangerous if a shift is working between 0400 and 0700. During this period, members may experience sleepiness and degraded alertness and cognitive function will be at its lowest. The combination of acute fatigue with desynchronosis can be lethal.

The severity of fatigue can be modified by such psychological factors as expectancy. The amount of time airmen expect to be working, the anticipated difficulty of the work, the expected reward, and other variables will affect the severity of fatigue-induced performance changes.



Sleep

MORE IS BETTER ... UP TO A POINT

SLEEP STRUCTURE

Sleep is associated with distinct brain electrical patterns on the electroencephalogram (EEG) that occur in cycles or stages. A night's sleep as described by the EEG is remarkably consistent between individuals. Sleep begins with lower frequency and lower voltage EEG patterns of stage 1 compared to our waking state and proceeds over about 60 minutes through slower frequency and higher amplitude patterns of stages 2-4. Stages 3-4 are called slow wave sleep (SWS) because of the marked high amplitude slow waves on the EEG. It is believed that slow wave sleep is associated with the replenishment of neurotransmitters and the removal of metabolic by-products. The first slow wave sleep epoch lasts about 15-20 minutes and the EEG patterns become progressively faster and lower in amplitude until a state that resembles an awake EEG is observed. This signals the onset of rapid eye movement sleep (REM), a period of active dreaming which is also called paradoxical sleep because although our EEG looks like an awake state, we are sound asleep as evidenced by the loss of muscle tone during REM. This loss of muscle tone is fortunate because otherwise we might be inclined to act out our dreams and risk injury in our stuporous state. After about 10 minutes of our first REM sleep, we begin to cycle back down to SWS over the next 60 minutes. After the second SWS epoch, after almost 3 hours asleep, the brain spends little time in SWS and instead cycles back and forth from Stage 2 to REM for the remainder of the night. The REM episodes occur more frequently and last about 20-30 minutes after the end of the SWS stages. REM is believed to be the period when events that are important to us are reviewed and perhaps stored as memories. All stages of sleep are important and it can be shown that selectively depriving an individual of a particular stage results in a rebound when the stage is permitted, that is, an increase in time spent in the deprived stage.

NAPPING STRATEGIES.

Crews are sometimes allowed to nap in-flight during long missions when possible. Little guidance is provided to the crews about when to nap or how long to nap and these can make a difference in the quality of the nap obtained. Current perspectives on napping suggest that 30 minute naps or naps of about 3-4 hours are much more restorative than naps for any other lengths of time. These are described below as the Short Nap and the Short Sleep, respectively. The basis for napping strategies rests in the sleep stages described above. For example, the SWS epoch is the most difficult stage from which to awaken someone. It is apparently difficult for the brain to switch from the giant slow waves to the low amplitude high frequency activity of wakefulness. This difficulty in awakening associated with great sluggishness and impaired mental functioning is called sleep inertia and can last 20 minutes or more after SWS. Sleep inertia is shorter after REM, perhaps as short as a minute or two. The Short Nap and the Short sleep are designed to miss the SWS epoch. The napping strategies are designed to provide an adequate rest while dramatically shortening the time someone who was asleep reaches useful consciousness.

The Short Nap

The short nap is defined as less than 40 minutes from the time one begins to attempt sleep to the time of awakening. It is designed to be too short to allow the individual to enter SWS and yet still get a brief, hopefully restorative, nap. Recall the first SWS epoch occurs within about 60 minutes. The Short Nap might be considered a 'combat nap' or a 'power nap' because often times it is enough to provide a few hours of useful wakefulness and yet short enough to prevent an impact on the mission. Research suggests that these naps can provide between 2 to 4 hours of useful physical and mental activity, for about 2-3 days, sometimes longer. After a few days however, cumulative sleep debt would be overwhelming. There are many conditions in which these naps would provide relief to crews and improve the quality of their work. Scheduled 30 minute naps might be recommended for shift workers for example. It would be a good idea to have 2 people awake at all times while on duty, particularly during the circadian performance nadir (circadian low point between 0200-0600) so that they can help each other stay awake. Otherwise, crew naps would be very useful to maintain crew efficiency.

The Short Sleep

The short sleep is best when more time is available for crew rest during a mission but not enough for a full sleep. Short sleeps are recommended to be at least 3-4 hours in duration. They are designed to allow the individual to progress through and avoid the SWS epochs. These sleep periods can maintain useful waking performance levels for 4-10 hours and perhaps longer. Although few studies have been done, anecdotal military evidence suggests that 3-4 hour naps can maintain crews for 4-5 days before sleep debt becomes overwhelming. These short sleeps are the most efficient during the circadian performance nadir.

Normal Sleep

The normal sleep period refers to the typical 7-8 hours of sleep that humans need every night. Longer crew rest periods should be recommended, perhaps sleep periods as long as 10-12 hours, in individuals recovering from extended periods of napping, such as during a continuous operation. It is also recommended that, prior to any long mission, crews get a long sleep, over 8 hours, to get rid of any sleep debt.

Napping

- Naps are 20 to 30 minutes long plus up to 10 minutes of sleep latency – the time it takes to fall asleep
- If longer naps are not possible, several naps of as little as 10 minutes each taken over a 24-hour period have helped airmen endure CONOPS.
- Combat naps of 10 minutes or more will help maintain alertness and job performance. There is some risk of "sleep inertia," a period lasting about 5 to 20 minutes after awakening characterized by confusion, sluggishness and incoordination (3).
- When transitioning from daytime to nighttime duty hours later that day, a nap at 1500 hours may well compensate for sleep loss incurred during the assigned sleep period.

Sleep

- Sleep periods occur in natural cycles that are about 90-100 minutes long plus time for sleep latency
- A single 2-hour sleep period during a 24-hour continuous work period can restore performance close to pre-sleep-loss levels for a short time.
- It is easiest to initiate sleep twice a day: in the early afternoon and just before the normal sleep time
- Use the mid-afternoon "siesta" to help prepare for night work.
- A 3-hour sleep period taken in midafternoon (e.g., 1500 hours) results in greater restoration of alertness than a 3-hour sleep period taken in the evening (e.g., 1900 hours).

THE COMBAT NAP

Conventional wisdom suggests that the combat nap is sought by junior officers as a means of avoiding the operations officer. From the standpoint of performance maintenance, however, it is probably the most useful tool we have during continuous and sustained operations. Unlike other interventions, sleep reduces fatigue itself. In other words, it treats the problem not the symptom. Research suggests that a period of sleep as short as 10 minutes, but no longer than 30 minutes, improves objective functioning. The only drawback to a longer nap is that individuals may awaken disoriented and lethargic, a phenomenon called sleep inertia that lasts approximately 5 to 20 minutes. "Practice" naps may reduce this period of sleep inertia.

It is strongly recommended that commanders encourage, and at times mandate, combat naps.

- Sleep cannot be stored or built up but the preload of sleep loss can be reduced (2)

- Sleep loss does not provide training to maintain performance

- The minimum amount of sleep to maintain performance during sustained operations is 6-8 hours per day. Fragmented sleep is less effective than continuous sleep (i.e. sleep 6-8 hours not 3-4 hours twice) (2).

- A “normal” sleep period is generally accepted as 8 hours

- Although rest helps, resting on a bed is not the same as sleep. For some unknown reasons, the regenerative properties associated with sleep cannot be accomplished by just rest (2).

- Commanders, department heads and strike leaders will sleep far less than normal the week prior to the first strike because of the multiple demands of running the squadron, planning and flying

- When time permits, sleep in 90 to 100 minute increments to avoid awakening in the deeper stages of sleep

Sleep Inertia

- Extensive sleep inertia, which may last up to an hour in some individuals, is especially likely when one is awakened from slow-wave sleep, which occurs most often in the middle of each 90 to 100 minute sleep cycle.

- “Non-habitual nappers” experience sleep inertia more frequently. Taking more naps (practicing) appears to reduce this problem (4).

- During CONOPS when crews must return to work immediately upon awakening, naps in the circadian trough should be avoided because the risk of sleep inertia will be high.

Sleep Habits

- Try to sleep at the same time every day, including weekends. If possible, go to bed at the same time and get up at the same time each day.

- Use bed only as a place to sleep—do not read, work, or do other similar activities in bed. Associating bed with sleep will eventually allow sleep to come more easily.

- When trying to sleep outside the usual sleep period (e.g., during the day), or location, prepare as if it is the normal sleep period—wear normal sleep clothes, darken the room as much as possible, keep noise to a minimum, and use a white-noise generator, such as a fan, if possible.

- When possible, sleep in complete darkness and avoid even momentary exposure to sunlight during the sleep period. To facilitate proper rest, sleeping quarters should:

    - Isolate night-shift personnel from the activity of day shifters
    - Reduce environmental noise
    - Reduce sunlight in all living areas during sleep periods (including restrooms)

- Do heavy physical training no closer than 4 hours, or 1 hour if mild exercise, before bedtime since exercise has a temporary alerting effect.

- Don't prop the pillows up to high if you sleep on your back as this can block the airways when REM atonia occurs

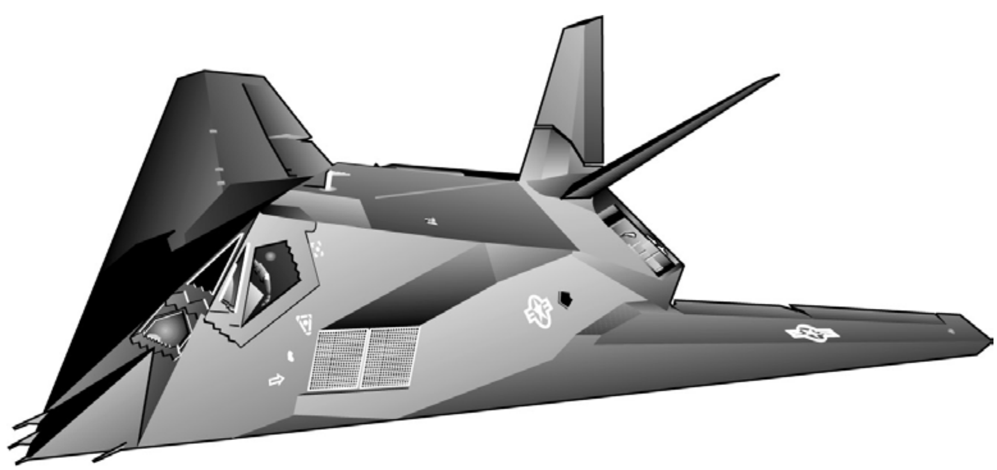
- Alcohol, while initially relaxing, significantly worsens the duration and quality of sleep

- Caffeine interferes with sleep. During Desert Storm fliers who drank less caffeine on non-flying days took longer naps (5)

- Avoid large meals before you go to bed (leave about 2 hours before sleep for digestion)

- Try deep breathing and muscle relaxation techniques to help with stress reduction and sleep onset

Crew Rest
Adequate crew rest is normally 7-8 hours of uninterrupted sleep, after applying the sleep hygiene principles (good sleep habits, above). It is important to distinguish between the officially designated crew rest times and the actual amount of sleep the crew gets. Often times these can be quite different. Assigned crew rest times are often more advantageous to the schedulers than to the crews. For example, a crew rest period of 24 hours sounds appealing and perhaps is of sufficient duration. However, it usually takes about 12 hours for a sufficient crew sleep period to be accomplished, 2 hours before and 2 hours after an 8-hour sleep period. That leaves about 8-12 hours of peak vigilance for the crew before they should begin feeling tired enough to sleep again. With a 24-hour crew rest period though, a crew that is just getting tired again and ready for another sleep phase would be required to start their duty day. It is often better for the crews to request a 16-hour crew rest period or, ideally, a 36-hour crew rest period. With a 16-hour crew rest, the crew starts their day soon after a sufficiently long sleep and should be performing at peak for several hours. Napping strategies outlined above might be recommended to the crews during periods of acute fatigue, such as those that always accompany the 0200-0600 biological rhythm performance nadir. A 36-hour crew rest is best for crew fatigue recovery because it provides 2 sleep periods and starts the crew duty day soon after the last sleep.



Sleep Scales

HOW TIRED ARE YOU REALLY?

Following are two different tests to determine your fatigue level at a point in time, and your chronotype. The Epworth Sleepiness Scale (ESS) was developed at the Stanford Sleep labs and is now used as a benchmark for many studies to determine subjective fatigue levels. Using this scale during a long mission allows people to determine how fatigued they are in definable terms and decide if they can safely accomplish their tasks or if they will need to take extra safety steps. The Owl/Lark Scale was developed to determine trends in sleepiness relating to time of day and fatigue susceptibility. This test teaches people about their body clocks and where they are prey to fatigue through a day. A lark, or morning person, should watch out for night missions, while the owls are more susceptible to fatigue in the early hours of the day. Simply follow the directions on either scale to see where you stand.

THE EPWORTH SLEEPINESS SCALE

How likely are you to doze off or fall asleep in the following situations, in contrast to feeling just tired? This refers to your usual way of life in recent times. Even if you have not done some of these things recently try to work out how they would have affected you. Use the following scale to choose the most appropriate number for each situation:

0 = no chance of dozing
1 = slight chance of dozing
2 = moderate chance of dozing
3 = high chance of dozing

SITUATION	CHANCE OF DOZING
Sitting and reading	____________
Watching TV	____________
Sitting inactive in a public place (e.g. a theater or a meeting)	____________
As a passenger in a car for an hour without a break	____________
Lying down to rest in the afternoon when circumstances permit	____________
Sitting and talking to someone	____________
Sitting quietly after a lunch without alcohol	____________
In a car, while stopped for a few minutes in traffic	____________

To check your sleepiness score, total the points.

1 - 6	Congratulations, you are getting enough sleep!
7 - 8	Your score is average
9 and up	Seek the advice of a sleep specialist without delay

Morningness – Eveningness Scale

1.During your last vacation week, how often did you get up later than planned or have difficulty getting ready on time even though you went to bed at your regular time?

A. It never happened
B. It happened once
C. It happened two or three times
D. It happened more than three times

2. When you have no commitments the next day, at what time do you go to bed compared with your usual time?

A. Seldom or never later
B. Not more than one hour later
C. Between one and two hours later
D. More than two hours later

3. Suppose that you have decided to exercise twice a week with a friend. The only time your friend can make it is from 7:00 a.m. to 8:00 a.m., twice a week. Assume you decide to go at these times. Taking into account how you usually feel in the morning, how would you do?

A. Very well
B. Well
C. Poorly
D. Very poorly

4. At what time in the evening do you usually start feeling tired and in need of sleep?

A. 8:00 p.m. - 9:30 p.m.
B. 9:31 p.m. - 10:45 p.m.
C. 10:46 p.m. - 12:30 a.m.
D. 12:31 a.m.- 1:45 a.m.
E. 1:46 a.m. - 3:00 a.m.

5. Suppose that you were able to choose your own working hours. Assume that your job was interesting and paid according to results. Which one of the following 3-hour blocks would be your most preferred work time?

A. 4:00 a.m. - 7:00 a.m.
B. 7:00 a.m. - 10:00 a.m.
C. 11:00 a.m. - 2:00 p.m.
D. 4:00 p.m. - 7:00 p.m.
E. 9:00 p.m. - 12:00 Midnight

6. One sometimes hears about "feeling best in the morning" or "feeling best in the evening" types of people. Which do you consider yourself?

A. Definitely a "morning" type
B. More a "morning" than an "evening" type
C. More an "evening" than a "morning" type
D. Definitely an "evening" type

When you have answered all six items use the Scoring Guide on the next page. Use the Scoring Guide as directed to identify your chronotype.

Directions: Referring to the items on the Morningness-Eveningness Scale, locate below the letter which corresponds with the answer you marked for each of the six items. Then, circle the numerical score that corresponds with each letter you marked. Add up the circled numbers, and write in the total score on the line provided. Use the Score Key provided to find out your personal chronotype.

Question No.	Answer	Score	Question No.	Answer	Score
1	A	6	**4**	A	7
	B	5		B	6
	C	5		C	5
	D	4		D	4
				E	3
2	A	7	**5**	A	7
	B	6		B	6
	C	4		C	5
	D	3		D	4
				E	3
3	A	7	**6**	A	9
	B	6		B	7
	C	4		C	3
	D	3		D	1

TOTAL SCORE ON SCALE _______

SCORE KEY

17 to 19	=	Extreme Owl
20 to 23	=	Moderate Owl
24 to 29	=	Mild Owl
30	=	Neither Owl nor Lark
31 to 36	=	Mild Lark
37 to 40	=	Moderate Lark
41 to 43	=	Extreme Lark

Circadian Rhythms

EARLY MORNING IS THE HARDEST TIME

There are numerous cyclic body rhythms in humans that collectively are described as circadian rhythms. The influence of the circadian rhythms on airmen's performance during continuous operations can be dramatic and warrants both appreciation and understanding.

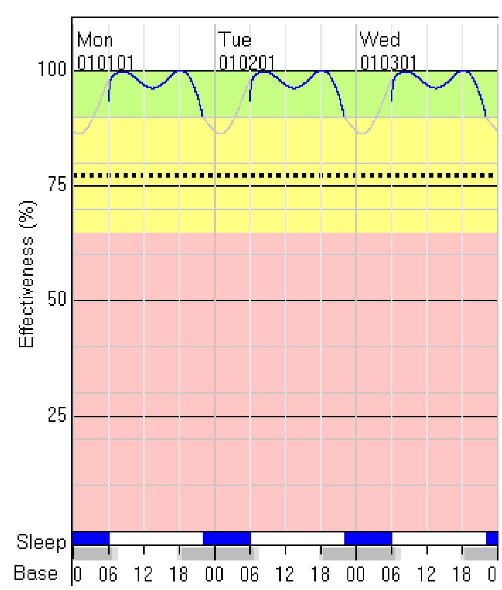
Experiments carried out in isolation (where all environmental cues have been removed) place humans on a free-wheeling cycle resulting in a spontaneous period that averages about 25 hours long. Entraining agents, however, reset the biological clock daily to 24 hours. These include light and darkness (the most powerful cues), sleep, meals, social activities and clocks. (25)

Desynchronization occurs when internal rhythms are no longer in tune with external cues or each other. Continuous operations, transmeridian travel (jet lag) and sleep deprivation (as found in SUSOPS) all force the rhythmic systems of the body to re-adapt.

Jet lag. After travel across time zones, cycles of physical and mental resources lag behind the rapid change to the destination light/dark cycle and the new sleep and work schedule. Following eastward or westward travel during which four or more time zones are crossed, readaptation can take from 4 days to several weeks. The amount of time required for readaptation depends on whether effective coping strategies are implemented soon after arrival to the new time zone. Inconsistent sleep/wake and daylight-exposure schedules will delay adaptation of the body clock to the destination time zone.

Systems shift their phases at different rates and therefore may not only be out of phase with local time (external desynchronization) but also out of phase with each other (internal desynchronization). There are substantial individual differences. For example, extroverts tend to readjust faster than introverts and individuals over age 40 take more time to readjust than the same person would at age 20. People who live on a more regimented schedule appear to have an easier time adjusting than a person who eats, sleeps, etc. when he or she feels like it. **Fortunately, the military member is normally younger and tends toward regimentation and extroversion.** A general rule is that your body cycles change at a rate of 40 minutes/day when traveling east and 60 minutes/day when traveling west. Therefore, westward travel requires less time to acclimate. This does not mean that a person cannot perform before all his/her systems are locked on, just that the performance will not be maximum.

Fig. 1 Typical Circadian Cycle



Eastward or westward travel across more than one time zone will result in some degree of jet lag. This may manifest as fatigue in the early night for westward travelers and reductions in total sleep duration for eastward travelers. Increasing the number of time zones crossed results in greater severity of symptoms. Although westward travel is usually considered more benign than eastward travel, fatigue management required in either case.

Seeing daylight after a normal night's sleep helps reset the body clock each day. This creates physical and mental energy peaks daily during daylight hours between 0800 and 1200, small troughs between 1300 and 1500, additional increases between 1500 and 2100, and finally a decline from 2200 through 0600. Figure 1 depicts this rhythm; note that at normal bedtime performance decreases to 90%. This level of performance is approximately equivalent to a 0.05 BAC (26). Many body rhythms are tied to sleep and by disrupting sleep these other cycles are also affected.

Shift lag. As crews transition from one work schedule to another, physical and mental resources lag behind the rapid change in the sleep/wake cycle. The most difficult challenge to the body clock occurs during the transition from the day shift into the early morning shift or into nighttime duty hours. This condition is called shift lag because the timing of the body clock always lags behind the sudden change in work/rest schedule.

About two weeks of continuous night work is required to adjust the body temperature cycle (and the associated performance peaks and valleys). However, due to the inherent difficulty of controlling light exposure and the frequent desire to maintain a day schedule on off days, this is very seldom fully accomplished. A single period of night work is more easily tolerated than three or four consecutive nights (which starts the process of circadian desynchronization) (7).

Rotations from daytime duty hours to nighttime or early morning duty hours will always result in some degree of sleep loss and fatigue during the initial days of transition. Controls should be implemented from the beginning of the work-schedule change. **Return to daytime duty hours after several days or weeks of nighttime or early morning duty hours produces significant desynchronosis and should not be underestimated.** At least a week is required to resynchronize from nighttime to daytime duty hours.

When unit members experience jet lag or shift lag, their inability to adequately assess self-performance may jeopardize safety. Fatigue is a subjective experience that is **ubiquitous, pervasive, and insidious**. In other words it effects everybody, in everything we do, and we often don't know how impaired we really are. Safety briefs teach us to take the keys away from a friend who has had too much to drink; if performance of a severely fatigued person is similar to an intoxicated one, perhaps we should "take the keys" from them in this situation as well. Crewmembers may not be able to reliably determine if they are safe to fly and may not respond to subtle warning remarks made by peers. However, as hypoxia symptoms, each member must be aware of their individual symptoms of fatigue and become sensitive to signs of fatigue.

Missions involving continuous and sustained operations are prime culprits in causing circadian desynchronization. By following circadian adjustment principles some fatigue can be avoided before the mission starts.

Circadian Rhythms

SOLUTIONS TO GETTING PAST THE DRAG

The advantage of a plan to prevent desynchronosis far outweighs any possible gains derived from not taking the time to carry it out.

These controls are designed for units bedding down at a fixed location in a new time zone for more than a week. Any deployment time less than this will result in unnecessary fatigue from shifting biological rhythms back and forth.

Jet lag

Pre-adaptation. Before deployment, a unit can attempt to pre-adapt to the new work shift or destination time zone. While potentially useful, pre-adaptation requires much coordination and cooperation from families and all levels of the involved unit. In a pre-adaptation scenario, deploying elements typically begin shifting their sleep/wake cycle from origination time toward the new sleep/wake cycle several days before transition.

The number of days devoted to pre-adaptation and the number of hours shifted daily will depend on many factors, including the number of time zones to be crossed and amount of advance notice received. For planning purposes the magnitude of the phase shift should be 1 hour per day.

Sufficient support must be provided to allow pre-adapting airmen access to finance and personnel services, properly timed meals, and so forth, or soldiers will be unable to follow the adaptation schedule.

Family members must be educated regarding the pre-adaptation plan so that they support the member's changing sleep/wake cycle.

Timed light exposure. The timing of daylight exposure is critical for the resynchronization of the body's biological clock. By carefully scheduling exposure to sunlight or proper artificial light, it is possible to speed adaptation to a new work schedule and/or time zone. Note, however, that incorrect timing of light exposure can actually worsen jet lag, so planners should carefully follow the specific suggestions provided in this section.

Illuminance levels of above 2500 lux (dawn brightness) are probably necessary to affect the body's timing mechanism. Exposures lasting at least 1 hour are effective in resynchronizing the sleep/wake cycle and other physiological rhythms.

Another way to look at the use of bright light to move the circadian rhythm around is to imagine a long, skinny balloon that is inflated just in the middle and still skinny at both ends. The inflated bubble represents the sleepiness (melatonin peak) that occurs between midnight and dawn. If you squeeze the right-hand part of the bubble, it will shift left. That's like morning light pushing the sleepiness (melatonin peak) earlier. If you squeeze the left-hand part of the bubble, it will shift right. That's like evening light pushing the sleepiness peak (melatonin peak) later.

For individuals who are accustomed to sleeping during the night, working during the day, and retiring at or about 2200, daylight or sufficiently bright light exposure between 0300 and 0700 (the advance body time zone) origination time (OT) will consistently advance sleep onset approximately 1 to 3 hours earlier per day. Predicting the exact amount of the advance requires information on physiological rhythms that will be impractical to obtain in most applied field situations.

In eastward travel, seeking daylight exposure during the advance body time zone for the first 3 days will speed the resynchronization process. The advance zone will shift to earlier times from day to day, and it is difficult to accurately predict the time range after 2 days of advances without data on physiological rhythms. Therefore after the third day, daylight exposure should be coordinated to occur as soon after awakening as it was in the OT zone.

In westward travel, seeking daylight or bright light exposure between 2000 and 0300 (OT) will help delay sleep onset. The duration of the delay depends on the duration of light exposure. In most cases, exposure durations of 1 to 3 hours will result in a corresponding delay of sleep onset.

Artificial bright lights can be used to influence these changes in sleep prior to or during shift changes or deployments, provided that the appropriate equipment is available. Bright light banks and visors are available from commercial suppliers and appear to be effective. Providing a brightly lit work area for night-shifters may be of benefit unless a dark or semi-dark work environment is required.

Wearing dark sunglasses may minimize unwanted exposure to daylight. Very dark sunglasses may be ordered from commercial sources. If these are not available, conventional sunglasses should measurably reduce light exposure.

Remember that these controls are designed for travel to a new time zone for more than a week. Any time less than this will result in unnecessary fatigue from shifting biological rhythms back and forth.

The tables below help speed adjustment to new time zones before departure or upon arrival. In the first column, identify the number of time zones to be crossed. The daylight exposure and avoidance schedules are then provided for both OT zone and destination time (DT) zone. This table assumes that the user has been on OT for at least 2 weeks (i.e., stable on OT) (28).

Table 1: Light Exposure After Eastward Travel – Daytime Duty

Time Zones Crossed		***Daylight Exposure***		***Daylight Avoidance***	
		Home	Destination	Home	Destination
4	Day 1 - 2	0300 - 0700	0700 - 1100	2000 - 0300	0000-0700
	Day 3		0700 – SS[1]		
6	Day 1 - 3	0300 - 0700	0900 - 1300	2000 - 0300	0200 - 0900
			0700 - SS		
8	Day 1 - 3	0300 - 0700	1100 - 1500	2000 - 0300	0400 - 1100
			0700 - SS		
10	Day 1 - 3	0300 - 0700	1300 - 1700	2000 - 0300	0600 - 1300
	Day 4		0700 - SS		

Table 2: Light Exposure After Westward Travel –Daytime Duty

Time Zones Crossed		***Daylight Exposure***		***Daylight Avoidance***	
		Home	*Destination*	*Home*	*Destination*
4	Day 1 - 3	2000 - 0300	1600 - 2300	0300 - 0700	2300 - 0300
	Day 4	1100 – SSDT[2]	0700 - SS		
6	Day 1 - 3	2000 - 0300	1400 - 2100	0300 - 0700	2100 - 0100
	Day 4		0700 - SS		
8	Day 1 - 3	2000 - 0300	1200 - 1900	0300 - 0700	1900 - 2300
	Day 4		0700 - SS		
10	Day 1 - 3	2000 - 0300	1000 - 1700	0300 - 0700	1700 - 2100
	Day 4		0700 - SS		

NOTE 1 & 2: SS = sunset and SSDT = sunset destination time

Shift lag

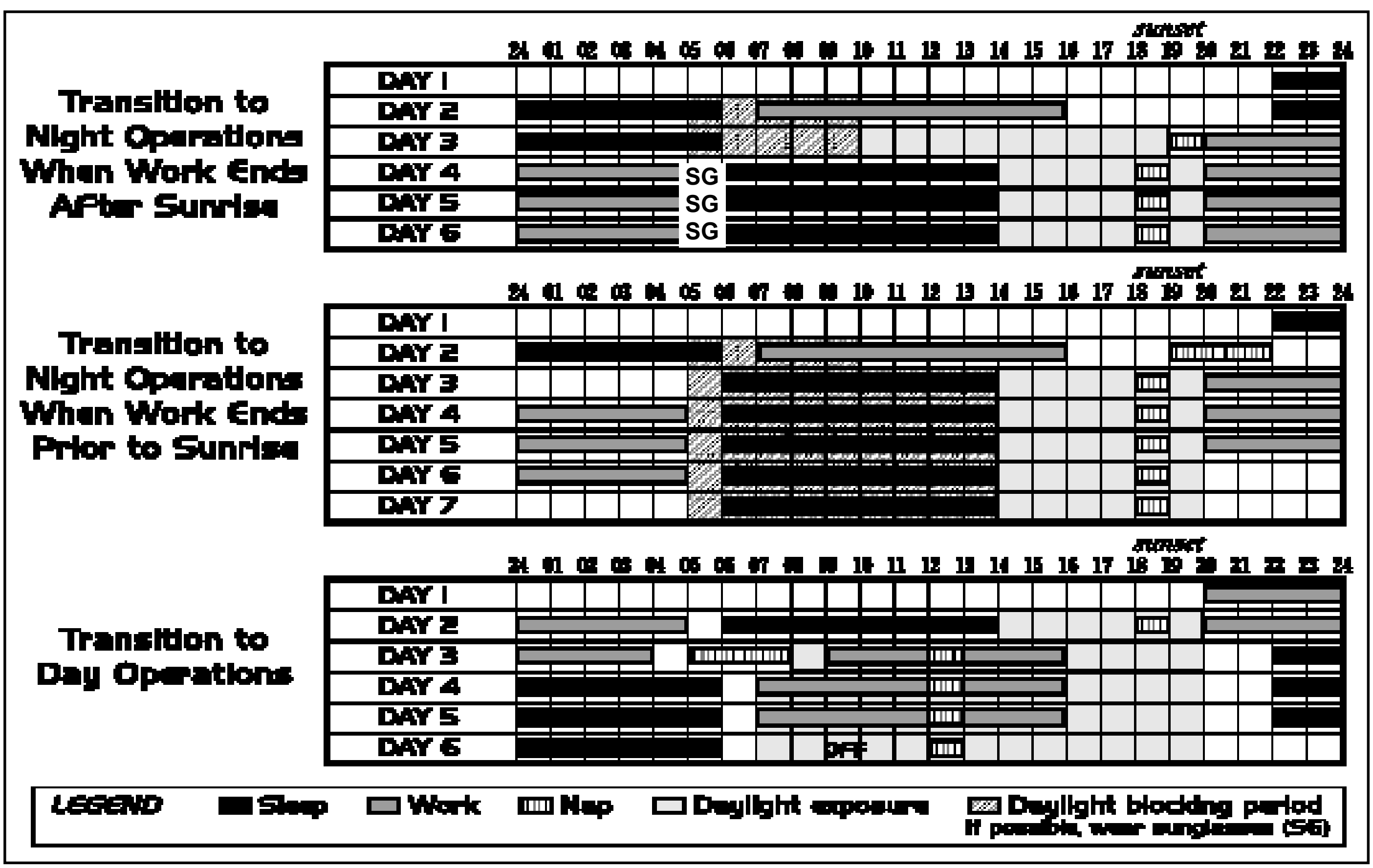
Crews permanently assigned to a night shift should avoid exposure to daylight in the morning after flying a night mission in order to minimize the natural synchronization of physiological and cognitive resources with daylight hours.

Exposure to sunlight before bedtime severely retards adaptation to night shift and result in the reduction of total day sleep time and its restorative quality. Schedule sleep to begin between 0400 and sunrise time, and delay exposure to sunlight until approximately 1200. Wearing dark sunglasses helps reduce unavoidable early morning exposure to sunlight. Upon awakening, engage in outdoor activities as much as possible in the afternoon. Consuming only 100mg of caffeine (about 1 cup of coffee) prior to reporting for duty will help maintain alertness.

If the shift change is only for 1 to 3 days changing sleep cycles may unnecessarily shift the body clock. Sleeping 8 hours after the midnight shift during the day can alter the normal circadian pattern, which is advantageous to maintain. Therefore, a short sleep immediately after the midnight shift and shortly before the next midnight shift should make it easier for most individuals to stay on a normal body cycle. After awakening from the second sleep period begin daylight exposure, caffeine consumption, and exercise to stimulate alertness.

Table 3 suggests work-sleep-nap schedules to assist planners during a transition to and from night operations. The daylight symbols indicate the time range during which you should attempt to obtain (or avoid) exposure to daylight. Pay close attention to the daylight symbols as they change during duty hour transitions. The word "sunset" indicates that you should be able to seek daylight exposure throughout the day until local sunset. When naps are indicated, you should try to take a nap that is at least 1 to 2 hours long to compensate for the anticipated sleep debt. Note that in the transition to Day 4, SG indicates that you should avoid daylight until bedtime by wearing sunglasses if necessary. Try to follow the sleep and daylight management schedules as closely as possible.

Table 3: Schedule for Transition to Night Operations



Performance

FOR THE MILITARY AVIATOR PERFORMANCE IS THE BOTTOM LINE

Poor performance is the cost of fatigue. At the extreme is disorientation, overwhelming sleepiness and inability to give and receive orders, as described during the Normandy operation of WWII. Although seldom ever get to this point it is common for some intermediate level of fatigue and compromised performance to occur.

Using a cognitive fatigue modeling program, we can estimate how performance degrades as a result of fatigue. Contributing factors that must be considered include: the type of task, preload of fatigue, time of day (circadian effects) and state of arousal.

These factors influence how fatigue fluctuates through a day, as it fluctuates it affects different capabilities at different rates. From most to least sensitive these would generally include: (1) subjective sense of well-being, (2) vigilance and attention, (3) judgment and decision making, (4) complex intellectual or physical tasks, and finally, (5) well learned/simple intellectual or physical tasks. Staying awake is sometimes the most important job occurring in an airplane.

Before reaching this extreme flyers may be heavily fatigued, such that judgment and decision-making are affected, but retain the basic psychomotor skills of flying an airplane, which are extremely fatigue resistant. Several studies illustrate this point. In Vietnam Naval aircraft carrier landings actually improved at night after 22 days of combat flying and only slightly worsened during the day (9,10). Likewise LSO scores in Desert Shield/Storm aboard the USS AMERICA remained the same or improved as operations progressed (11). The Army studied three two-man crews who flew a helicopter simulator for 14 hours a day for 4 days and 10 hours on the 5th day while sleeping four hours each night. Cognitive and judgmental errors were made, but pilots flew well into the 5th day (12). Interestingly, flight surgeons deemed the aviators unsafe to fly after the third night. Copilots were noted to increasingly fall asleep due to the boring nature of their duties. **Falling asleep on the job is the ultimate failure of performance.**

In sustained operations performance becomes a critical issue because after approximately 17 hours awake, measurements on performance tasks are equivalent to a .05% BAC. After approximately 24 hours of sleep deprivation these scores drop to the equivalent of a .10% BAC (26).

FIVE DETERMINANTS OF PERFORMANCE

TYPE OF TASK – Takeoff and landing skills are more fatigue resistant than maintaining vigilance

PRELOAD – How tired you were when you started

TIME OF DAY – Performance is best 1200 to 2100 and at a low 0300 to 0600

AROUSAL – What is happening during the flight.

TIME ON TASK – Performance decreases with greater time on task

All things being equal you will be more awake flying through AAA than flying circles in the tanker pattern.

Preload of fatigue is a concept not commonly studied in the laboratory but is extremely valuable when trying to predict how well an aviator will do on a given mission. It is all too easy to focus entirely on what the aviator is about to do and not consider what his schedule has been for the past week.

Circadian effects are also important. The most fatigue sensitive skills (vigilance/attention) are particularly vulnerable to circadian effects. A change in arousal may have a temporary alerting affect though.

Different phases of flight have widely varying levels of arousal. Boring aspects might include flying an aircraft on station for several hours, the transit between inter-theater operations or holding above an airfield prior to landing. Tasks with high arousal would include combat off-loading, infiltration of troops or simply taking-off and landing. **We can predict that performance in situations that are inherently arousing will be much better than those that are boring.**

Nutrition and Performance

WHAT KEEPS US GOING?

There are many myths and misconceptions about nutrition and performance. These myths often can be traced to unsubstantiated claims made by book authors, supplement manufacturers and sometimes even, well meaning, but uninformed health care professionals. The dietary supplement and publishing industries are businesses with one principal objective – to make money. Almost everyone has seen infomercials (a form of paid advertising) that make fantastic claims about the benefits from particular dietary supplements or nutrition programs. Similarly many popular books advocate specific diets that are claimed to enhance well-being and performance. Unfortunately these claims are not based on scientific evidence, although their advocates want you think they are proven to be safe and effective.

One of the common misconceptions about nutrition and performance is that carbohydrate foods will make you sleepy and protein foods will wake you up. Many people also believe that turkey (which is a protein food) or milk will make you sleepy because they contain the amino acid tryptophan. In fact, there is no conclusive evidence that any of these anecdotes are true. About the only thing we can say for sure that is large meals, regardless of their composition, will induce drowsiness. This explains the post-Thanksgiving Dinner somnolence that many people report.

Dietary supplements and diets are minimally regulated in the United States, and exaggeration, misrepresentation and sometimes outright fraud are common. There are hundreds of dietary supplements sold in the United States in pharmacies, supermarkets and supplement stores, including those on military bases. Most of the products sold are useless, some are potentially harmful and consuming others may result in a positive drug test because they contain illegal substances. The supplement of greatest concern currently is ephedra (ephedrine) because it is a potent stimulant, similar to amphetamine, with many adverse effects, and is found in many different types of dietary supplements (30).

Unfortunately, there are **no** special diets or dietary supplements that have been shown to improve pilot performance, prevent fatigue or have long-term health benefits. Think about it – if scientists and public health officials could recommend specific dietary supplements or diets that were proven to be safe and effective wouldn't you be seeing public health announcements for these products instead of infomercials!

What follows is a list of scientifically proven facts about nutrition and some general common-sense guidance – there are no spectacular claims and no quick fixes.

1) Your body, and especially your brain, need an adequate supply of fuel to function properly – they can only get that fuel from the food you eat. Keep yourself properly nourished – don't skip meals, but if you must miss a meal, at least have a snack. The exact composition of the meal or snack is not critical but a balanced diet is best.

2) Keep yourself adequately hydrated. Dehydration impairs both mental and physical performance. Don't reduce fluid consumption to avoid having to urinate – this will quickly lead to dehydration.

3) Caffeine in moderate doses can improve some aspects of cognitive performance even during severe operational stress (31) but can interfere with sleep. Consumption of moderate doses of caffeine does not result in dehydration (32). Caffeine is particularly good at restoring vigilance and alertness but it is not a substitute for sleep. In high doses it may impair fine motor coordination and control.

The usual dose is 100 - 200 mg every three to four hours. Caffeine is not useful for individuals already consuming 300 mg or more of caffeine a day. Due to its low abuse potential and wide availability, caffeine still offers significant utility (especially in ground personnel). Caffeine was used successfully during flights over Iraq supporting Operation Southern Watch in August 1992 (20).

4) If you are a regular consumer of caffeine do not suddenly stop consuming it. Headaches, impaired mental performance and bad mood may result. This is particularly important before and during long missions.

5) Poor nutrition, particularly skipping meals, inadequate fluid consumption, sleep loss and stress all individually degrade mental and physical performance, in combination they can lead to devastating effects on operational performance.

6) Do not store fresh foods for longer then four hours without refrigeration. A cooler is not adequate refrigeration. Food-borne illness is common and it can quickly incapacitate a crewmember.

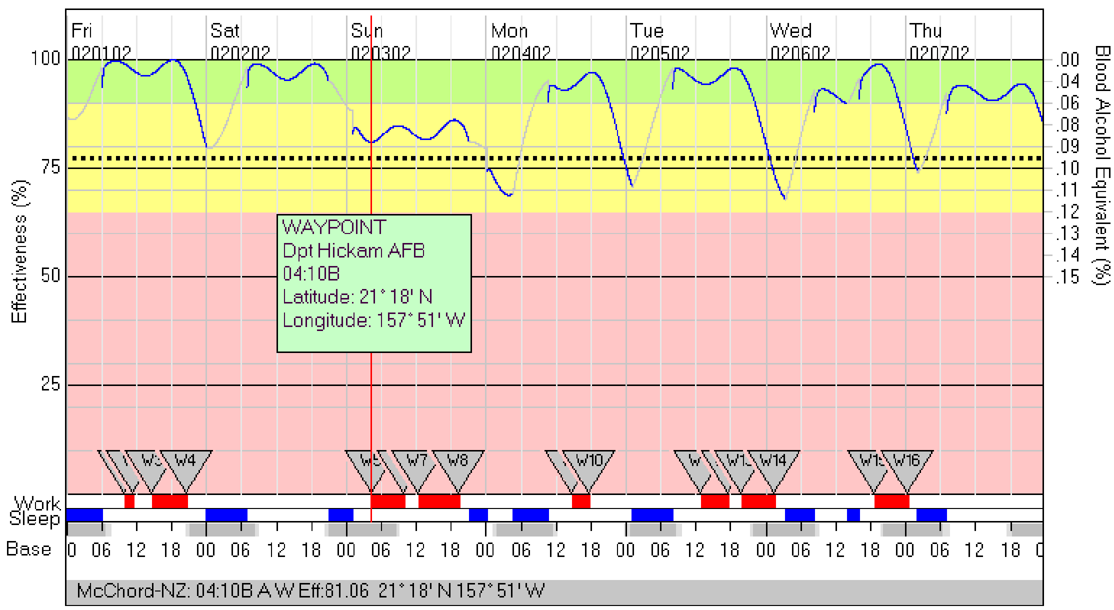
7) Do not consume dietary supplements without first consulting with your flight surgeon – many common supplements are banned by the Air Force for individuals in flight status.

FAST

FATIGUE AVOIDANCE SCHEDULING TOOL

The Fatigue Avoidance Scheduling Tool (FAST) is based upon the SAFTE model, a cognitive fatigue model accepted by the DOD. FAST is a computer program that allows users to correlate the effects of various work/sleep schedules on human performance. The FAST model calculates effectiveness at a point based on the amount of sleep, circadian effects, and sleep inertia at that time.

- Work schedules are shown as red bands on the time line across the bottom of the graphic presentation format (figure, below). Average cognitive effectiveness for work periods of any length may be extracted and printed.
- Sleep periods are shown as blue bands across the time line, below the red bands.
- The vertical axis of the diagram represents composite human performance. The axis is scaled from zero to 100%. The oscillating line in the diagram represents expected group average performance on these tasks as determined by time of day, biological rhythms, time spent awake, and amount of sleep.
- The green area on the chart ends at the time for normal sleep, 90% effectiveness.
- The yellow indicates caution.
- The area from the dotted line to the red area represents performance level during the nadir and the 2nd day without sleep.
- The red area represents performance effectiveness after 2 days and a night of sleep deprivation.



Flight surgeons, aerospace physiologists, or schedulers can input and rearrange sleep periods to maximize the effectiveness of crews during critical events. Crews can then use this output to predict the roughest parts of a mission and plan counter strategies, such as carrying an augmented crew and creating a sleeping/flying schedule, double-checking actions, or considering the necessity of medications. Although FAST is a theoretical model, it could be useful in examining the various stressors on performance. It is only a guide.

The Air Force Research Laboratory Warfighter Fatigue Countermeasures Group (AFRL/HEPM), at Brooks AFB has been the primary sponsor for this program to date. For more specific information on FAST and possible ways to implement the program talk to the local Flight Surgeon or Aerospace Physiologist, or look at http://wwwsam.brooks.af.mil/web/cope.htm.

Strategies and Ideas

SUGGESTIONS FOR THE WING, SQUADRON, INDIVIDUAL AND FLIGHT SURGEON

WING LEVEL:

- Fatigue is a commodity to be managed. The wing commander must establish this policy/attitude.
- Everyone else's resistance to fatigue will rarely be the same as the wing commander's.
- Recognize that planning/ground duties fatigue CO's and department heads prior to the first strike.
- Minimize unnecessary changes in tasking (weaponeering, rules of engagement, etc.). The cost is lost sleep.
- Task squadrons/units so they can minimize circadian disruption (allow day or night specialization).
- Expand facilities support when needed. Examples include longer food service hours, an additional sickcall or augmented base transportation.
- Optimize sleeping quarters for sleeping (sometimes hard to do).
    - Install dark curtain or blinds to darken the rooms
    - Reduce noise
    - Isolate day sleeper and keep day workers (housekeeping, etc.) away from them
    - Make sure the air condition is working

SQUADRON LEVEL:

- Fatigue is a commodity to be managed. This policy/attitude must be established by the commanding officer.
- Plan rest periods; put some of the squadron in a rest period prior to everyone getting exhausted. Break into shifts early when sustained operations are expected, then send some troops home.
- Preparation/planning for a strike may be harder than the strike itself; don't make it harder than it needs to be.

  Don't needlessly fatigue the troops **- Napoleon Bonaparte**
- Six to eight hours of sleep per night is the minimum required for indefinite sustained operations.
- A change in squadron dynamics, such as losing a sense of humor, is an early and reliable indicator of fatigue.
- Kick people out of the squadron and send them to bed; encourage combat naps.
- It is harder to sleep at mid-day than at 0300; schedule a longer block of time for rest during the day.
- It takes about seven days to adjust to working nights. Working only three to four nights in a row starts the process of circadian desynchronization but doesn't complete the shift. Therefore, working a single night or seven in a row is better tolerated.
- Bright lights not only maintain alertness but also are a strong factor in accelerating circadian adaptation.

- Establish “grounding” guidelines for both overly fatigued aircrew and ground support personnel.
- Reduce administrative additional duties.
- Use your flight surgeon.

INDIVIDUAL LEVEL:

- Decide early to “manage” yourself.
- Ensure proper use of crew rest (see Sleep Habits, page 12).
- Be honest about your limitations; no one can sprint 26 miles.
- Pay attention to nutrition, hydration and physical conditioning.
- Exercise sleep discipline; unless it is really important go to bed.
- Combat naps work (even as short as 10 minutes).
- Many people are sluggish and confused for several minutes after taking a nap; this feeling can last over an hour in some individuals. This could be a problem when manning an alert aircraft.
- Ten hours is the maximum effective sleep period (even when sleep deprived).
- During the day it is easiest to get to sleep just after lunchtime (whether you ate or not).
- Caffeine works well to keep you awake. Strategic caffeine consumption is more effective than continuous caffeine consumption -- stop drinking coffee several hours before you want to sleep.
- Watch for fatigue symptoms in your squadron mates
- Take yourself off the flight schedule or end your shift early if you recognize you’re dangerous.

FLIGHT SURGEON UTILIZATION:

- The squadron flight surgeon (FS) can be of great value during Continuous Operations and SUSOPS. The FS’s familiarity with squadron members and knowledge of the signs and symptoms of fatigue place him in a unique position to assist the squadron.
- Consider the FS and Aerospace Physiologist (AP) in planning/scheduling/briefing; they may think of things you didn’t and can be a good conscience.
- The FS and AP can be a problem solver by improving the sleep and work areas and general facilities support.
- The FS can provide the aircrew an “out.” An aviator can save face by having his FS ground him verses having to go to the OPSO and admitting that he is too fatigued to fly.
- Anti-fatigue medications are an additional augment that the FS can provide should operational necessity demand it.

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