

GroundEffects

Reporting Maintenance and Groundcrew Error Reduction Efforts

Winter 1999/2000
Volume 4 Issue 4
\$8.00 per issue

Website:
www.marss.org

Editors Note: Mr. Gordon Dupont is a well know Human Factors training specialist. He has taught Human Factors training all over the world. Gordon holds an AME licence in Canada, America and Austrailia. Gordon has previously worked as Transportation Investigator and for Transport Canada developing a Human Factors workshops. He currently is the C.E.O. of System Safety Services. Visit him on the web: www.system-services.com

Fatigue - It's SOMETHING THAT AFFECTS US ALL THROUGHOUT OUR LIVES.

It is a problem that most industries vastly underestimate the danger and the individual vastly overestimates his ability to cope with it. Many serious accidents have a strong fatigue component in the cause of the error in judgment. Chernobyl, a nuclear explosion in 1986, which is continuing to kill today, is a case in point. Or Bhopal an accident that killed over 8,000 people as they slept and affected another 500,000. Forty tons of a cyanide gas covered a 20 square km area due to an error, which had a fatigue component in the root causes. People are dieing today from the aftermath.

Aviation also has its "midnight" accidents. Aloha is one of the most dramatic results of a fatigue (among others) influenced error in judgment.

In this article I will attempt to gather the latest thinking on fatigue and propose some safety nets that one can use to lessen the effects of fatigue. There is no magic formula or cure besides a good nights sleep at the right time but we can lessen or delay the effects.

What is fatigue

So what is this thing called fatigue. There are many definitions but I like: the loss of alertness that usually ends in sleep. As fatigue progresses the person finds it more and more difficult to respond to the task at hand. The difficult thing about fatigue is that its onset is very insidious. The fatigued person is often not aware of the state of his fatigue until it is extreme and he is about to fall asleep.

(Con't on page 4)

The 14th International FAA/ CAA/Transport Canada Human Factors in Aviation Maintenance Symposium

The 14th International FAA/CAA/Transport Canada Human Factors in Aviation Maintenance Symposium will be held in Vancouver , BC March 28 to 30 2000. Anyone who has any interest in the subject should be there. The cost is very reasonable (\$350.00 Cdn) and the program is excellent. I look forward to seeing you there. For more detailed information visit their website:

[www.tc.gc.ca/aviation/
mainten/aarpc/hfiam.htm](http://www.tc.gc.ca/aviation/mainten/aarpc/hfiam.htm)



GroundEffects would like to extend our thanks to the following companies for their generous contributions.



System Safety Services

Help us to prevent accidents before they happen!



GroundEffects (ISSN 1094-0146) is the official newsletter of **MARSS (Maintenance and Ramp Safety Society)** and is published four times per year to discuss issues affecting maintenance safety. We offer practicable solutions to maintenance managers, regulatory authorities, and unions charged with improving safety and reducing costs.

Newsletter editor : Renee Dupont
(604) 207-9100
email: dupont@home.com

As we believe that safety information is of greatest value if it is passed on for the use of others, readers are encouraged to copy or reprint any item or article for further distribution (except where copyright is indicated), and should acknowledge *GroundEffects* as the source.

Trademark protection for

GroundEffects has been applied for.

Subscriptions (four issues per year) are available for a cost of \$32.00 per year. (includes postage and handling)

MARSS Ph: 604 207-9100
Fax: 604 207-9101

ACE Aviation Colleges in Europe

ACE started up one year ago – the European Union have created a Joint Aviation Authority, and they are busily producing JAR's: Joint Aviation Requirements. These requirements oblige the colleges involved in aviation maintenance training to change and adapt, and so the need was felt to get together and discuss this.

From this first discussion, which took place in Eisenstadt, Austria, came the first theme meeting in Vasteras, Sweden, and the partnership grew.

The second meeting was on computer based training – several CBT's have been developed, and the ones shown at this third meeting in Hoofddorp, The Netherlands, were produced by KLM/Vega and Lufthansa Training.

The third theme meeting was on Human Factors, and Gordon Dupont, an expert in the field from Canada, introduced the theme and elaborated upon it. Our hosts this time were the Hungarian Kossuth Lajos College and MALEV.

Who are the partners?

Looking at funding – some of our partners are non-autonomous colleges who need funding to attend the conferences – there are three partners:

- the Netherlands Aviation College, Hoofddorp, The Netherlands
- Kossuth Lajos College, Budapest
- Höhere Technische Bundeslehranstalt, Eisenstadt, Austria

These partners are funded through Comenius, which is a European funding programme. We hope to be able to extend this funding either under Comenius again, or under Leonardo da Vinci II.

(Con't on page 3)

Table of Contents

FAA/CAA/Transport Canada 14th Annual Symposium	1
Fatigue	1
ACE	2
Two New Videos	3
Sustained Wakefulness	8
EDITORS NOTE	11

(Con't from page 2, ACE)

Other partners, who have financed their own participation, are:

- The Aviation College of Sweden, Vasteras, Sweden
- Flygteknik Gripenkolan, Nyköping, Sweden
- Rovaniemi Vocational Institute, Rovaniemi, Finland
- Lulea Flygteknik Centrum, Lulea, Sweden
- ROC Midden Brabant, Breda, The Netherlands
- ROC Deltion College, The Netherlands
- Tampere Vocational College, Tampere, Finland
- Rovaniemi Polytechnic School of Technology, Rovaniemi, Finland
- AVIACONSULT, Finland
- City of Bristol College, Bristol, UK
- (Pontypridd College, Wales, UK)
- Lufthansa Training

and we have had participants to our meetings from

- Joint Aviation Authorities
- VEGA
- KLM, MALEV
- The Dutch Aviation Authority
- the Swedish Aviation Authority
- the Finnish Aviation Authority

We welcome all other interested participants!

The network is an informal one, and based on shared interest in the field of training for aviation, mainly maintenance training, but also cabin-crew, logistics employees and apron work.

Our next meeting is going to be

in Lulea, Sweden, and it will be organised by the Lulea Flugteknik Centrum. Theme will be Avionics, including helicopters, and the other theme will be Cold Climate Engineering – and as both Lulea and Rovaniemi are on the Arctic Circle, they should know about this!

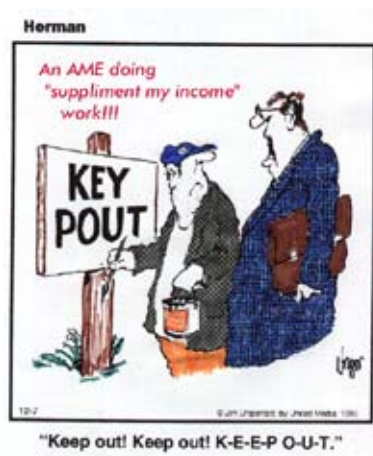
The meeting is planned for 9th – 12th March of 2000.

If you are interested in participating, please contact: Peter Lindberg Principal, Lulea Flygteknik Centrum Luftfartsvägen 11 972 54 LULEA Sweden Tel. **-46-920-23 21 64 Fax: **-46-920-29 43 44 e-mail:

peter.lindberg@ftc.lulea.se
www.edu.lulea.se/
bergnasskolan/flyg/

We look forward to meeting you!

Dorothy Mooij International Coordinator The Netherlands Aviation College Tmm.mooij@roc-ams.nl www.roc-ams.nl



Two New Training Videos Available Through MARSS!

TOO MANY COOKS

A serious training video produced by MARSS, wherein a tired and harassed AME becomes distracted and forgets to tighten up the N1 tach generator canon plug on a helicopter.

During a flight the next day the canon plug falls off and the inexperienced pilot hearing the erroneous "engine out" horn auto rotates the helicopter into the ocean below.

DANGER ZONE

In this video, produced by MARSS, the viewer is challenged to discover for themselves the links that lead up to an accident. The video begins in the cockpit and takes you up to the moment of the accident. The viewer is then challenged to determine which of the events depicted in the video contributed to the incident. Further, the viewer is presented with some safety nets that might have prevented the accident. You, the viewer, then decides which one might have been used.

These and other training videos are available through our MARSS office by calling (604) 207-9100 or visit our website for on on-line order form: marss@marss.org.

GroundEffects

(Con't from page 1, Fatigue)

Fatigue will degrade ones judgment and decision making skills. In fact it will degrade all aspects of human performance such as reaction time and situation awareness.

There are basically two types of fatigue. **Acute and Chronic.**

Acute fatigue is intense and of short duration. It could more correctly be called exhaustion but it is cured by one good nights sleep. Running a marathon or working a 12-hour shift would result in acute fatigue. As long as one gets a good sleep the problem disappears.

Chronic fatigue is the more difficult one to recognize and cure. It is the result of frequent recurrence and long duration. It results in a sleep debt, which we'll talk about later and cannot be cured by one good nights sleep. Anyone who has worked long hours over a couple of weeks without a break knows the feeling of chronic fatigue. You find that you go to bed exhausted and wake up feeling just as bad. With chronic fatigue you end up with what is called a sleep debt. If we don't get our required amount of sleep (reasons which will be listed later) we begin to accumulate a sleep debt. For example if you normally get 8 hours sleep per night but due to a party only get 5 hours than you have a 3 hour sleep debt. This sleep debt will begin to affect your performance. The larger the sleep debt the more ones performance will be affected. Jim Horne of Loughborough University states you lose the equivalent of 1% of your IQ for every hour of sleep debt you are carrying. As Stanley Coren, author of the book "Sleep Thieves" says, a sleep debt of 10 hours could drop the average persons IQ down to 90, which "could make you so dumb you could run for parliament"

So what are the symptoms and effects of fatigue? The first is you begin to experience difficulty in staying awake. You find yourself yawning and it becomes more and more difficult to maintain concentration on the task at hand. You find that your memory becomes diminished and you begin to forget things. Your mood begins to become withdrawn. You don't wish to converse with anyone and if you do it likely will be in an angry mood. You even begin to develop a "I don't give a d__" attitude as your mood worsens. An enhanced stimulus will be required before you respond. By that we mean that normally you would be able to detect a .20-inch crack when inspecting a part. When fatigued you may not see the same crack until it is .50 inches long. You will likely find yourself drinking more coffee or smoking more in an effort to combat the fatigue. You will reach a point where all you want to think about is sleep and you begin to lose awareness of the situation. For example you are driving down a busy freeway at 100 km per hour and all you want to do is nod off. Finally, you can't remember the last few seconds because you did nod off into what is called a microsleep. Microsleeps can be very dangerous depending on what you are doing at the time. A microsleep is involuntary and can last from a few seconds to several minutes. (To a lifetime if they occur while

you are driving on that busy freeway)

It is very important that we begin to recognize and look for these symptoms in both ourselves and others so here they are in point form

1. Feel sleepy and yawning
2. Have trouble concentrating on the task.
3. Have trouble remembering things.
4. Start making stupid mistakes.
5. Mood becomes worse.
6. You don't want to talk.
7. An enhanced stimulus is required before you respond.
8. Begin drinking more coffee and smoking more.
9. Begin to lose situation awareness.
10. Can't remember what you were doing a few seconds ago. (Microsleeps).

If sleep is the cure all for fatigue just what is sleep and how much do we need? Sleep is a physiological state that is vital to survival. In other words if you don't sleep you die. How long would it take? Depending on a lot of variables like age and health, the average person can remain awake for between 14 and 21 days before dieing.

It is not known for sure just what sleep does that is so vital but one theory is it rebuilds the immune system. It is known that people who don't get enough sleep live a shorter life than those who do but there may be other variables. Too much sleep can also shorten your live but that again may also be related to the lifestyle of an excess sleeper. I.e. no exercise,

(Con't on page 5)

(Con't from page 4,, Fatigue)

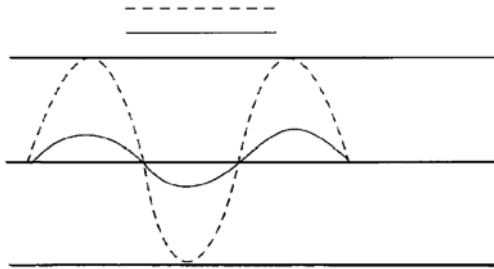
eats too much, etc. So how much sleep do we need? Napoleon once said: A man needs six hours, a woman needs seven and a fool needs eight. (Napoleon had trouble sleeping) It is known that women need about 15 minutes more sleep than a man. It is believed that we need between 6 and 10 hours sleep with 8 being the average. The problem is that we need a good nights sleep where the brain can cycle through various stages of sleep without interruption.

What are the stages of sleep? By direct observation and connecting electrodes that read the electrical activity of the brain, psychologists are able to determine that sleep involves two main stages #1. REM for rapid eye movement and #2 non-REM or Deep or Delta or Slow Wave Activity (SWA) sleep (The same name for the second main stage of sleep). This second stage of sleep is then divided into 4 sub stages with each one leading to a deeper sleep and back up again in about a 2 hour cycle. The cycle time varies between individuals depending on age, health, and factors like alcohol intake before going to sleep.

It is generally thought that the immune system is built up during the deep sleep stage while the REM sleep is the time that the day's events are stored into the memory. REM sleep is characterized by rapid eye movement and a almost total paralysis of voluntary movement during this stage. For some reason the muscles "profoundly relax"

While all of the above is the best theories to date on sleep, much research is being done in this area, as sleep is a very complex process.

Circadian Rhythm Then to make the matter more complex we throw in circadian rhythm. Circadian comes from the Latin words circa = about and dies = day. Within our bodies are many natural rhythms that cycle like a roller coaster through the day. Body temperature, blood pressure, heart rate, alertness to name but a few vary throughout the day. Sleep is one of the things regulated by this biological clock. We have a natural time of maximum sleepiness between 3 to 5 am and a lesser one between the same times in the afternoon. It is thought that this time of maximum sleepiness is predicated on when you normally wake up and is a time about 2 ½ to 3 hours before that time.



Subjects who have been deprived of any means of telling the time have been found to fall into an approximate 25-hour cycle. Light from the sun appears to be the adjuster to the 24-hour cycle. Throughout the

centuries the body has prepared man to work during the day and sleep at night. But today about 25% of the service sector work force now works night shift. It is a fact of life for many and something that many workers have to learn to live with. Ones circadian rhythm can be shifted but the sunlight is always trying to bring it back to "normal". The "what to do's" will attempt to offer some ways to make it easier.

So what are some of the causes of fatigue?

1. Long hours of labour, both physical or mental, will lead to fatigue. The longer the hours, the more the fatigue, plus any sleep debt you may have.
2. Lack of sleep. This obvious cause may be due to lack of time to sleep, or the inability to sleep for a number of physiological reasons such as sickness, noise, or a disruption in ones circadian rhythm. There are also medical conditions such as sleep apnea that is estimated to effect as many as 30% of the population in varying degrees. In sleep apnea, the person's trachea becomes blocked and he/she stops breathing until they wake up and begin breathing again. This goes on throughout the night and one person was measured at being wakened over 380 times though the night but could remember none of them. He would awake each morning feeling tired and drained. His wife complained of his snoring and heard him stop breathing (and snoring) for periods of about 30 seconds at a time. If you are chronically tired after a "normal"

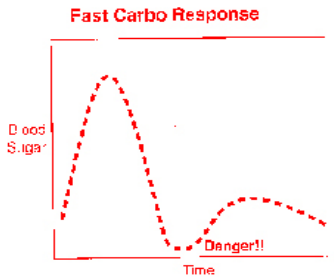
(Con't on page 6)

GroundEffects

(Con't from page 5, Fatigue)

nights sleep than it may be a good idea to seek medical advise.

3. Stress. If your mind is racing and you can't go to sleep, it is likely stress that is doing it. Stress can come from a number of things, from concern about one's family life to a letter from the tax auditor.
4. Large temperature variations, too much or too little will lead to fatigue. Too hot leads to heat exhaustion while too little leads to hypothermia.
5. Noise leads to a fatigued state. In fact noise above 100 db over time can result in a loss of situational awareness (confusion) Persons have been known to walk into rotating propellers after being exposed to high engine noise.
6. Vibration also leads to a feeling of tiredness. It can also cause headaches and muscle discomfort.
7. Strong lighting and to a lesser degree weak lighting can also contribute to fatigue.
8. Working during the low periods of ones circadian rhythm. The urge to sleep is very strong during the low periods.
9. Working with a low blood sugar level. Our body has an ideal blood sugar level that it seeks to maintain. If it gets too high we become irritable and edgy while if it gets to low we become lethargic and moody. Some foods give what is called a fast carbo response.



High sugar content foods like chocolate bars give the blood sugar level a fast boost, but the body than pumps in insulin to counteract the high blood sugar and often results in an even lower blood sugar than before. If the body is fatigued this swing may be even more pronounced.

The Safety Nets or What can we do?

Shift work is a fact of life for many and it is very important to do what we can to minimize the effects of the constantly changing work times.

1. Awareness is one of the biggest weapons in minimizing fatigue. Knowing about sleep debt should make a person think twice about holding down two jobs at once. Read the rest of the safety nets carefully and use as many of them as you can. Making use of these will make you less prone to making an error and as a bonus will enable you to live longer.
2. Try to avoid working the long (over 12 hours) hours of labour. In an article in this issue Dr. Drew Dawson equates the impact of fatigue to drinking alcohol. 17 hours of being awake equate to a blood alcohol level of .05%. Read that article carefully as it is a real eye opener. Everyone likes the extra days off that the long days bring but there is a price to pay for them in the form of fatigue and sleep debt.
3. Try to avoid constant shift changes. It is better to stay on a constant shift, be it midnight, afternoon or days than constantly changing. Some airlines are now putting their employees on the same shift for a year at a time after seeing improvements in the one-month and six month time trials. It may not sound appealing but it is better.
4. If there are shift changes, they should always be in the clockwise direction. I.e. Days, afternoons than midnights as this takes advantage of the bodies natural tendency to go to a 25 hour clock.
5. Establish a sleep routine. How is that possible if your shifts are always changing? To the extent possible, always try to do the same things before going to bed. I.e. shower, brush teeth, glass of warm milk while reading for 10 minutes to unwind than go to bed.
6. Make sure that the bedroom is completely dark and or if it is daytime, wear sleep goggles. That way if you half wake up during your sleep, you are more likely to go back to sleep.

(Con't on page 7)

(Con't from page 6, Fatigue)

7. If you have to go to the bathroom in the middle of your sleep during the day, make sure it is also has no sunlight peeking in. The sunlight, even for a short period of time, will make it harder to go back to sleep.
 8. Make sure the bedroom is cool or find a room that is. During the day in the summer it is difficult to sleep if it is hot. A window air conditioner is worth its weight in gold if it helps you get your proper sleep.
 9. Keep the loud noise out. No you may not be able to send the kids to grandmas every day but you can invest in earplugs, soundproofing and/ or "white noise"(a steady noise that blocks out other noise).
 10. Invest in a comfortable bed. You are going to spend about 1/3 of your life there so a good bed is a wise investment.
 11. Learn some relaxation techniques. Some involve deep breathing; deep muscle relaxation, yoga or even self-hypnosis can help.
 12. If you are still wide awake after about 20 minutes, than get up and do some quiet activity (listen to relaxing music and/ or read the air regulations) in the dimmest light possible and with NO sunlight. One interesting tip calls for visualizing a blackboard. If anything appears on it wipe it off. It's more original than counting sheep. When sleepy, go back to bed.
 13. Try to go to sleep on neither a full or empty stomach. Warm milk is actually a help in going to sleep while alcohol may help you go to sleep but it will cause you to have poor quality sleep.
 14. A big help in sleep is a regular exercise routine. This should not be done just before going to bed but about four hours before going to sleep. Exercise helps burn off the many "awake" chemicals in your body such as adrenalin and makes you physically tired.
 15. Avoid drinking coffee about four hours before you intend to go to sleep. Caffeine increases heart rate and many things you don't want when trying to go to sleep. It is also a diuretic and having to get up to go to the bathroom does not help ones sleep pattern.
 16. Try not to bring stress to bed with you. This is easier said than done but writing in a diary can help as well as taking an earlier time to worry. Sit down, write the worry down and try to write down some possible solutions. If there are none than write down all the worse possible scenarios ways and devise ways to at least lessen the problem. Than make a conscious effort to leave the worry in the book for tomorrow.
 17. Try to get your needed amount of sleep. I.e. don't set your alarm for five hours later just so you can have lunch with the family. If you need eight hours, try to take it. Here is where an understanding family helps.
 18. Learn the secret of the "Power nap" If you are feeling tired and it is possible to do so take a short nap of about 20 minutes. Some sources say it is OK to take up to 40 minutes or more than two hours in order to avoid waking up from delta or deep sleep. If you wake up from deep sleep you will find yourself disoriented and groggy while the short sleep allows almost instant alertness and feeling refreshed. Do not do this if you intend to go to sleep within four hours of this time.
 19. If you snore heavily and are always tired when you wake up consult a doctor about possible sleep apnea.
 20. A sympathetic family to the problems of being a shiftworker will help as well. If they can understand that you will not be able to always live the "normal" social life that others do, your stress and regular sleep times will be better. Talk about it with them.
- But when you are awake and have to remain awake to work, what can you do?**
1. Coffee is one of the most used stimulants to help keep awake. The caffeine in coffee is also found in tea, coke and chocolate to a lesser extent. Use coffee to help keep your heart rate and

(Con't on page 8)

GroundEffects

(Con't from page 7, Fatigue)

- blood pressure up but remember to stop taking it about four hours before you intend to go to sleep.
2. Try to exercise or do some physical action during this time.
 3. Avoid the fast carbo foods and the heavy meals. It is better to eat lots of little meals than one heavy one. A few slow response foods are pastas, ice cream, most fruits and peanuts. A few avoid ones are the turkey dinner, high sugar foods, chocolate and carrots.
 4. When you have a short break, take that power nap.
 5. Use bright lights if possible. The brighter the light the better but not right in your eyes.
 6. Drink lots of fluids.
 7. Engage in conversation: the more stimulating the better. Few people fall asleep talking.
 8. Cold water on the face provides a short stimulation.
 9. Avoid the complex jobs during the known circadian rhythm time and try to avoid dull jobs as well.
 10. Develop a buddy system to enable someone to check your work when you are not mentally at your best.

For the drive home.

1. Remember the short power nap if needed.
2. Talk to someone is a help.
3. Eating an apple is also a trick that can help keep you awake for a short term
4. The open window, driving with your shoes off, loud music can give a very limited relief but if you are at that stage. **PULL OVER** and take a short nap before the microsleeps cause you to have an accident.

Our industry has realized the fatigue problem in the cockpit and there are strict regulations on the number of hours that a pilot can work. Maintenance Technicians are human also and are no better than the pilots in combating fatigue. The day must come when we will also be regulated in the number of hours we can work. Many won't like it, (they like and/or need the extra money) but it will result in a safer working environment.



Editors Note: Drew Dawson is the Director of the University of South Australia's Center for Sleep Research. He is considered to be one of the world's leaders in research into fatigue as an occupational health and safety issue.

Sustained Wakefulness and Alcohol Intoxication

INTRODUCTION

Since the industrial revolution shiftwork has become an increasingly common work practice. It has been estimated that 15-20% of the working population in industrialized countries are currently

“21 hours of sleep deprivation produced a decrement in performance on the grammatical reasoning task equivalent to that associated with a BAC of 0.09%”.

- Drew Dawson

employed on some form of non-standard work schedule. While the economic benefits of shiftwork are self evident, the benefits are accompanied by significant health and social costs. Research studies over the last 20 years have clearly identified shiftwork as an occupational health and safety risk factor.

Reduced opportunity for sleep and reduced sleep quality are generally considered to be the major risk factors associated with shiftwork related accidents. Not surprisingly, the

(Con't on page 9)

(Con't from page 8, Sustained Wakefulness)

combination of these factors leads to increased fatigue, lowered levels of alertness and impaired performance on a variety of cognitive psychomotor performance tasks.

Experimental studies have shown that sustained wakefulness impairs several components of performance including hand-eye coordination, decision-making, memory, cognition, visual search performance and speed and accuracy of responding. In addition to cognitive factors, affective components of behaviour such as motivation, and mood are altered as the duration of shift work (SW) increases.

From the studies I have conducted it is clear that there is a general consensus that cognitive psychomotor performance is impaired by the sleep disruption and extended wakefulness associated with shiftwork. Moreover, this performance impairment is associated with an increased risk of accident.

Surprisingly, however, policy makers in western industrialized countries have generally not legislated to manage and control fatigue in a manner commensurate with the statistical risks associated with it. This attitude is in stark contrast to the response to alcohol-related performance impairment. Policy makers and the community have frequently proscribed work and/or the operation of dangerous equipment under the influence of alcohol. Given that the effects of SW are qualitatively similar to the effects of even moderate alcohol intoxication, it is paradoxical that fatigue-related performance impairment has not been subject to similar levels of regulatory intervention. This failure to address the occupational, health and safety impact of fatigue may, in part, reflect a failure to provide policy makers with a readily understood index of the relative risk associated with sleep loss and fatigue.

The current studies sought to express the impairment associated with fatigue equivalent to those currently accepted by policy makers and the community. That is, by expressing the performance impairment as its equivalent level of alcohol intoxication. By expressing the performance impairment associated with fatigue in terms of its equivalent BAC it is hoped to provide an easily-grasped index of comparative impairment.

DISCUSSION

Cognitive psychomotor performance levels for all tests except for vigilance decreased significantly in the alcohol condition. Similarly, cognitive psychomotor performance levels decreased significantly for all performance tests in the SW conditions. Comparison of the two effects indicated that moderate levels of sustained wakefulness produce performance decrements comparable to those observed at moderate levels of alcohol intoxication in social drinkers.

In the alcohol condition increasing blood alcohol concentrations were associated with a significant linear decline in cognitive psychomotor performance. For example, in study one mean relative performance in the alcohol condition was impaired by approximately 5.8% at a BAC of 0.05% and by 11.6% at a BAC of 0.10. Overall, mean relative performance declined by approximately 1.16% per 0.01% BAC. These results are consistent with previous findings that suggest that cognitive psychomotor performance declines linearly with increasing intoxication between 0.0-0.075% BAC.

It is important to note that there was no decrease in mean relative performance up until a BAC of 0.03%. This is similar to the findings of Wilkinson and Colquhoun (1968) who also reported an increase in performance on a choice serial reaction test up until a BAC of 0.032%. This result is thought to reflect the fact that alcohol acts as a stimulant at low blood alcohol concentrations.

In contrast, cognitive psychomotor performance in the SW condition showed a more complex relationship. Mean relative performance showed three distinct phases. In the first phase (0-10 hours) performance remained relatively stable at a plateau. In the second phase (10-26 hours) performance declined linearly. During the third

(Con't on page 10)

GroundEffects

(Con't from page 9, Sustained Wakefulness)

interval (26-28 hours) mean relative performance increased again presumably reflecting the well reported circadian variation in cognitive psychomotor performance.

Since few shiftworkers remain awake for less than 10 or more than 26 hours between shifts, the comparative analysis focussed on the second phase. Between the 10th and 26th hours mean relative performance, showed a strong linear decline of approximately 0.74 % per hour. The performance decline observed between hours 10 and 26 is consistent with previous studies, documenting cognitive psychomotor performance decreases for periods of sustained wakefulness between 12 and 86 hours.

While the results in each of the individual experimental conditions have, in and of themselves been previously established equating the effects is relatively novel.

The results of this comparison indicate that the effects of 10-26 hours of SW from 1800-1000 hours, and moderate alcohol consumption have quantitatively similar effects on cognitive psychomotor performance. Although there are previous anecdotal reports indicating qualitative similarities between fatigue and alcohol intoxication, these studies establish the quantitative similarities of the two forms of impairment. In study one, equating the performance impairment between the 10th and 26th hour indicated a mean

BAC equivalent of approximately 0.08% after 18 hours and 0.096% after 24 hours. If the results of this study were generalised to an applied setting they suggest that between 0300h and 0800h on the first night shift a shiftworker would show a cognitive psychomotor performance decrement similar to or greater than the legally proscribed BAC for many industrialised countries.

The second study further expanded on these findings. The results of the comparisons indicate that sleep deprivation effects specific components of performance differently, dependent on their relative degree of complexity. That is to say, sustained wakefulness effects more complex cognitive psychomotor abilities before simpler abilities. In accordance with the Information Processing Model earlier referred to, the simplest measure of performance incorporated in this study, simple reaction time, required only perception and response execution functions. It was found that 24 hours of sleep deprivation were necessary to produce a performance decrement comparable to that associated with a BAC of 0.05%. Whereas for performance on the predictable tracking task, a slightly more complex task that also requires attention resource functions, a decrement equivalent to that of BAC of 0.09% was observed after 21 hours of sustained wakefulness.

Similarly, 21 hours of sleep deprivation produced a decrement in performance on the grammatical reasoning task equivalent to that associated with a BAC of 0.09%. It is interesting to note, however, that a decrement in the speed component of grammatical reasoning, equivalent to that associated with a BAC of 0.05%, was observed after only 13 hours of sustained wakefulness (graph not shown). While this may at first contradict the suggestion that more complex abilities are affected sooner by sustained deprivation, it must be remembered that subjects were told to concentrate on accuracy in this task, rather than speed. Indeed, the apparent speed-accuracy trade-off observed in the grammatical reasoning task is similar to that found in previous studies.

The data from both studies supports the idea that sustained wakefulness may carry a risk comparable with moderate alcohol intoxication since approximately 50% of shiftworkers on 8 hour shift patterns typically spend at least 24 hours awake on the first night shift in a roster (Knauth et al, 1981). Furthermore, the highest level of impairment observed in this study (~0.096% BAC) would occur at the end of a typical night shift (i.e. 0600-0900h) and would frequently coincide with the trip home for many shiftworkers.

While the results of this study clearly illustrate the comparative risks associated with sustained wakefulness for the first night shift, these results may underestimate the effect of night work in many real world settings. Previous research suggests that the

(Con't on Page 11)

(Con't from page 11, Sustained Wakefulness)

performance impairment associated with shiftwork may be even greater on subsequent night shifts because of the reduced recuperative value of poor daytime sleep (Akerstedt, 1995b). Several studies have reported that the performance decrements, reduced alertness and fatigue reported by night shift workers is greater on the second and third night shift (Tilley et al, 1981). If this is the case, then it may be reasonable to assume that the alcohol impairment equivalent on these nights may be even greater than reported here for the first night.

However, it is not a simple process of calculating the performance decrement for hours of wakefulness, since shiftworkers may be sleeping at different times of the day and night. In addition they may have accumulated sleep loss from night one to three of their work schedule. Therefore, it may be useful to use longer experimental protocols to model actual shift schedules and establish the BAC equivalence for the performance decrement associated with the fatigue that can accumulate over a sequence of night shifts.

Taken together, the results from this study support the idea that the performance impairment and, by inference, the risk associated with sustained wakefulness across the night are not insubstantial and are quantitatively similar to those observed for moderate alcohol intoxication in social drinkers.



FROM THE EDITOR!

Happy New Year and welcome to the first edition of GroundEffects for the year 2000, Issue Number 15! This issue is dedicated to a very well known subject - Fatigue! We have two very interesting and informative articles on this subject. First we have Fatigue - It's something that affects us throughout our lives

written by a well know human factors specialist - Gordon Dupont. The last of the Fatigue articles is one that comes to us from down under. Sustained Wakefulness and Alcohol Intoxication written by Drew Dawson, a Director of the University of South Australia's Center for Sleep Research. He is considered to be one of the world's leaders in fatigue research as an occupational health and safety issue. These articles make you stop and think about the effects of shift work and how we think when we are tired. Unfortunately in our industry, shift work is a fact and sleep deprivation is very common. It is important for everyone concerned to understand the effects of fatigue in the workplace and try to put more safety nets in place so to help avoid those terrible mistakes. Please take a few moments and read both of these articles and think about whether you have ever felt like this. Or maybe someone you know, works night shift and does not realize these amazing facts. Please pass on this information to anyone you know who might be able to use it. My fiance works shift work as a nurse and he has taken HPIM. He found it very informative and well put together. Although he may not be an AME, he still has been in situations where the Dirty Dozen were present and the need for safety nets were essential.

It is hard to believe that we are now starting a new millenium, a time for change and growth. If we stop and think back to the last century, we realize that in the very beginning of aviation, the pilot was also the AME. As technology started to progress, aviation divided into the pilots and the AME's. For years "the pilots" appeared to be the important people and the AME's were the lowly workers at the bottom. There was no human factors training for AME's, only for pilots. After the big Alhoha Airlines "Convertible" accident, management started to think more and more about the AME and Human Factors training became available for the AME. Still not everyone has taken HPIM and if you are one that has not taken this essential course, ASK FOR IT! Because being aware of potential problems, can and will save lives!



GroundEffects

GroundEffects™

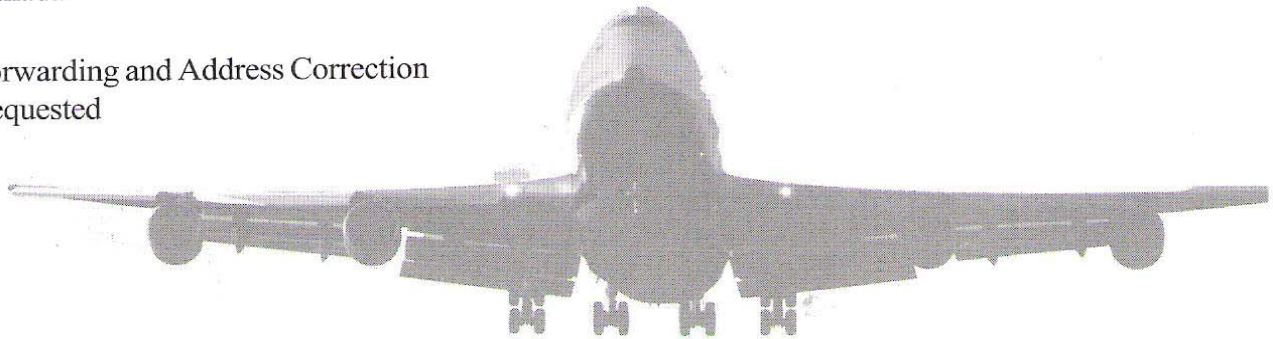
MARSS

5750 Cedarbridge Way

Richmond, B.C. V6X 2A7

Canada

Forwarding and Address Correction
Requested



**System
Safety
Services**

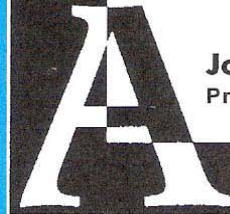
Gordon Dupont AME

Human Factors Safety Consultant
www.system-safety.com

23100 Willett Ave
Richmond, B.C. Canada
V6V 1G1

Phone/Fax: (604) 526-3993
Email: dupontg@home.com
Home Phone (604) 526-8367

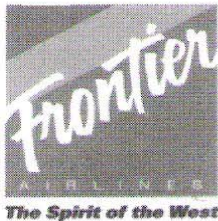
LATTA Aviation
Consultants Inc.



John Latta
President

Bus: 250-656-5433
Fax: 250-656-4801
email: john@lattaaviation.com
web: <http://www.lattaaviation.com>

9295 E. Saanich Road, Sidney, B.C., Canada V8L 1H6



Wayne Elliot
*Director, Aviation Safety &
Regulatory Compliance*

Frontier Airlines, Inc.
12015 E. 46th Ave., #200
Denver, CO 80239-3116
303/375-4609 or
303/371-7400 Ext. 1022
Fax 303/371-7007
welliott@flyfrontier.com
www.frontierairlines.com

BEACH GROVE BUSINESS SOLUTIONS
5088 58b STREET, DELTA, BC V4K 3J5

P. Dwight Hooper

Colleen Williams

Tel: (604) 940-9937 • Fax: (604) 940-9947

Bookkeeping Service
Web Page Design
Office Management
Computer Support

For only \$50.00 an issue, your company can advertise with us! GroundEffects™ is distributed to hundreds of aviation companies world wide.