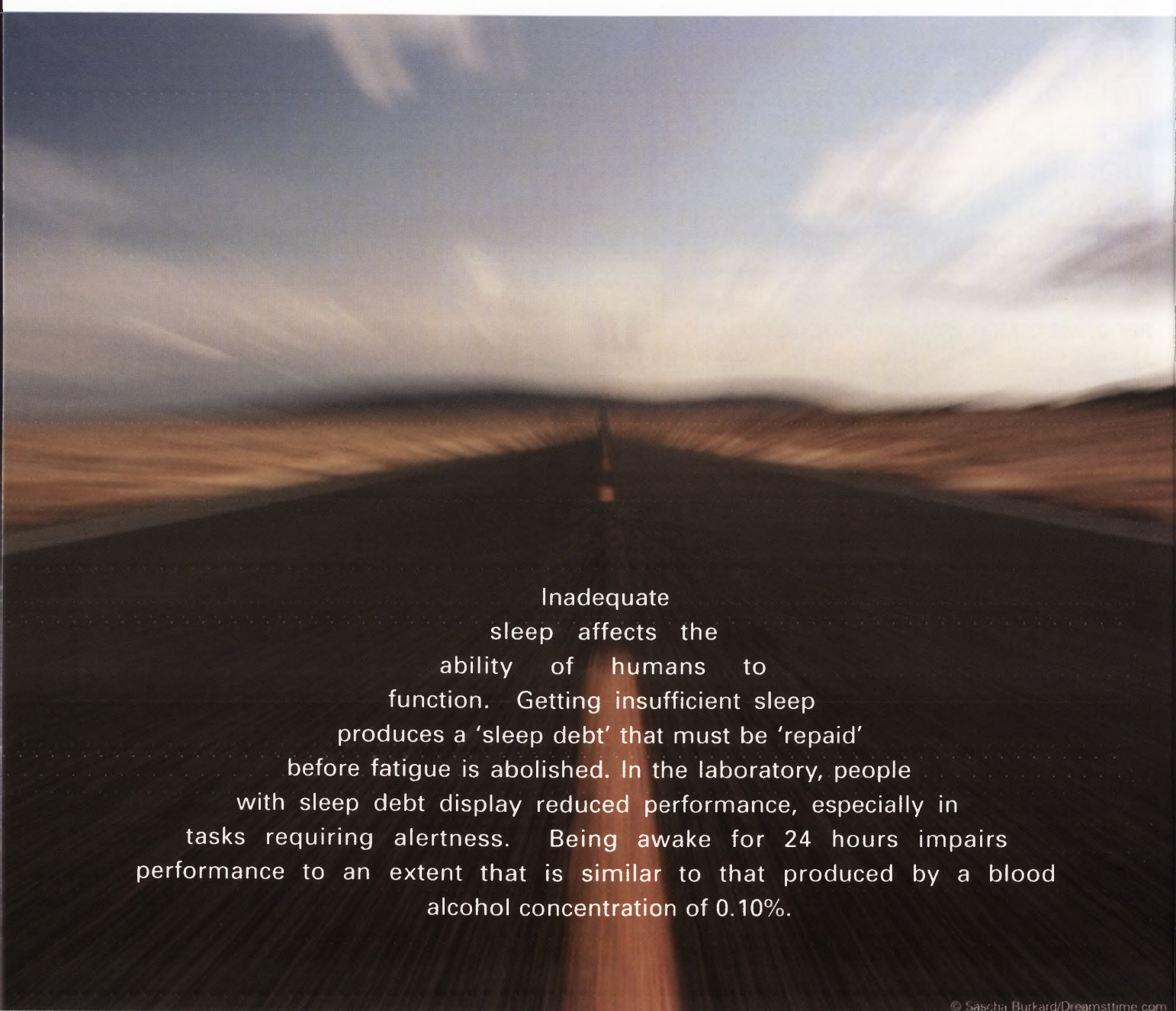


FATIGUE

– A NEW AREA OF LITIGATION?

By Edward Ogden



Inadequate sleep affects the ability of humans to function. Getting insufficient sleep produces a 'sleep debt' that must be 'repaid' before fatigue is abolished. In the laboratory, people with sleep debt display reduced performance, especially in tasks requiring alertness. Being awake for 24 hours impairs performance to an extent that is similar to that produced by a blood alcohol concentration of 0.10%.

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Amphetamines can be used to overcome physical exhaustion or fatigue, maintain alertness, and increase energy. Small doses have the capacity to improve some aspects of human performance in people who are fatigued or sleep-deprived. Any potential advantage, however, is overshadowed by the increased risk. Using 'responsibility analysis', truck drivers who have stimulants detected in their blood after fatal collisions are 8.8 times more likely to be 'responsible' for the collision as drug-free drivers.

Several jurisdictions are now paying attention to fatigue as a factor in occupational and driving safety.

NORMAL SLEEP

Sleep is an essential biological phenomenon common to all mammals and birds. Its function is not fully understood, but it is essential to health and wellbeing. Normal sleep is accompanied by disengagement from

the environment, lying down, closing the eyes and becoming unresponsive. It comprises two clearly separate states – one in which the eyes move rapidly (REM sleep) and one in which the eyes move slowly or remain still. REM sleep involves increased brain activity associated with dreaming, and relative inactivity of the body. By contrast, non-REM sleep is associated with relative inactivity of the brain and involuntary movements of the body.

REM and non-REM sleep alternate during the night in cycles of about 90 minutes, starting with non-REM sleep. REM sleep normally predominates in the last third of the night, and comprises about 20% to 25% of the total sleep time.

SLEEP DEPRIVATION

Insufficient sleep affects our ability to function. Common symptoms are red eyes, drooping eyelids, yawning and a tendency to fall asleep when bored or under-stimulated.

The drive to sleep is as basic as the

drive to breathe. One can put off the need for adequate sleep just as one can hold one's breath for a time, deliberately overriding the drive to sleep for a limited time. Eventually the drive to breathe becomes overwhelming, and even the fittest and most strong-willed people must breathe; so, too, with the physiological imperative to sleep.

A tired person who is 'fighting to stay awake' may have 'micro-sleeps' during which they fall asleep for fractions of a second with complete loss of attention. As time goes on, the 'micro-sleeps' get longer and more disruptive. Eventually the person must fall into deep sleep. The most obvious effect of sleep deprivation is the subjective feeling of sleepiness, accompanied by objective degradation in performance.

Typically human beings have a 'core sleep requirement' of 7 to 9 hours per 24 hours. Failure to achieve necessary sleep levels produces sleep deprivation and incurs a 'sleep debt'. The sleep required to make up for sleep >>

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deprivation may be less than the total time of sleep lost, but the 'debt' must be 'repaid' before fatigue is abolished. The only treatment that makes any real difference is sufficient amounts of normal sleep. Younger people recover from sleep debt more rapidly than middle-aged and older people.

In the laboratory, people with sleep debt fall asleep and display reduced performance, especially on tasks requiring alertness. They display difficulty with memory, learning, logical reasoning, pattern recognition and decision-making.

FATIGUE AND HUMAN PERFORMANCE

Fatigue is difficult to define. It is most commonly seen as the result of deprivation of adequate sleep and rest. In this sense it is a psychological phenomenon like memory, which has no physical existence, but can be shown to have measurable effects. There is no universal agreed definition of 'fatigue' and no reliable means of determining whether (or the extent to which) fatigue is present or causes impairment.

Fatigue can be subjective ('I feel tired'), objective (poor performance noted), or physiological (measurable changes in body dynamics or chemistry). No good physiological measures equate with mental fatigue or predict degradation of performance. Nonetheless, fatigue is believed to make a primary contribution to between 4% and 30% of vehicle crashes.¹

The brain (and central nervous system) is delicately balanced between factors causing arousal and factors causing sedation and sleep. An optimal level of arousal can be found that produces the best performance. A person who is over-stimulated will experience anxiety and hyperactivity. A person who is under-aroused will be inefficient and sleepy.

During the day, the 'biological clock' opposes the sleep drive, especially in the hours of normal wakefulness. This drive to wakefulness is usually absent in the early hours of the morning and lessened in the early afternoon.

Fatigue can be accentuated by the depletion of mental reserves caused by

over-stimulation (driving for hours in city traffic) or by the boredom from under-stimulation (long hours on country highways). Long-distance driving is a paradoxical task: high levels of alertness, concentration and readiness to execute skilled responses are all required during long periods of monotony with little actual activity. There is abundant evidence that sleep deprivation, and the consequent sleepiness, causes impairment in psychomotor performance: 18 hours of wakefulness can be equivalent to having a blood alcohol level of 0.05%; 24 hours of wakefulness produces impairment similar to a blood alcohol concentration of 0.10%.²

In assessing driver fatigue, the critical variable is not hours spent driving, but hours on duty. Regulations limiting driving to 12 hours per day, or 72 hours per week, are attempts to recognise the impairment that follows excessive hours. International experience shows that drivers who violate logbook regulations are significantly over-represented in truck crashes.

Rest periods improve short-term performance and are recommended in circumstances such as those experienced by long-haul airline crews. However, although naps reduce the sensation of fatigue and improve performance, they will not reduce sleep debt.

IMPLICATIONS FOR WORKPLACE SAFETY

In terms of workplace safety, 'fatigue' is defined as impaired performance on an important task as shown by:

- lack of attentiveness, slower reaction times, impaired judgement, poor performance on skilled tasks; and
- increased probability of falling asleep associated with feelings of drowsiness or tiredness; brought on by long periods awake with inadequate amount or quality of sleep over an extended period.

Fatigue is the most common cause of fatal-to-driver truck crashes. Fatigued drivers display a loss of accuracy in steering and pay less attention to correcting their lane position, similar to those errors seen with moderate doses

of alcohol. A fatigued driver will tolerate more errors of lane position and speed than when rested. Whether the effective vehicle speed increases or decreases will depend on whether sensitivity to speed or steering error is lost first.

If a person can muster all their resources and receive enough stimulation, they can mask the effects of fatigue for a short time. Noise and other stimulation may help to drive the nervous system in the direction of wakefulness, just as silence and lack of stimulation will promote sleep.

Fatigued subjects may fail to respond to stimuli for increasingly long periods. This may be due either to 'micro-sleeps' or increased difficulty in processing information. Sleep can intervene in less than a second, producing a state akin to unconsciousness. Sleepy people are often not aware that they are sleepy and attribute their feelings to boredom, a meal or a warm room (or vehicle). Small doses of sedative drugs (including alcohol) can exacerbate this situation and produce exaggerated impairment out of proportion to the level of sedative consumed.

THE STIMULANTS

One strategy, employed in industries where fatigue is an issue, is to use stimulant drugs to reduce the sense of fatigue and produce a feeling of exaggerated wellbeing. Freud experimented with cocaine in the late 1880s, believing he had found a pharmacological panacea for many of life's ills.³ The stimulant of choice in Australia has been amphetamine, and related compounds.⁴ These drugs have so many similarities that much of the literature refers to them collectively as 'amphetamine-type-stimulants' or simply 'ATS'.

Amphetamines are a group of stimulants derived from the naturally occurring alkaloid 'ephedrine' from plants in the genus *Ephedra*. As a herbal extract, ephedrine has been used in Chinese medicine for millennia. For instance, Ma huang (*Ephedra sinica*) is a shrub native to the semi-arid areas of China. Ancient physicians prescribed ephedra tea and pills for the common cold, coughs, asthma, headaches, and

Several jurisdictions are now paying attention to fatigue as a factor in occupational and driving safety.

hay fever.⁵ Modern pharmacies offer numerous cold remedies containing the derivative compound pseudoephedrine.

Amphetamines have been used to overcome physical exhaustion or fatigue, maintain alertness, or increase energy. Small doses of the stimulant amphetamines have the capacity to improve some aspects of human performance, especially in people who are fatigued or sleep-deprived,⁶ and the combination of ephedrine and caffeine increases strength and endurance in elite athletes.⁷ The armed forces, long-distance truck drivers, students and athletes have exploited this effect.

Amphetamines are the most commonly used illicit drugs after cannabis, with around 9% of the Australian population reporting that they have used them. They are particularly common among young male adults (20 to 29 years). Most users report experimenting with stimulants in their teens by taking tablets or 'snorting'.⁸

Despite their wide usage, stimulants are not benign substances. These drugs stimulate the body, mimicking aspects of basic reflexes.

Animals that are suddenly frightened release a number of hormones that increase arousal for immediate short-term survival. This so-called 'flight or fight' response includes increased heart rate, increased muscle activity and mental alertness in preparation for a do-or-die situation. In correct doses, the use of stimulants can elicit a similar 'flight or fight' reflex.

If the dose is carefully matched to the immediate need, the stimulation that follows this sort of arousal is potentially beneficial for sporting activity and mental challenges. However, while small doses may increase competitiveness, larger doses increase aggression and defensiveness.⁹ In addition, the stimulated brain runs faster, not better, creating the potential to make more mistakes in a shorter time.

Habitual users require increasing amounts of the drug to achieve the desired effect. Increasing the dose in turn means increasing side-effects. Physical side-effects mimic the effects of adrenaline – dry mouth, tremor, sweating and palpitations. Psychological side effects include anxiety irritability, moodiness, and restlessness. Extreme sensitivity to irritation can lead to aggressive irrational behaviour, anxiety and suspicion.

In sufficiently high doses, all amphetamines can be lethal, but some members of the group are particularly toxic at lower doses.¹⁰ When toxic amphetamines are present as contaminants of illicit drug manufacture, they increase the risk of sudden death due to hyperthermia (raised body temperature), cardiac failure or stroke.

Moreover, the physiology of 'flight or fight' is only part of the story. The stimulants also have complex effects on the systems in the brain that deal with pleasure and reward.

Messages are passed along nerves as electrical impulses, but nerves communicate with each other by releasing small amounts of local hormones, which convey the message across the tiny gaps between nerves. These chemicals are collectively known as 'neurotransmitters'. Amphetamines and cocaine both increase concentrations of several neurotransmitters in the part of the brain that makes us feel good. It is this instant chemical 'reward' that leads to the addiction potential (other addictive drugs, including narcotics and alcohol, also stimulate the reward pathway). It is likely that some individuals are more susceptible to addiction than others. >>

Stimulants and human performance

There is a considerable body of knowledge about the effects of amphetamines and cocaine on thinking and behaviour, but the results are not easy to interpret. Some studies report improvement in performance following dexamphetamine administration,^{11,12} while other studies report impairment.^{13,14} There seems to be a dose relationship, because low doses are more likely to improve speed performance, while higher doses cause impairment. No dose of MDMA improves any physical performance.

There are other paradoxes too. Several amphetamines effectively treat attention deficit hyperactivity disorder (ADHD). Appropriate doses reduce the symptoms of impulsivity, restlessness and inattention. On the other hand, recreational use in normal people has the opposite effect – it increases impulsive behaviour and risk-taking.¹⁵⁻¹⁷

Epidemiological research into the effects of amphetamines on driving performance has generally involved the analysis of specimens from drivers who have been arrested for traffic violations or killed in road crashes. The data generally combines all subtypes of amphetamines as one class, ignoring subtle differences between the related substances. Driving behaviours that have been observed in drivers under the influence of methamphetamine include drifting out of the lane, erratic driving, weaving, speeding, drifting off the road, an increase in risk-taking, and high-speed collisions.¹⁶

Australian data on deceased drivers has shown that stimulants are the most likely drugs after alcohol to be associated with culpability for fatal collisions. Stimulants were detected in 4.1% of all drivers and 23% of deceased truckers. The odds of any driver using this drug being culpable for the collision in which they died were 2.3 times those of a drug- and alcohol-free driver, while the relative odds were 8.8 times for truckers on stimulants.¹⁸

LEGISLATIVE RESPONSE

All jurisdictions specify safe driving hours for truck drivers, but some jurisdictions are taking the risk-management task to the next level by requiring employers and supervisors to plan for fatigue management. For example, NSW regulations to reduce the danger of fatigue among long-haul truck drivers, which will come into effect on 1 March 2006, impose a duty on employers to assess and manage the risk of driver fatigue and either eliminate the risk, or take reasonable steps to control it by having a Fatigue Management Plan.¹⁹

The National Road Transport Commission (NRTC) was established in 1991 to develop uniformity across Australian jurisdictions. The National Transport Commission (NTC) replaced the NRTC under the *National Transport Commission Act 2003*. The Commission's role is to undertake research and consultation, and prepare proposals for model legislation for the approval of federal, state and territory

transport ministers who together form the Australian Transport Council (ATC). The Commission is currently working on reforms that include management of fatigue in the heavy transport and rail industries.²⁰

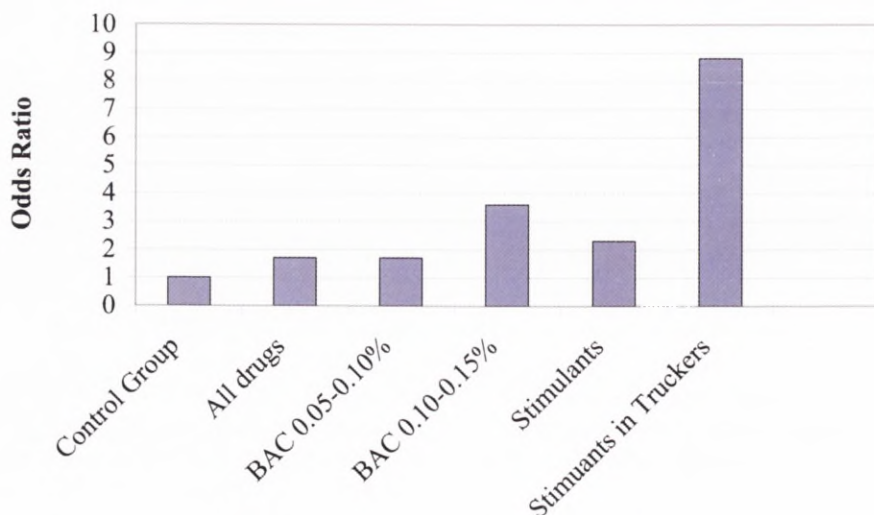
The industrial safety bodies in each state are also looking at fatigue and safety issues in a range of other industries where alertness is a crucial factor. WorkSafe in Western Australia is seen as a lead agency, having produced a wealth of literature and policy in relation to fatigue in commercial vehicle drivers that is readily transferable to other industries.²¹

SUMMARY

We all know that sleep deprivation affects the ability of humans to function and that people with sleep debt display reduced performance, especially on tasks requiring alertness. Many are surprised that 24 hours of wakefulness produces impairment of performance similar to a blood alcohol concentration of 0.10%. As a consequence, most jurisdictions are paying attention to fatigue as a major preventable factor in occupational and driving safety.

Stories of the use of amphetamines to overcome physical exhaustion or fatigue, maintain alertness, and increase energy are legion. Although small doses have the capacity to improve some aspects of human performance, any advantage that can be obtained is overshadowed by the increased risk.

Litigation practitioners will be increasingly confronted with these issues as jurisdictions struggle to enforce good practice, both on the roads and in the workplace. ■



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Dr Edward Ogden PSM is a medical practitioner in clinical practice and senior partner in Forensic Medical Consultants. He is Adjunct Research Fellow at the Centre for Drugs and Driving at Swinburne University of Technology, and Senior Medical Officer in the Operations Coordination Department, Victoria Police.
PHONE (03) 9855 9699 **EMAIL** edward@forensicmedicalconsultants.com

CASE STUDY

Inspector Campbell v James Gordon Hitchcock
 NSWIRComm 87 (21 October 2004)

In 2004, the NSW Industrial Relations Commission held the director of a trucking company (James Hitchcock) personally liable for a collision that resulted in one of his drivers being killed. On 1 September 1999, a semi-trailer being driven by a Mr Haynes swerved into the path of another semi-trailer being driven by a Mr Walker. Mr Haynes was killed when the cabin of his truck ignited following the crash. Mr Walker escaped without injury.

Mr Hitchcock was charged with breaches of the *Occupational Health and Safety Act 2001* (NSW). WorkCover alleged that Hitchcock was guilty of various breaches that combined to create the risk to safety that Mr Haynes would 'fall asleep while driving a heavy vehicle at speed on the highway'.

Walton J found that:

- (a) *Long hours of working, especially at night, lead to fatigue;*
- (b) *Six hours of sleep during the core period of midnight to 6.00am (or an equivalent restorative period of sleep during day time, which may take longer due to the deficiencies of day-time sleep) is the bare minimum to manage fatigue appropriately;*
- (c) *The high levels of attention required for driving will also contribute to fatigue;*

- (d) *Chronic fatigue can develop over a series of long work days in the absence of adequate rest;*
- (e) *Sleep is the only way to effectively alleviate fatigue;*
- (f) *The most beneficial, restorative sleep is taken between midnight and 6:00 am. Longer periods of day-time sleep are necessary to reduce a build-up of fatigue;*
- (g) *Driving when fatigued is extremely dangerous because the skills necessary for driving – paying attention moment by moment – are significantly impaired by fatigue;*
- (h) *The nature of fatigue makes this situation even more dangerous: the more tired a driver becomes, the less able they are to respond safely to that fatigue by electing to take appropriate rest-breaks, or to stop; and*
- (i) *Fatigued drivers have a higher risk of crashing.'*

The defence argued that it was necessary for the WorkCover Authority to establish beyond a reasonable doubt that Mr Haynes was actually fatigued at the time of the accident, not merely tired. In convicting Mr Hitchcock, the Commission found that Mr Haynes was in fact fatigued because he was only able to have two breaks of 3 hours and 44 minutes and 3 hours and 5 minutes in the 4 days preceding the collision.

Mr Hitchcock has sought leave to appeal the conviction.