SORIC E168

The Effect of Sleep Deprivation and an Unprescribed Influenza Medication on Driving Performance

Woodside A.R, Gunay B, Wilson I
Transport and Road Assessment Centre (TRAC)

University of Ulster - Newtownabbey
BT37 0QB, Northern Ireland, UK
Phone: +44 (0) 28 9036 6376
Fax: +44 (0) 28 9036 8707
E-mail: ic.wilson@ulster.ac.uk

According to leading doctors and researchers the average human being requires at least eight hours sleep to provide for sixteen hours of sustained wakefulness. This project found that if people are deprived of much needed sleep at night they will become sleepy throughout the day and are more likely to fall asleep at inappropriate times.
This paper presents the results of an interview-style questionnaire of 302 drivers, aimed at investigating a connection between the likelihood of being involved in a sleep-related accident and the nature of drivers. The objective of the survey was to obtain basic information on the general nature of individual drivers and associate these with their likely driving performance by using the pilot group as a sample basis.
The pilot study found that driving standards for most of the sample group whilst under the influence of 'Night Nurse' influenza medication deteriorated marginally compared to that of the 'normal' driving conditions test. Whereas the effect of 24-28 hours lack of sleep deteriorated the driving standard visibly more.
Drivers who possess dozy related qualities obtained poor results in the driving tests, this effected about 28% of the sample study. The initial investigation highlights the deterioration in driving performance as a result of the conditions 2 and 3 above. Driver fatigue may be a contributing factor to one in five road traffic accidents and this is a potentially dangerous problem for road safety. The interview-style questionnaire noted that people, who tend to be dozy per se, were more inclined to have poorer results in the driving tests. Those who took a tendency toward alert behaviour normally, showed better test results all-round. This research is beneficial as it proves that there is a definite link between drowsiness and driver performance.

Keywords: accidents; driver behaviour: driving performance; sleep deprivation; sleepiness

1. INTRODUCTION

Road traffic injury accidents are a daily occurrence and are responsible for a vast number of deaths and serious injury in each society. The Global Burden of Disease study estimated traffic injury to be the ninth leading cause of death and disability in the world in1990, and it projected that it would be the third leading cause by 2020 [1]. Many causes and contributing factors of road traffic injury accidents have been identified, such as drink, drugs, use of mobile phones, speed and the list goes on. However, major reviews and in depth research have suggested that *fatigue* or

sleepiness in drivers of cars or other road vehicles dramatically increases accident risk.

As research has proved fatigue related crashes have many of the characteristics of drink related accidents (inability to brake or swerve until it is too late). Despite their similarities, fatigue has not been considered with equal concern. It must be said however, that fatigue is considerably more difficult to identify or measure; there is no device available to police officers that detects fatigue of a driver.

Driver fatigue has particularly injurious consequences because of its ability to impair drivers from making critical, sound, spilt-second and in many cases life-saving decisions, such as swerving or braking.

It is true that a majority of drivers would never contemplate driving under the influence of alcohol, however driving when drowsy seems to be no big deal. It is actually accepted as a part of life as Northern Ireland and indeed the UK move towards a 24-hour society. Many of the populace place major consideration and time on jobs and family and sleep is not considered a priority.

Fatigue is much more than just lack of sleep – it originates from other less apparent but very real experiences of daily life. In relation to driving and within the road transport industry it is causing major problems and discontent among many companies and drivers. In addition to, the failure of delivering a service or making a meeting on time, the controversial issue of the loss of human life as a result of a sleep related road traffic accident cannot be eluded.

2. BACKGROUND INFORMATION

2.1 What Is Sleep?

'It is a basic necessity of life, as fundamental to our health and well being as air, food and water. When we sleep well, we wake up feeling refreshed, alert and ready to face the day. When we don't, every aspect of our lives can suffer' [2].

Sleep is a necessity for all, the less sleep acquired the more dozy or less alert we become and laborious daily duties become. The nature and attitude of the individual who lacks sleep is one distinguish by 'dozy', slow mannerisms and not giving 100%. A daily requirement for many people and in particular drivers is SLEEP!

2.2 Sleep Deprivation

What happens to us when we deprive ourselves of much needed sleep? The answer is very clear – we do not perform as we normally would, our condition deteriorates and we do not give 100% to any element of life/work. We are less alert and attentive, more irritable and prone to mood changes that can make our relationships with family, friends and co-workers difficult. Our concentration declines and judgment suffers, our ability to perform even simple tasks is made more difficult, and productivity is sabotaged.

Sleeplessness, whether it is the result of a sleep disorder or an overextended lifestyle, invites diminished quality of life and deteriorating health. Moreover it could lead to a serious accident if we choose to drive whilst sleep deprived. When we lack sleep, we put those around us and ourselves at risk, a risk that is potentially high and somewhat unnecessary. The risk could be reduced if the person who is deprived of sleep decides not to drive. Major catastrophes such as those that have occurred in Northern Ireland and indeed in the UK have been attributed to human error that occurred during times when drivers feel sleepiest. If we ignore our sleep needs and get behind the wheel of a car, lives may be at stake. It only takes a few seconds, just long enough for a tired body to steal a much needed "micro sleep"- to run off the road or into an oncoming car.

2.3 Sleep Disorders

One crucial explanation why people are fatigued is due to the multitude of sleep disorders that are both prevalent and non-diagnosed among a number of the population. Sleep disorders are illnesses and although somewhat rare, some conditions are highly prevalent such as Sleep Apnea, Restless Legs Syndrome and Chronic Insomnia. Although the above sleeping disorder examples are recorded as clinical illnesses and does not fully extend to the whole Northern Ireland population, many people will relate to having had

difficulty sleeping at one time or another. The British Sleep Foundation [2] state that at least two percent of the UK population has a medical reason for sleepiness and up to 10% suffer insomnia at some point each year.

Sleep disorders are becoming more and more common, however many still remain undetected and untreated. As Northern Ireland and many other countries move toward a 24-hour operational society priorities change and sleep is positioned bottom of many people's list.

2.4. Influenza Medication And The Drowsy Factor

Non-prescription, or over-the-counter (OTC) sleep and cold aids use antihistamines to induce drowsiness. Medications such as Night Nurse have properties that aid pain, and work as a decongestant. However, these medications also have side effects which can be detrimental e.g. drowsiness. Many of the non-prescription or OTC medications will stipulate on the label if they contain any drugs that cause drowsiness. The medication will also instruct users if the content effects driving or operation of machinery. These warnings must be adhered to and received with seriousness.

2.5. Causes Of Fatigue

Fatigue accrues as a result of a range of activities or indeed a lack of them. Many of the causes of fatigue are more serious than others and some are more easily identified than others such as, lack of sleep. Although it must be noted that all cases regardless of cause must be treated with utmost concern and dealt with immediately.

It is more than the obvious that contribute to fatigue:

- Long roads,
- Less than average 8 hours sleep,
- High in-car or external temperatures,
- Repetitive nature of terrain exacerbate the causation of fatigue and lead to incidents where the driver can no longer control the over powering influence of sleep,
- Nature and monotony of roads – drivers find it very difficult to keep continued observation and can switch to 'autopilot'
- Familiar roads and journeys
- New mothers, getting less sleep as baby has a different and sporadic sleep pattern and mother is expected to partake in 24-hour supervision of baby,
- Occupationally induced fatigue – result from long hours of work or a heavy, pressurised work load, and
- Work related stress caused by deadlines, limited resources, stretched time, long, often boring meetings, extended working hours, expected overtime, and ever increasing demands disseminate pressure on the individual to work and perform harder.

2.6. Signs Of Fatigue

It is imperative to know that the need to sleep does not occur in an instance but gradually and the individual will experience this over a period of time. Tiredness will show in different ways and is identifiable via signs such as, the need to open the window, turn down the music and even stealing much needed micro sleep.

Signs of fatigue should be evident to the driver before they become apparent to anyone else (i.e. passenger or other drivers).

- Back tension,
- Burning eyes,
- Deep/shallow breathing,
- Inattentiveness, and
- Erratic driving: drifting lanes, abnormal speed, tailgating, or disobeying traffic signs/lights).

2.7. Who Is Most at Risk?

Well the list is long and to some extent endless and no one automatically escapes or is excluded from the effects of fatigue. Everyone can suffer the ill effects of fatigue for many different reasons.

All drivers who are:

- Sleep-deprived or fatigued,
- Driving long distances without rest breaks,
- Driving at high risk time e.g. through the night, early morning and mid afternoon,
- People who work night shifts, long hours or more than one job,
- Taking medication that increases sleepiness,
- Driving alone,

- Driving on long, monotonous stretches of road or even on familiar journeys, and
- Frequent travellers, e.g., business travellers, sales reps.

3. BACKGROUND TO STUDY

This paper presents the findings of face-to-face interviews that initiated to investigate driver performance as a result of sleep deprivation. This investigation follows on from a previous research pilot study.

Evidently there is a problem relating poor sleep habits to below average driver performance. The fact remains that NI is a small dwelling about 5,500 square miles in area (about the size of Yorkshire) with approximately 1,688,600 inhabitants, of which on average 150 people each year are killed as a result of a road traffic accident. Fatigue is an up and coming problem as NI moves ever closer to becoming a 24-hour society. Sleep for many is becoming less of a priority and hectic work schedules and over active social lives are taking over. Not only is individual health deteriorating but for the population who drive this is becoming a death weapon on our roads. Road Safety is stressed constantly and at the highest level, fatigue is a new phenomenon and is one that is not going away as it grows steadily affecting everyone.

The study conveyed in this paper is concerned with one symptom of fatigue, that is sleepiness, and more importantly how it affects driver performance and the chances of a sleep-related accident occurring.

Driving is a skilled task, which is to a large extent self-paced. However, it is a task, which requires sustained vigilance if accidents are to be avoided [3].

The objective of the overall study is to obtain information about the relationship between sleepiness and the chance of being involved in a road traffic accident and to pinpoint the extent to which these associations depend on the individuals nature. The intention of the extended questionnaire was to highlight drivers who tend to be of a 'dozy' or 'average' nature are more inclined to show poorer results in the driving performance tests than those of an 'alert' nature.

3.1. What Is Already Known On This Topic?

- Statistics show that NI have not escaped without the ill effect of sleep related accidents, over a five-year period (1996-2000), NI has fallen victim to a total of 163 accidents where the principal factor was driver fatigue. Of these 163 accidents, 13 were fatal, 54 serious injuries and 96 slight injuries.
- Driving while sleep deprived is clearly a risk factor to the majority of the populace particularly those who take the risk to driving whilst feeling sleepy / fatigued.
- Studies have indicated that it is as potentially dangerous as drink driving as the same inability to swerve or brake until it is too late is a common denominator.
- There are an estimated high proportion of car crashes that are attributable to the driver and that a high percentage if these accidents involve single vehicles (hitting a tree, drifting lanes or plunging off the road).
- Persons whom are prone to sleep-related accidents are shift workers and people who work long hours or people with a sleep disorder.
- RAC motoring foundation release findings from a poll which showed 'more than 60% of drivers questioned said they had driven while sleepy. Of these 8%, said they had nodded off momentarily at the wheel'.

3.2. What Does This Study Add?

This study endeavours to relate the possibility of being involved in a sleep-related accident to an individual's behaviour, namely their nature. It also highlights that it is not only the obvious (shift workers etc) that could be involved in sleep-related incidents but it extends to a much larger section of the driving population.

4. HISTORY OF SLEEP-RELATED ACCIDENTS IN NORTHERN IRELAND

Sleep deprivation is a major contributing factor to many road traffic accidents in NI. During the period 1999/00 fatigue related incidents accounted for 34 accidents of which the primary factor primarily attributed to the driver was sleep deprivation. Of these 34 accidents resulted in 3 fatalities, 17 seriously injured, 34 slightly injured and a total of 54 casualties. These figures were an improvement on the same period for the previous year. 1998/99 experienced a total of 40 accidents, resulting in 5 deaths, 17 seriously injured, 47 slightly injured totaling 69 casualties. In Northern Ireland over a five-year period (1996-2000) a total of 163 accidents occurred where the principal factor was driver fatigue. Of these 163 accidents, 13 were fatal, 54 serious injuries and 96 slight injuries and it must be added all were unnecessary.

It has been clearly stated throughout this investigation that driving while deprived of much needed sleep can significantly distort driving ability. This deterioration of driver performance has lead to many accidents and will continue to be a nuisance for road safety.

5. STUDY OBJECTIVES

The initial pilot study tested seven healthy adult drivers (3 female and 4 male) to ascertain any changes in reaction times and driving performance during the following three conditions:

1) 'Normal' conditions (normal day-to-day activity and a normal night's sleep),
2) One hour after consuming an over-the-counter influenza medication 'Night Nurse', and
3) After at least 24-28 hours lack of sleep

The initial pilot study also required the subjects to complete a 3-day sleep diary. Simply this task was to detail their sleep pattern over a 3 nightly period. What time they went to bed, how long did they sleep, did they wake throughout the night, and how refreshed did they feel when they awoke – were just some of the questions included in the sleep diary. The pilot group also participated in the interview-style questionnaire.

5.1. Interview Style Questionnaires To Detect Drowsy Driver Before Performance Testing

The driving skills of the preliminary study group were tested; therefore it proved beneficial to question their sleep IQ and the priority that sleep was allocated in their lives. The questionnaires were instigated to detect the drowsy driver before performance testing occurred. This technique was thought to be hugely beneficial in an industry setting whereby a potential employee (for a driving job) could be questioned in the interview stages, determining his/her level of daytime sleepiness therefore by way of this questionnaire – detecting his/her nature and likelihood of being involved in a sleep-related incident. This was assessed on the indication taken from the primary studies that those with a poor driving performance showed signs of a dozy or average nature in the questionnaire.

6. METHOD OF ANALYSIS

6.1. Subjects

It would be sensible at this stage to point out that there will be reference to two groups. Firstly, the pilot group are those who participated in the performance tests and questionnaires and secondly the overall group of 302 drivers who took part in the questionnaire phase only. Approximately 400 drivers were asked to partake in the interview style questionnaire, of which 302 agreed to be interviewed. The 302 drivers were identified from the sex bands (figure I), age range (figure II) and profession bands (figure III).

During the original pilot study driving tests were completed and results obtained, these same drivers then completed a 3-night sleep diary and a detailed questionnaire (which analysed their sleep IQ, Epworth sleepiness score and general questions about themselves). From this a relationship between performance and daytime sleepiness was established.

Tests show that for each of the sample group signs of poorer driving aptitude were experienced as the tests were conducted respectively:

1) Normal,
2) Under influence of 'Night Nurse' influenza medication, and
3) With 24-28 hours lack of sleep.

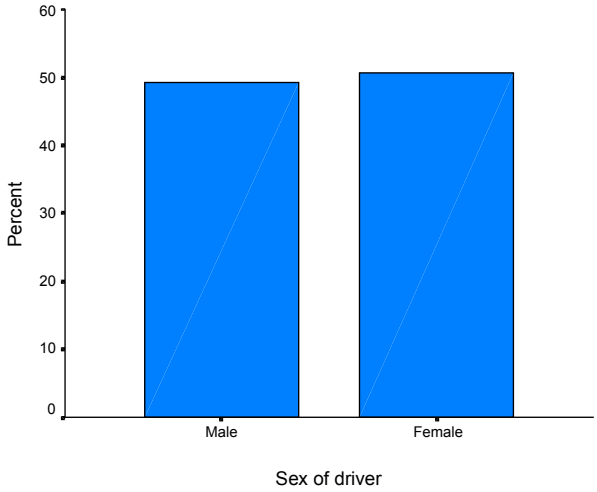

Figure I Sex of Drivers

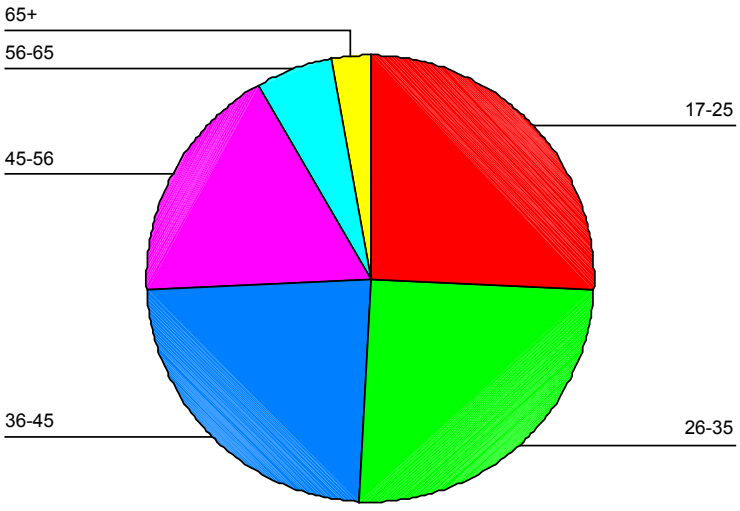

Figure II Age Range of Drivers



Figure III Profession Band of Drivers

6.2. Design

The desired target group was redefined to obtain a practical group to be surveyed. It was impossible to move forward with a target group of 'drivers' the vast amount of them even in Northern Ireland was excessive. Therefore the following definition was formed for the targeted population:

1) *All drivers above 17 years of age,*
2) *Who hold a full current UK drivers licence,*
3) *In Northern Ireland, and*
4) *During 2002*

6.3. The Questionnaire

The questionnaire that was used in the study consisted of four component parts. Each part was analysed independently and then cross tabulated with each other. Section 1 was simply an 'about you' section and it requested information about the driver, namely sex, age range, profession and driving history etc. This section also took the chance to ask drivers about accidents in the past five years and average nightly sleep. These replies were essential to build a better picture of individual habits and induced fatigue.

Section 2, consisted of the Epworth Sleepiness scale [4], which gives a simple measure of excessive daytime sleepiness. It is brief, user friendly and simply asks the interviewee to rate their chances (on a scale of 0-3) of dozing or falling asleep in eight different situations.

The chances are as follows:

0 = Would never doze
1 = Slight chance of dozing
2 = Moderate chance of dozing
3 = High chance of dozing

The situations in question are:

Sitting & Reading
Watching TV
Sitting inactive in a public area (i.e. theatre)
As a passenger for an hour without a break
Lying down to rest in the afternoon
Sitting and talking to someone
Sitting quietly after lunch without alcohol
In a car, while stopping for a few minutes of traffic

Each subject can have a total score between 0 and 24; depending on how likely they would be to doze under the above circumstances. A score of 10 or greater is said to be a definite cause for concern as it indicates significant excessive daytime sleepiness. A score below 10 is not a concern for excessive daytime sleepiness.

Figure IV shows the results of the Epworth sleepiness scale and details how many drivers scored ten or over, indicating that they are experiencing excessive daytime sleepiness. This daytime sleepiness applies to 21% of the group.

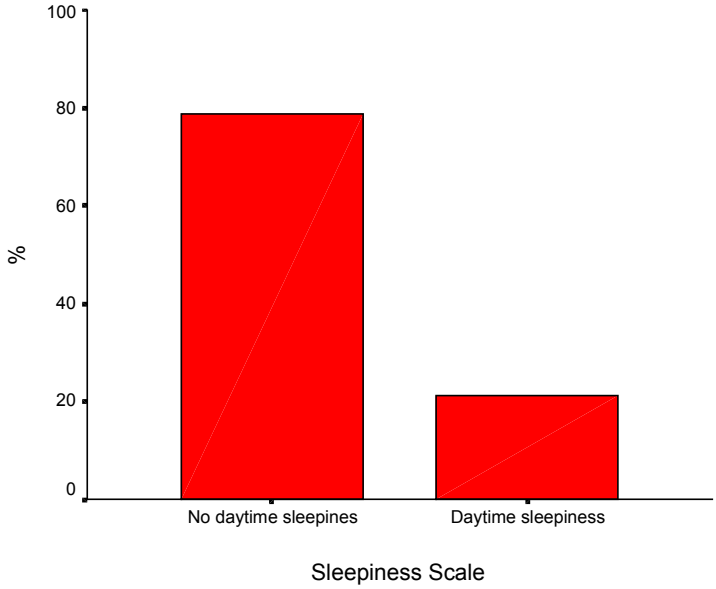

Figure IV Concern for Excessive Daytime Sleepiness

Section 3 examined the individual's sleep IQ, questioning them about sleep and factors associated to it. This was simply a true/false task with drivers being scored on their results as poor, average or good. Figure V illustrates that 8% of drivers had a poor sleep IQ with 30% scoring a good sleep IQ.

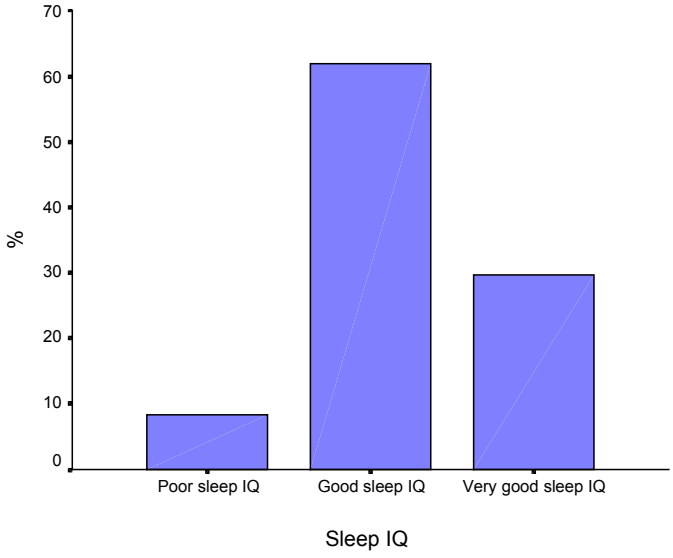

Figure V Sleep IQ of Drivers

Section 4, again another true/false task, dealt with statements regarding the individual's rest needs and excessive or necessity to sleep. Questions such as, do you have trouble concentrating, do you need an alarm clock to wake you up, do you feel drowsy when driving, were asked. A scale was determined as a result of the number of true/false answers that were received. This concluded whether the drive was of a dozy, average or alert nature. Figure VI demonstrates that although one third of the drivers were classed as alert, an overwhelming 59% just scored average and 7% were deemed dozy.

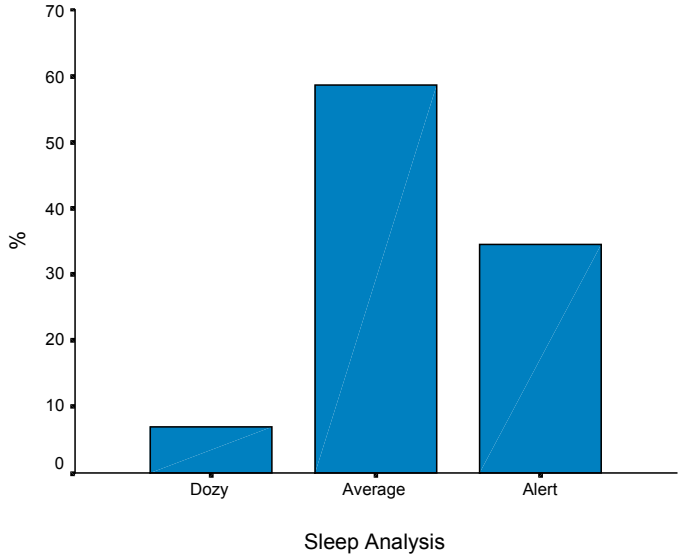

Figure VI Sleep Analysis of Drivers

6.4. Drivers Characteristics

The average age range of the drivers who took part in the pilot study was 17-25, with on average 8.6 years driving experience. From this group only 2 drivers were accident free in the last five years, with each of the other drivers experiencing one accident in this time period.

In the overall questionnaire study the average age range was 26-35, with on average 16.7 years driving experience. An amazing 74.5% of this group claimed to be accident free in the past five years, 15.9% being involved in one accident and the remaining 7.6% and 2% being involved in two and three accidents respectively.

6.5. Selection Bias

This survey was designed to target drivers in all forms – no member of the driving public was to be excluded in the selection criteria. Due to non-responses the actual survey population may differ slightly from the desired target population but this could not be avoided.

6.6. Information Bias

Many of the drivers who participated queried the reply that they felt they should give. Many, if being totally honest would have exaggerated ever so slightly on certain areas, such as, proneness to feeling tired, accidents involved in and also profession categories tend to confuse people as to what 'box' they fitted into. The interviewer strived to make this as understandable and user-friendly as possible.

In reviewing all literature on the issue of fatigue, it is important to remember that not all variables can be controlled or examined in a single study. Every study regardless of topic area will have its weak points and no single study can offer the ultimate, final answer or sets of answers. What are important are the conclusions drawn and recommendations made for the particular study and its circumstances. The overall picture that emerges must be credited in its own right for the work done.

7. RESULTS OF PILOT STUDY

The pilot performance study indicates that overall participants were poorest during sleep-deprived tests and performance was much better and safer during 'normal' conditions. Reiterating and proving that lack of sleep deteriorates driving standards. However in depth analysis of the pilot tests shows how some drivers were much more poorer than others. These poor results match the poor responses given in the questionnaire; this data will be used as an indicator for the others. Different drivers were poorer at different tasks and the same

drivers were poor at every test – each experienced difficulty and performed poorly. One common denominator is that all experienced diminish in driving standards under night nurse conditions and performed poorest whilst sleep-deprived.

Table 1 Pilot group results from driving test and questionnaire

Driver	Driving Experience (years)	Pilot Performance Tests (overall)	Epworth Total*	Sleep IQ	Nature (dozy/alert)	Feel Drowsy when Driving
1	7	Poor	3	Average	Alert	False
2	1	Average	1	Poor	Average	False
3	4	Average	5	Average	Alert	False
4	6	Good	3	Average	Alert	False
5	25	Good	5	Good	Alert	False
6	10	Poor	11*	Average	Average	True
7	7	Poor	17*	Average	Dozy	True

*A score of over 10 is a definite concern for excessive daytime sleepiness

Table 1complies a representation of the pilot group results, which are to be used as a platform for the overall study. On the whole there were two good performers, two average and three poor. The results of these will form the bones of the study and will facilitate to identify the outcome of similar drivers via the questionnaire.

Figure VII shows the average sleep gained by pilot study; all participants obtain adequate sleep, which is the recommended average 8 hours.

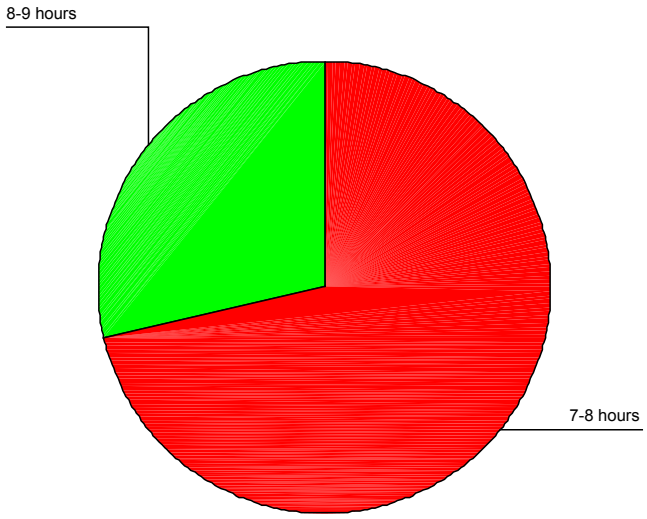

Figure VII Average Sleep gained by Pilot Study Group

However, referring to figure VIII, one quarter of the pilot study showed a concern for daytime sleepiness. In addition to indicating excessive daytime sleep, the same drivers also experienced poor overall performance tests. This information will be used as an embryo to detect potential poor performers in the questionnaire stage.

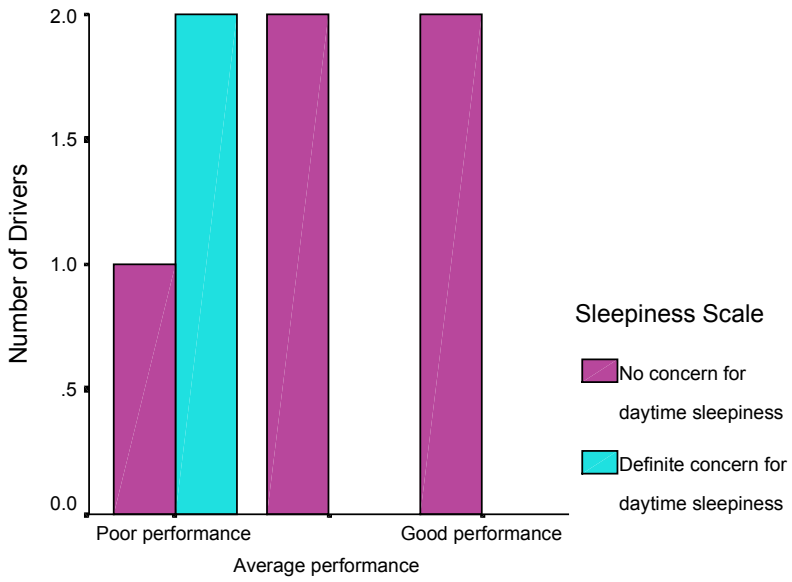

Figure VIII Overall Results from Pilot Performance Tests and Daytime Sleepiness

Figure IX, gives remarkable insight correlating performance and nature of the driver. Two connections are highlighted here:

- Good performers were drivers of an alert nature only and
- Those who possess a dozy nature performed poorly

It must also be added that those of average tendencies performed both poorly and averagely!

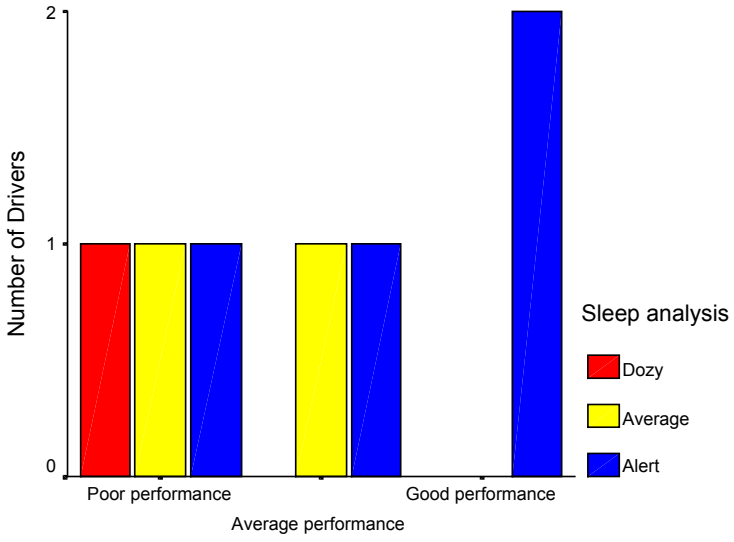

Figure IX Overall Results from Pilot Performance Tests and Sleep Analysis

Again, figure X emphasises that poorer performers in the driving tests, stated in the questionnaire that they also felt drowsy while driving.

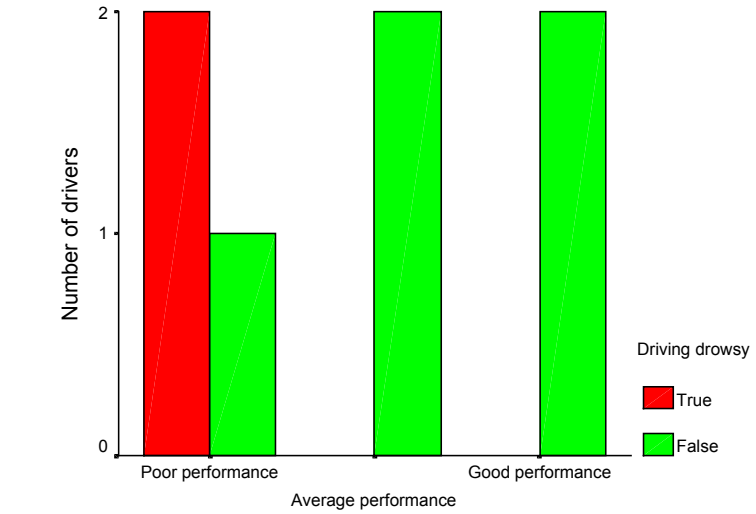

Figure X Overall Results from Pilot Performance Tests and likelihood of feeling Drowsy whilst Driving

Figure XI represents the theory and the performance. It is clear that those with poor and average performances have a poor and average sleep IQ. It is only those drivers with a good sleep IQ who completed good overall performance tests.

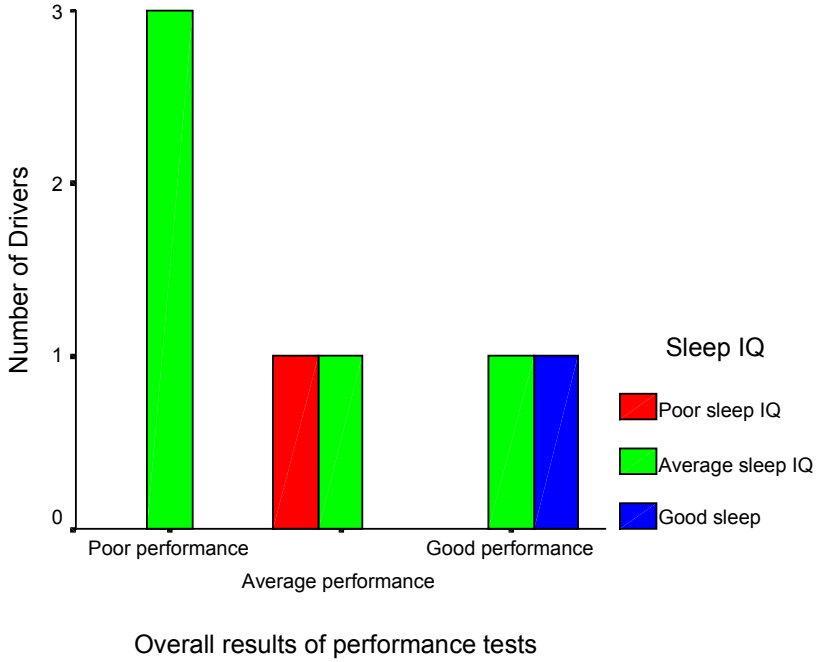

Figure XI Overall Results from Pilot Performance Test and Sleep IQ

The conclusive evidence derived from the pilot study allows a basis to be made when analysing the further 302 questionnaires. As a foundation for the further study it can be said that those drivers with an Epworth score of ten and over (therefore having a definite concern for excessive daytime sleepiness) will result in a poor performance test, an average sleep IQ, a dozy or average nature (sleep analysis) and will often feel drowsy whilst driving. This information is highly significant as these persons are all drivers and take to the roads daily bearing these fatigue-related symptoms. The pilot study served its task and will help conclude and identify the

fatigued-induced drivers present within the questionnaire-based study. The benefits sought from this style of analysing will be of much assistance to all involved with road safety reduction.

7.1 Results Of Questionnaire

Firstly, it would aid to identify all those drivers who have scored 10 or more in the Epworth scale, as these are a definite concern for excessive daytime sleepiness. Figure XII below presents all Epworth scores for the 302 drivers. Interestingly 21% of drivers had an Epworth score of over ten, indicating concern for excessive daytime sleepiness. Of the 21%, nearly 5% of those drivers also admitted to feeling drowsy whilst driving. This is of grave concern to the general public and road safety groups. This is only a sample of the drivers in NI and on this bases one quarter of NI's driving population have problems with daytime sleepiness.

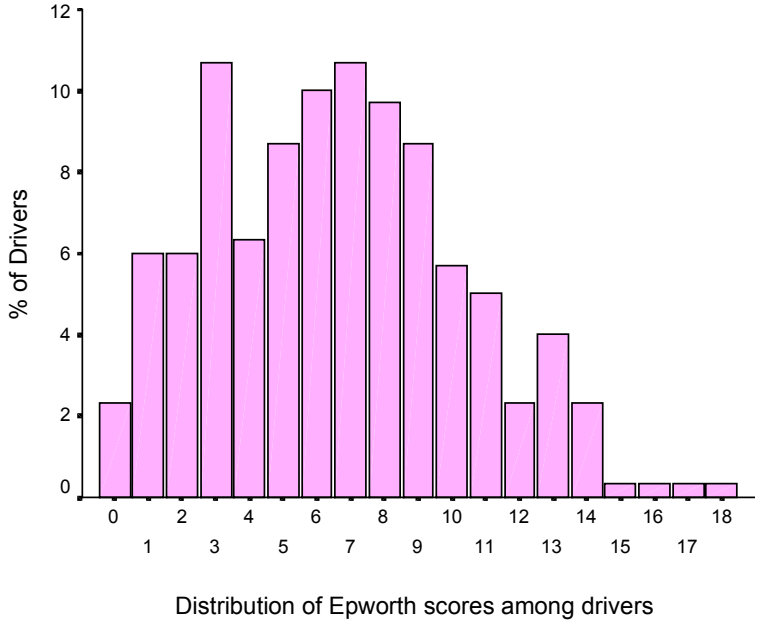

Figure XII The Distribution of Epworth Scores among Drivers

Figure XI below depicts the average hours of nightly sleep received by the 302 drivers. It is reassuring to know that little over three quarters of these drivers are receiving adequate sleep of roughly 8 hours or more. However, it is worrying that approximately 22% of drivers are sleeping on average 5-6 hours nightly and nearly 1% obtains less than 4 hours sleep each night. Of those with less than 7-8 hours sleep, 20% have real concern for excessive daytime sleepiness.

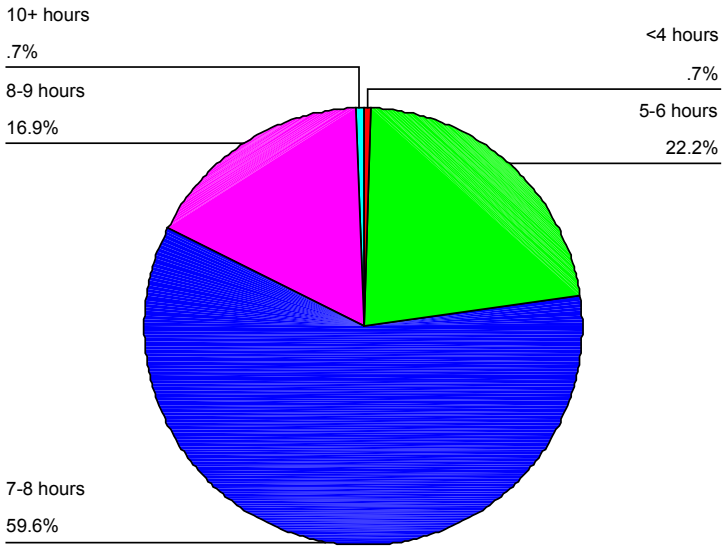

Figure XIII Average Nightly Sleep

With the same sample group, daytime sleepiness could be compared with sleep IQ. Only 30% of the drivers questioned have a good sleep IQ the remaining 62% and 8% have average and poor sleep IQ's respectively (figure XIV). Of the 62% with an average sleep IQ approximately 23% of them had a definite concern for excessive daytime sleepiness. Similarly of the 8% who obtained a poor IQ rating almost one fifth of them were victims of extreme daytime sleepiness.

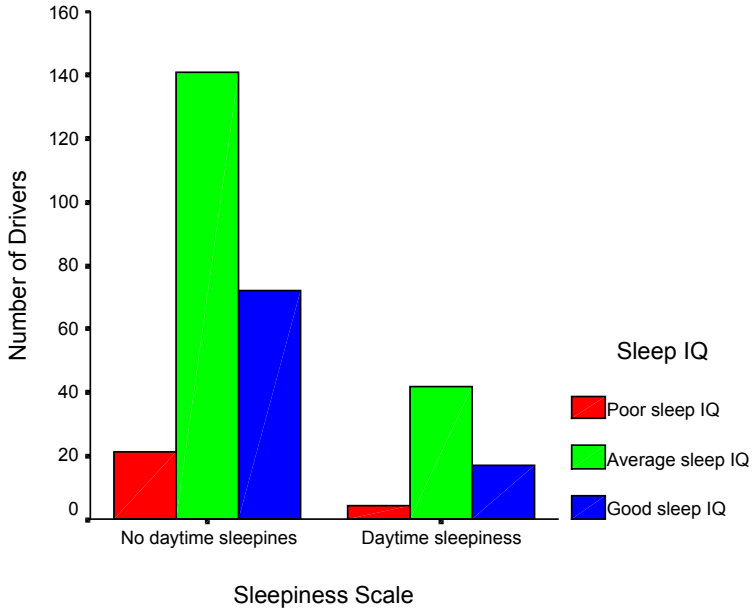

Figure XIV Daytime Sleepiness Scale and Sleep IQ

A relationship can also be derived concerning daytime sleepiness and the nature (dozy/average/alert) of a driver (figure XV). The majority of drivers (58%) in the study identified as being average, meaning they were neither dozy nor alert all of the time. A smaller group of 34% of the overall group could be described as alert, while 7% expressed dozy characteristics. One quarter of the 'average' natured drivers also experienced daytime sleepiness. Of those drivers who possess a dozy nature over half of them had concern for excessive daytime sleepiness.

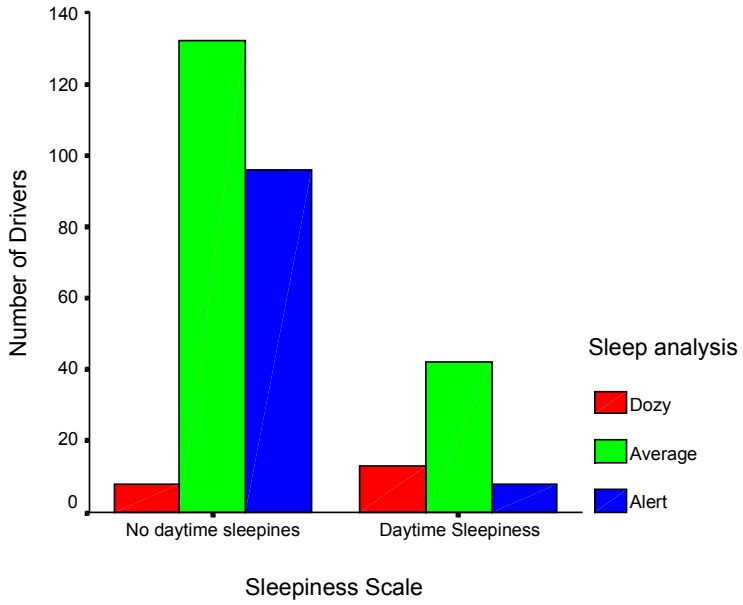

Figure XV Daytime Sleepiness Scale and Sleep Analysis

The overall outcome of the data represented above is that of the initial hypothesis: drivers with a dozy or average nature and a poor or average sleep IQ, who often feel drowsy while driving will ultimately perform poor in performance tests. What do this mean in real terms? Simply and alarmingly that these types of drivers will be major potential for being involved in sleep-related road traffic accidents and they pose as a road safety nuisance for all.

8. DISCUSSIONS AND CONCLUSION

Driver fatigue is being accepted and recognized as a major contributory factor to road traffic accidents in NI and around the world, despite the extreme difficulty police officers encompass in quantifying the problem and then dealing with it.

Driving whilst being sleepy or very tired is not a new experience for most of the driving population. Many drivers think of it as 'no big deal' and accept it as part of daily life and work. On one hand a large majority of drivers would never contemplate drinking and driving, but when driving when we are deprived of sleep we are putting ourselves and others around us at risk, a risk that is as severe or has the potential to be more severe than alcohol related accidents. The British Sleep foundation conducted research that found many people in Britain suffer with sleep disorders, which causes them to be sleepy during the daytime. This applies to about one person in fifty.

Alertness determines the amount of information one can process – it can be thought of as mental energy and its opposite is tiredness or fatigue [5]. There is a general tendency for drivers to rate themselves as more alert than they would be on a daily basis. However, as proved in this paper, those drivers who are not alert, have a higher likelihood of deteriorated driving standards and are therefore more prone to be involved in a sleep-related accident.

Drivers who fall asleep at the wheel cause approximately 1 in 5 of major road accidents in Britain and these accidents result in a higher rate of death and serious injury due to the main fact that sleeping drivers don't swerve or brake until it is too late. From the data found 1 in 4 drivers possess dozy or less alert characteristics, which for driving purposes where one needs to be vigilant and alert, is detrimental.

There is a definite link between driver fatigue and sleep-related accidents. The probability of falling asleep at the wheel or merely stealing a micro sleep is closely tied to the Epworth scale. Those who are a definite concern for excessive daytime sleepiness are in real danger of succumbing

to the possibility of being involved in a sleep-related incident. A total of 28% of the pilot study experienced poor performance testing. These drivers were also noted to be of a dozy or average nature, had average IQ's and often felt drowsy when driving. This sample study of NI drivers could be extended to state that approximately one quarter of NI drivers have a high chance of being involved in a sleep-related accident due to:

- An average or poor sleep IQ,
- Often feeling drowsy while driving,
- Possessing a dozy or average nature and
- Gaining a below average nightly sleep.

9. RECOMMENDATIONS

Simulation is a creative medium for testing driver's capabilities and in this study and indeed future studies would be exceptionally beneficial. A simulator provides a safe off-road demonstration and monitoring system that can produce effective results.

Countermeasures are a good form of prevention and steps need to be taken to avoid this unnecessary death caused by fatigue. However, there is a lot that the driver can do to prevent them from entering a situation of this kind, such as,

- Have a good night's sleep (at least 8 hours) every night not just prior to a long journey,
- Plan long drives and if possible do not travel alone. Travelling with another driver is beneficial as the driving can be shared,
- Schedule your day and include driving periods and adequate breaks,
- Avoid alcohol (regardless of low doses) and medications (over-the-counter and prescribed) that may induce fatigue/drowsiness. The pilot study emphasised the impairments that OTC's stimulated,
- Consult your doctor if you have difficulty sleeping or are experiencing daytime tiredness for a diagnosis.

If you are in the situation where you are driving look out for the signs of fatigue and act immediately. The first step is to recognise that there is a danger of falling asleep and the prediction of when a micro sleep may occur is very difficult. Self-awareness and remedial action are imperative conduct to develop when stepping behind the wheel of a vehicle.

Of course in an ideal world all drivers would obey speed limits and other road signs, drive with consuming alcohol or drugs and never leave home if they are tired. These factors can be disseminated to the huge driving and road using population via education or even enforcement. However, if the lateral fails engineering is much needed. Maybe all three together could work hand-in-hand to help reduce and eventually prevent these types of accident. Engineering aspects such as, rumble strips to alert drivers who have nodded off and are veering off the road. The advantage is that once a vehicle drives over a rumble strip the combination of the car jittering and the loud noise can be effective in wakening up the driver and preventing them from going off the road. Providing adequate well-maintained and safe rest areas along the roadside could enable sleepy drivers to take a break, refreshing them for their onward journey.

It has to be stated that having asked drivers about the distractions the face when driving the answers were restricted to a common few – a few which are easy to dispense blame to. However, whilst many drivers considered the distraction of mobile phones and children to have an ill effect on their driving performance, the effect of fatigue was rarely considered. It is recommended and highly credibly for a driver to admit feeling fatigue and necessary before action can be taken.

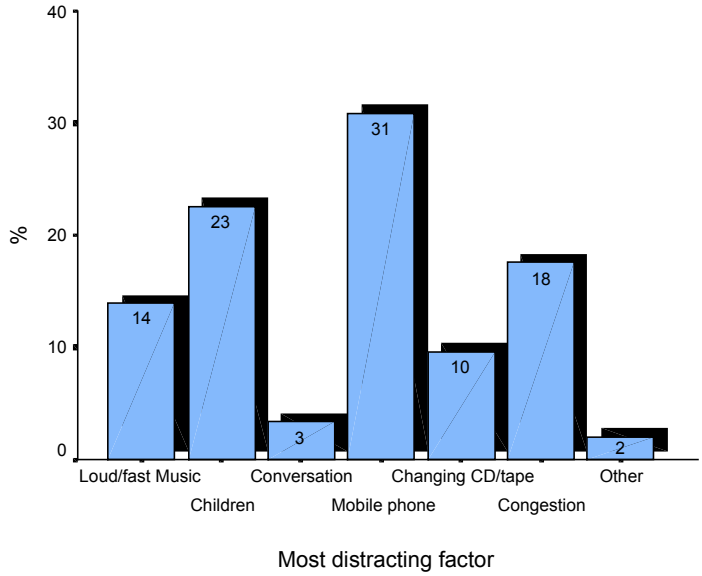

Figure XVI Most distracting factors for drivers

Employer enforcement could be initiated when it comes to appraisals or interviews, any employee who fails a 'fatigue questionnaire' could be denied the job or promotion (as they would be deemed unfit / unsafe to drive). A program that would assess employees (especially drivers) bimonthly through out their term of employment would prove advantageous to the company.

Changes in driver's hours of work regulations alone will not be enough to solve the problem of fatigue within the road transport industry. Much more action is needed to address driver fatigue through a combination of innovative hours-of-service regulation and enforcement, education, driver work scheduling, fatigue management programs, driver screening (at early stages), fitness for duty programs and alertness monitoring systems and additional research. Other recommendations take the form of mechanisms inside the vehicle, such as an eyeball scanner, which will take readings of eye movement. This would also be useful with drug/drink drivers, as the purpose is to scans the drivers wondering tired eye and trigger a bleeping noise to alert the driver that they are dozing off. Another would be a sensor in the steering wheel to notify the driver if his/her hands have slipped off.

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