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Fatigue related research at ITS University of Leeds

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Group Leader: Safety and Technology Group



ITS



- Introduction: ITS and the Safety and Technology Group at Leeds
- Our work on fatigue:
 - Critical analysis of current research on fatigue
 - Clinical assessment: obstructive sleep apnoea
 - Low cost engineering measures



- Largest Transport Research Institute in the UK
- 2010: Awarded the *Queen's Anniversary Prize for Higher and Further Education*.

For “*sustained excellence - 40 years' impact in transport research and teaching.*”



THE QUEEN'S
ANNIVERSARY PRIZES
FOR HIGHER AND FURTHER EDUCATION





- Conduct research for a range of clients:
 - European Commission (EC)
 - Various government agencies (DfT, HA, TfL, CfIT..)
 - Local councils
 - UK Research Councils (ESRC, EPSRC)
 - Rail and Bus Industries (RSSB, NR)
 - Charities
 - Industry

The Safety and Technology Group



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- The group is multidisciplinary consisting of psychologists, human factors experts, social scientists, physiologists, engineers and computer scientists (8 members of staff, 8 PhD students).



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Safety and Technology Group Interests and Expertise



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- Traffic Safety, Human Factors and Driver Distraction
- Road Design and Engineering
- Speed behaviour and New Technologies
- Large scale Field Operational Tests
- Local emissions testing



*“New Technologies, Driver Behaviour and Safety”
USING
Field Studies, Driving Simulator, Questionnaires/Focus Groups*

Facilities



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- The University of Leeds Driving Simulator
- Psycho physiological measures of driver behaviour (eye tracking, heart rate)
- Lab-based driving simulator
- On-road 'drive-through' vehicle emission testing instrument



Eye tracking



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ITS recent studies on fatigue





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Road Safety Research Report No. [XX]
FINDINGS

Department for
Transport

Fatigue and Road Safety: a critical analysis of recent evidence

Abstract

This report, produced by a consortium consisting of Clockwork Research, University of Leeds and TRL, provides a comprehensive and critical review of the literature which synthesises the evidence relating to

Ten questions



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1. What are the effects of fatigue on driving performance?
2. What psychological and physical factors, such as mood state and illness, can affect fatigue?
3. Fatigue and road safety campaigns – what approaches have been taken and what have campaign evaluations shown?
4. What evidence is there regarding the link between fatigue and work-related road safety?
5. Fatigue as a contributory factor to road accidents/fatalities: What is the accident risk associated with fatigue, and what is the prevalence of fatigue-related accidents?
6. What is known about the behaviour and attitudes of road users towards the issue of fatigue and road safety?
7. What countermeasures have been designed for reducing the likelihood of fatigue-related crashes for non-commercial and commercial drivers/riders?
8. To what extent are road users aware of their fatigue/impairment?
9. Who drives when tired? For what proportion of commercial and non-commercial drivers is fatigue an issue?
10. When and Why do people drive tired? What measures are they currently taking to avoid driving when tired, if any?

Definition of Fatigue



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Fatigue: Gradual and cumulative process associated with a loss of efficiency, and a disinclination for any kind of effort.

Sleepiness: Signals the likelihood of falling asleep, and can be defined as difficulty in staying awake.

Literature shows that the two terms are inextricably linked

Some Headliners



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Interchangeable use of the terms sleepiness and fatigue in the literature

Young (17-25) male drivers, shift workers and commercial vehicle drivers most prone to the effects of fatigue.

But: Inter individual differences between fatigue and performance make it difficult to make firm conclusions.

Many campaigns but their effect is never really scientifically assessed.

Some Headliners



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Campaigns need to target certain groups and highlight the danger signals of fatigue

But: Even when drivers know this they continue to drive tired – goals/rewards outweigh risks.

Need for a better understanding of the contribution of sleep disorders to crashes and help with diagnosis.

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Clinical studies on Obstructive Sleep Apnoea

In collaboration with Clinicians at St. James Hospital, Leeds



Aiding clinical decision making



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Drivers who suffer from Obstructive Sleep Apnoea (OSA) are more likely to be involved in road traffic accidents, compared to healthy normals.

Advising patients with OSA about whether they are safe to drive is challenging as there are no agreed criteria of safety

Driving simulator studies have shown that OSA patients perform poorly but a pass/fail criteria has not been established

In a pilot study we have investigated what parameters might predict drivers behaviour in safety-critical scenarios.

The aim is to develop a tool which can aid clinical decision making

Current research activity



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Over 100 patients (with varying degrees of OSA and a control group) have been tested, supplemented with clinical measures.

Further work is being undertaken to develop the test so it is suitable for a clinical setting in terms of ease of use and length of testing required





Can engineering measures combat fatigue?

Low cost engineering measures to Combat Fatigue (2007-2008)



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- 20% of UK road accidents thought to be caused by fatigue (Maycock, 1997), resulting in around 300 deaths per year (DfT).
- Fatigue related accidents :
 - Normally involve single occupant vehicles
 - Are not usually associated with skid marks or other signs of severe braking.
 - Result in serious injury or death
 - Involve driving at high speeds during the early hours of the morning or at night

Young male shift workers driving on the motorway during the early hours of the morning

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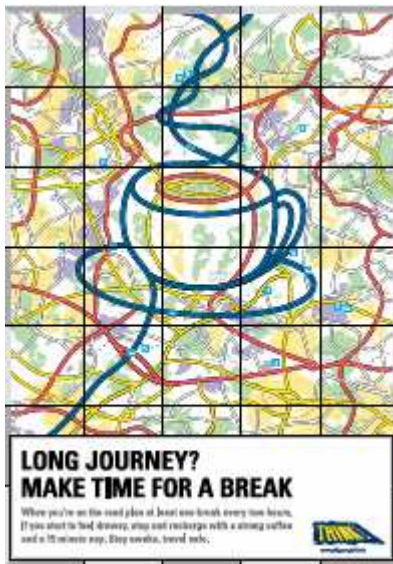
www.its.leeds.ac.uk The ITS logo, consisting of the letters 'I', 'T', and 'S' in a stylized, bold font.

Measures to combat fatigue



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- Many of the countermeasures for fatigued drivers are either:
 - In-vehicle: rumbling seats or steering wheels, in-car alarms etc.
 - or rely on drivers themselves: e.g. caffeinated drinks, take a break, don't drive tired, take a nap etc.



Engineering Measures to Combat Fatigue



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- Funded through the Highways Agency, the aim of this study was to examine the effect of three low cost engineering treatments on reducing driver fatigue





- Not much known about the type of road which is particularly prone to fatigue-related accidents or engineering countermeasures
- Task: to *identify* particular stretches of road in the UK that involve fatigue related accidents and *categorise* by geometry etc, using STATS19 database 2005-2007 – *failed!*

Literature:

- Long monotonous straight roads induce fatigue
- Because they consist of a repetitive and predictable visual environment

Example of treatments



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**Centre line rumble strips:
15-20% reduction in fatigue related
accidents (Persaud et al., 2003)**



**•Edge line rumble strips: 40%
(Mahoney et al., 2003)**

**Transverse rumble strips
used in Texas (Miles et al., 1995)**



Examples



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California Melody Road: Funded by Honda (Lone Ranger Theme Tune!)



Japanese Melody Road



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Our study



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→ Workshop with engineers, road safety experts and members of HA

→ 10 measures identified, they had to be:

- Low-cost
- an engineering measure
- implementable and effective within the driving simulator
- Not edge line rumble strips!

→ 3 treatments chosen

→ Focus Group Discussion (10 male shift workers)

The three treatments



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Focus Group Comments



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- N=10, Aged between 21 and 56 years
- Shift working drivers
- All admitted to driving when tired and fatigued

“I have done it I think twice where the cats eyes have woken me up, you know, where it goes dum, dum, dum, dum!” [Driver 7, HGV driver]

“If I get over tired I go on those rumble strips or whatever.” [Driver 2, Service Engineer]

“Well when you wander onto them they make your wheels rumble and it makes a noise, so it is makes you more alert.” [Driver 2, Service Engineer]

Focus Group Comments



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“I count chevrons, from Chester. I know all the chevrons on the road. I do from Chester services. (Laughing) There are sixty two going west and seventy two coming east.” [Driver 9, HGV driver]

“... anything that is there like buildings, trees, anything that is at the side of the road. Them sort of things, or people walking about. Lolly pop ladies and things like that, it always keeps you more alert.” [Driver 2, Service Engineer]

“Those signs as well that say slow down or watch your speed. The ones that just flash at you and say slow down to 30” [Driver 6, Police Officer]

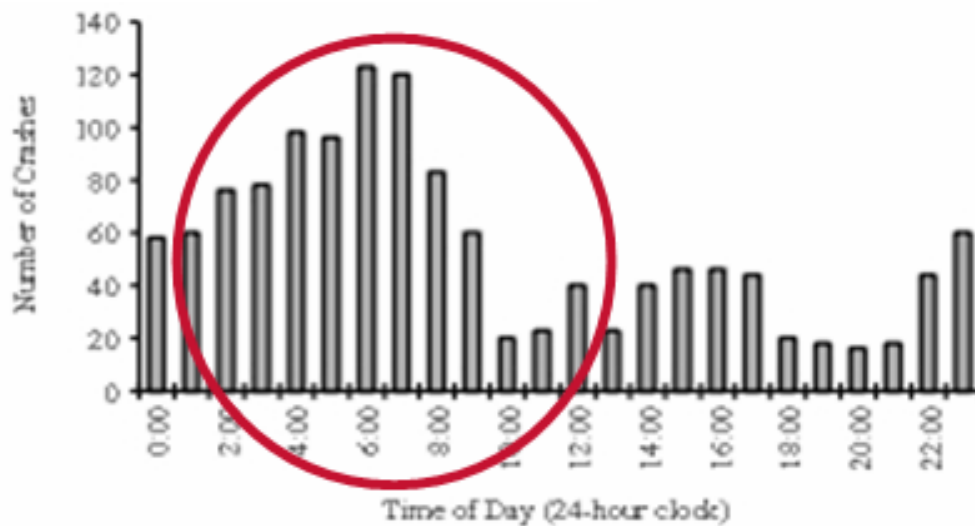


The Simulator Experiments



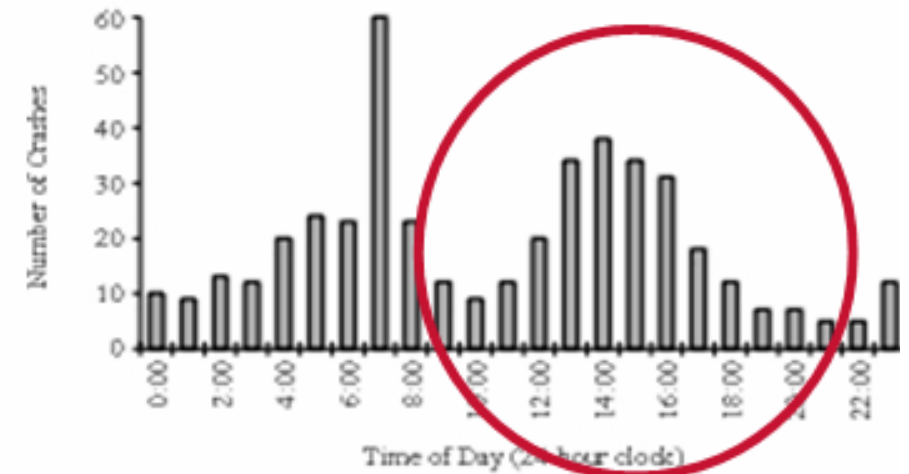


Between 26 and 45 years



Shift workers (N=17)

Between 46 and 65



Older drivers: post lunch dip (N=17)

Two visits each:

Day 1 → Baseline

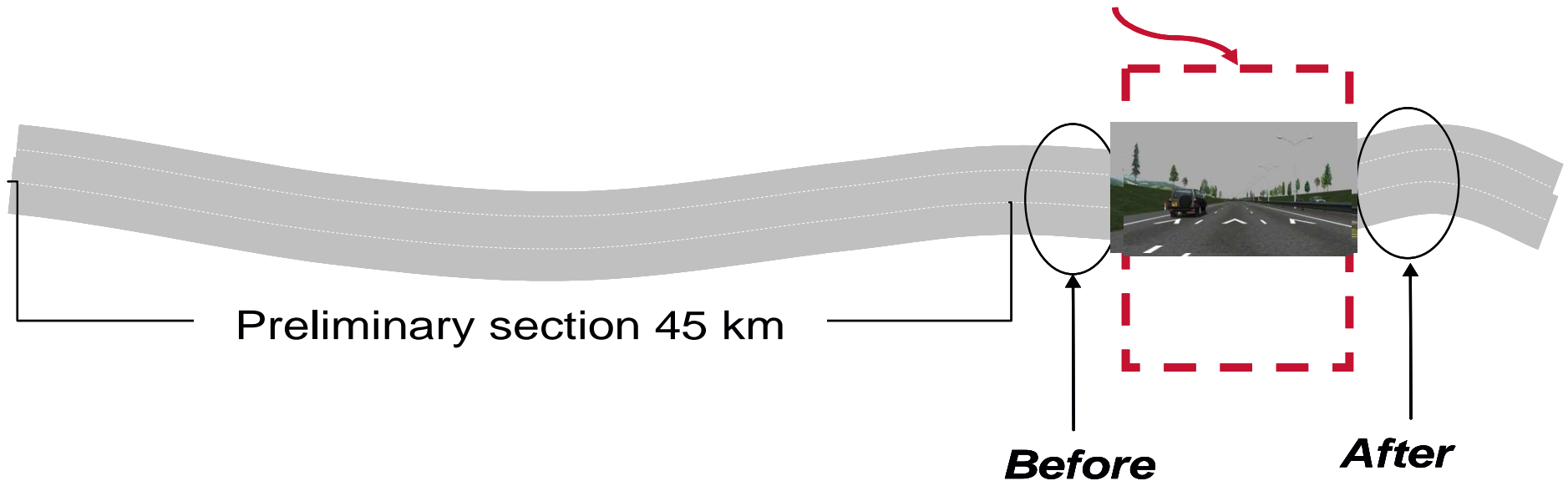
Day 2 → Experiment

The Road



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*Treatments (Chevron
VMS or Rumble)*

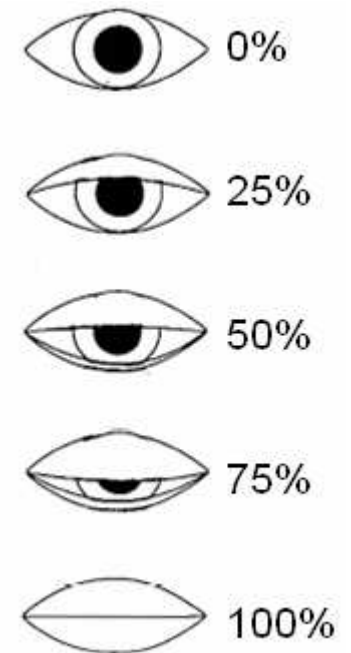


Measures - Objective



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- Looked at PERcentage of eye CLOSure (PERCLOS)
 - % of time eyes closed for 75% or more over a 180 sec time window
 - Blink duration: increase with fatigue



Dinges et al., 1998

Example Clip



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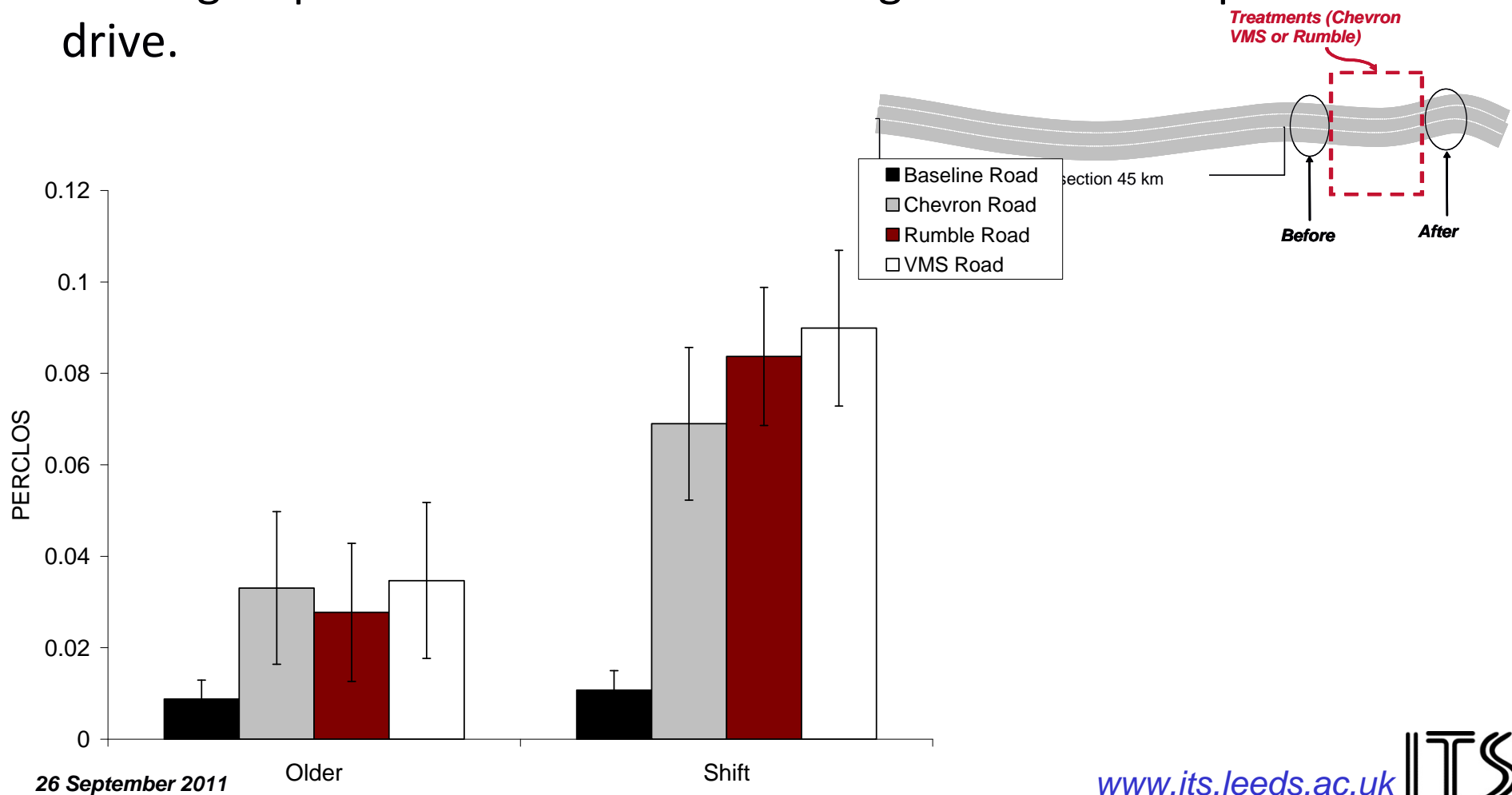
COMPARISON OF DAYS 1

AINDRoad



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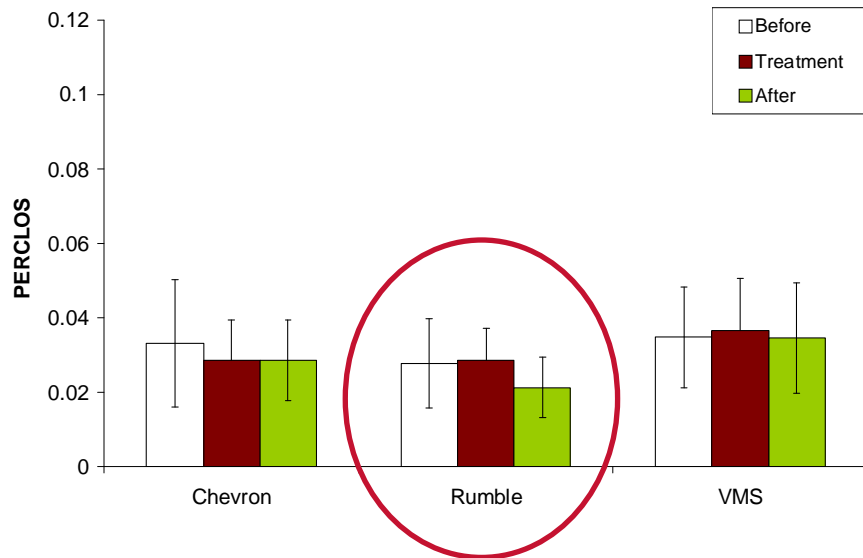
- Both groups of drivers much more fatigued on their experimental drive.



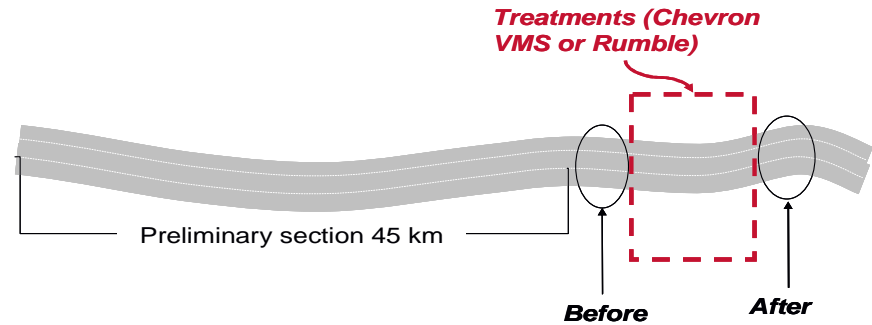
PERCLOS ON DAY 2



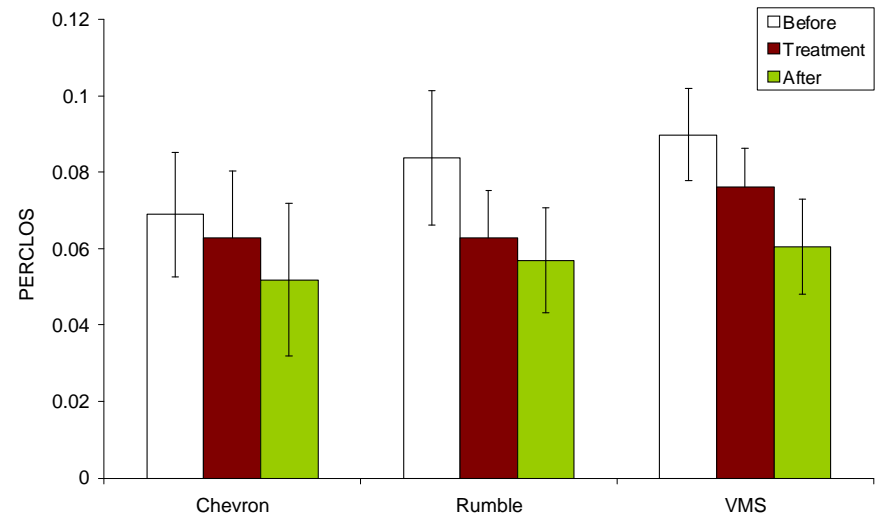
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Older Drivers



Shift Workers



Main findings



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- Treatments found to be most effective for Shift workers.
- No *significant* difference between the three treatments
- All three treatments showed some alerting effect, although this was short lived.
- There is certainly no harm in including such treatments in sections of road identified as hot spots for fatigue related accidents – but with some caution!

However, the onus of safe driving must remain with the driver!



Chevrons

“Good idea. Make you more aware of your distance to the vehicle in front.”

“Didn’t even notice them” !!

VMS

“Can always act as good way to stimulate your brain and make you more mentally aware”

“A distraction that should be reserved for emergency information”

Rumble strips

Good. Wake you up”

“Irritating and could possibly destabilise a vehicle especially if towing”

Concluding remarks



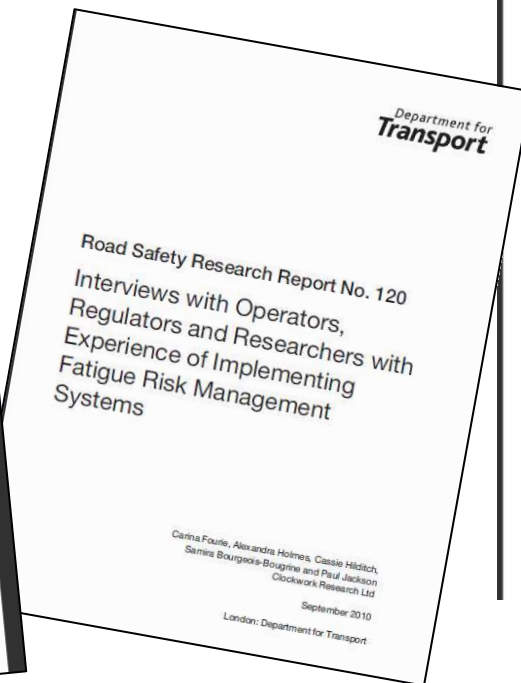
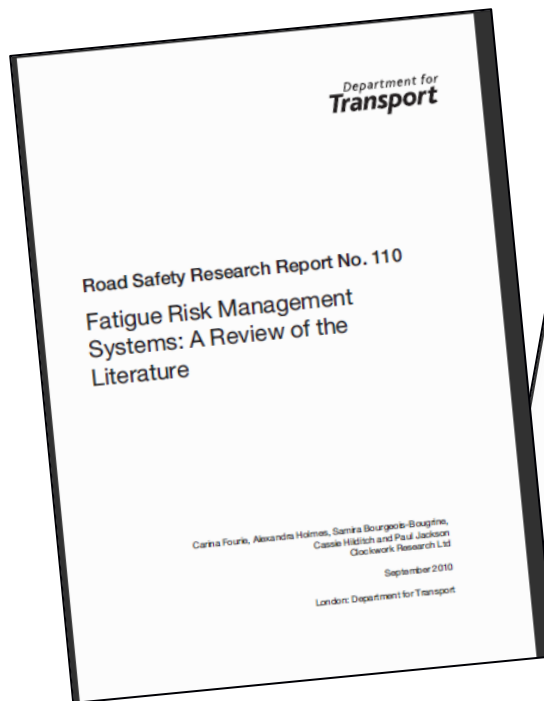
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- Like distraction, the effects of fatigue on road safety are difficult to measure and enforce.
- There is much still to be understood about prevalence of driver fatigue in the UK and the countermeasures used by drivers to combat fatigue.
- There needs to be a better understanding of the effects of fatigue on work-related road safety and the role of commuting to work.
- We need to change drivers' attitude to ensure they fully understand the risks associated with fatigue.

Other useful material



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Low cost workshop **BOOK TODAY!** **Brake** stopping the carnage caring for victims

Tackling Driver Tiredness

Waking up to the dangers

Driver tiredness kills 300 people a year and one in ten at-work drivers admit to having fallen asleep at the wheel.

This workshop covers the latest research and guidance for fleet managers on preventing driver tiredness. Fatigue risk management specialists and academics will outline the extent of the problem, the law and company responsibilities. They will explore the practical ways that companies can tackle driver tiredness through journey planning, employee training and awareness programmes.

Limited availability BOOK NOW!

DATE: Thursday 21 October 2010
VENUE: Bristol, UK
TIME: 12.30pm-4pm, lunch provided

Speakers:

- Paul Jackson - Managing Director, Clockwork Research
- Tony Wallace - Training & Development Manager, Johnsons Coaches
- Anthony Leeds - Senior Fellow, University of Surrey

Delegates will receive **FREE** resources on relevant topics, including guidance, posters and leaflets.

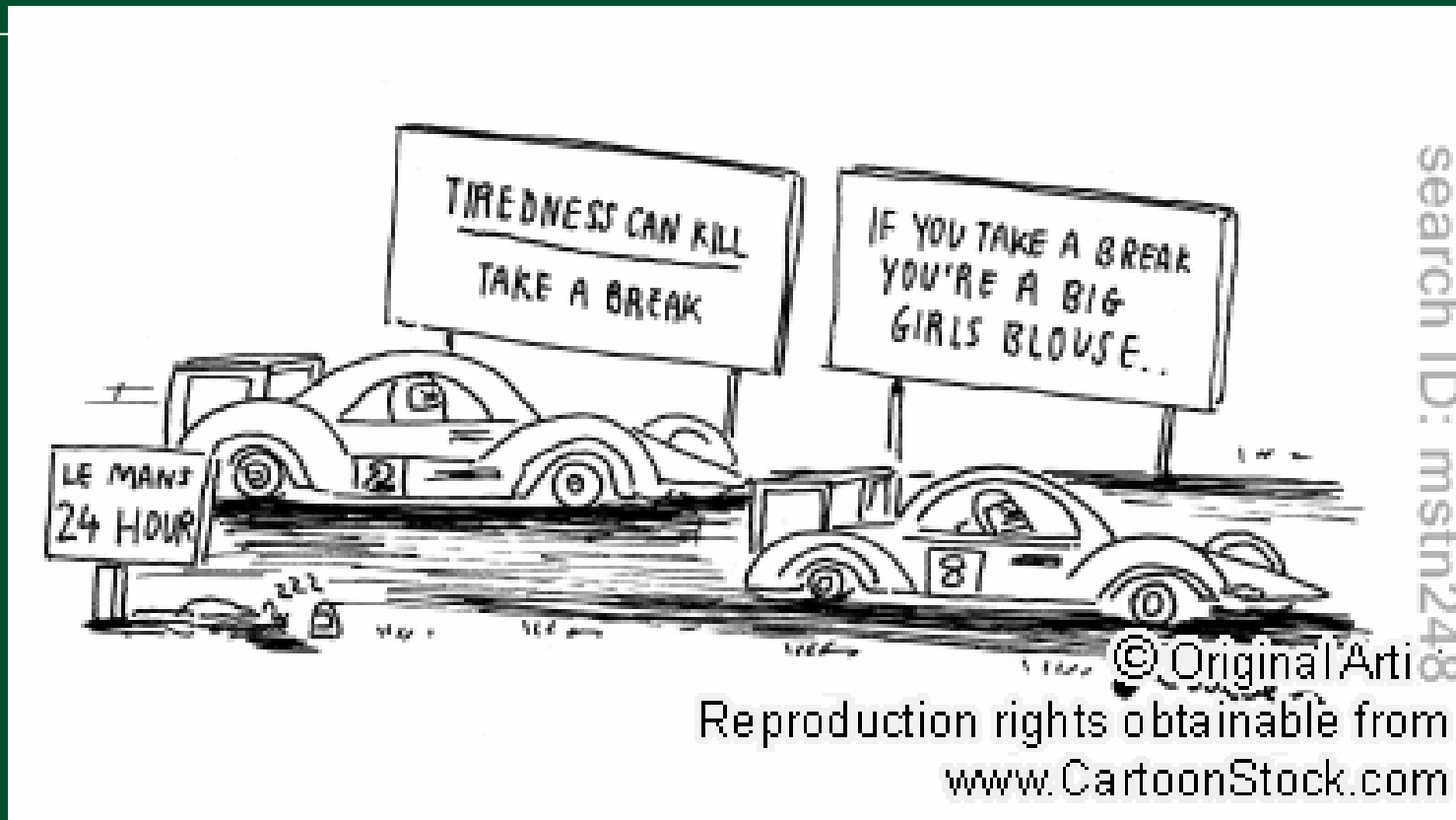
£70+VAT for subscribers or £80+VAT for non-subscribers

Register TODAY!

"Brake's workshops are absolutely superb and an essential learning tool."
Gery Webster, UK road safety manager at Christian Salverton

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Thank you for your attention!

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