

Trötthet och sömnhet – vad är det och går det att mäta?

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vti

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What is fatigue, sleepiness, drowsiness, alertness, ...

Laws and regulations

The sleep/wake continuum and how to measure sleepiness/fatigue?

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Definitions

Fatigue

Refers to an inability or disinclination to continue an activity, generally because the activity has, in some way, been going on for “too long”

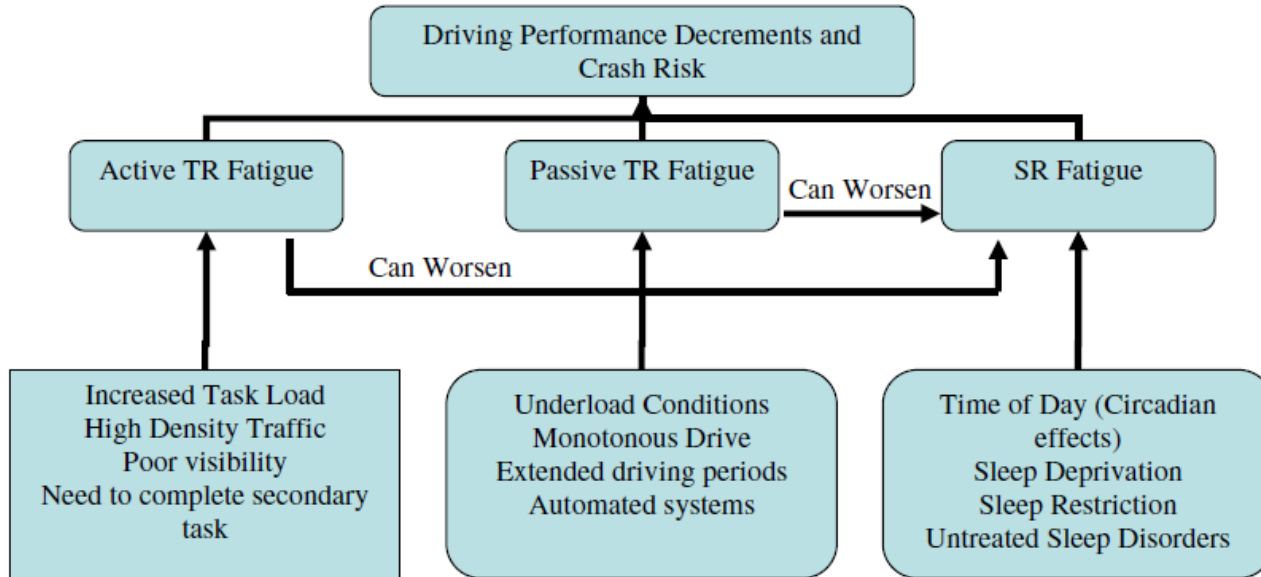
(Bartley and Chute 1947)

Sleepiness

Operationally, sleepiness has been defined as “a physiological drive to fall asleep”.

(Dement & Carskadon, 1982)

Do we need to know the reason behind fatigue?



May and Baldwin, 2009

Laws and regulations

Trafikförordningen 1998:1276 - kapitel 3 paragraf 1

"Fordon får inte föras av den som på grund av sjukdom, uttröttning, påverkan av alkohol, andra stimulerande eller bedövande ämnen eller av andra skäl inte kan föra fordonet på ett betryggande sätt"

Inte straffsanktionerad - men den sätter en ram.

Trafikbrottslagen (TBL 1951:649)

...i förarbetena till TBL så pekades förande av fordon i uttröttat tillstånd ut som ett sådant medvetet risktagande som typiskt sett kan leda till ansvar för vårdslöshet i trafik.

Laws and regulations

I Transportstyrelsen författningssamling 2012:19 står följande:

”För innehav av behörigheterna AM, A1, A, B, BE, C, CE, D, DE, traktorkort eller taxiförarlegitimation

11 kap Sömn- och vakenhetsstörningar

§1 Sömnapné, snarksjukdom (ronkopati) eller annan sjukdom med sömnstörning samt narkolepsi utgör hinder för innehav om förhållandena bedöms innebära en trafiksäkerhetsrisk.

§2 För innehav av behörigheterna C, CE, D, DE eller taxiförarlegitimation ska den ökade trafiksäkerhetsrisken som följer med sådant innehav beaktas.”

Krav på läkarintyg !

Hours of service regulations

- **Daily driving period shall not exceed 9 hours**, with an exemption of twice a week when it can be extended to 10 hours.
- **Total weekly driving time may not exceed 56 hours** and the total fortnightly driving time may not exceed 90 hours.
- **Daily rest period shall be at least 11 hours**, with an exception of going down to 9 hours maximum three times a week.
- Daily rest can be split into 3 hours rest followed by 9 hours rest to make a total of 12 hours daily rest.
- **Weekly rest is 45 continuous hours**, which can be reduced every second week to 24 hours. Compensation arrangements apply for reduced weekly rest period. Weekly rest is to be taken after six days of working, except for coach drivers engaged in a single occasional service of international transport of passengers who may postpone their weekly rest period after 12 days in order to facilitate coach holidays.
- **Breaks of at least 45 minutes** (separable into 15 minutes followed by 30 minutes) should be taken after 4 ½ hours at the latest.

Regulation (EC) No 561/2006, as amended by Regulation (EU) 2020/1054

NOTE:

The starting point is not human centered

No difference between day and night driving! Do not take type of task into consideration

Law and regulations

General Safety Regulation (GSR) - comprises a number of minimum safety requirements for new vehicles

Definitions

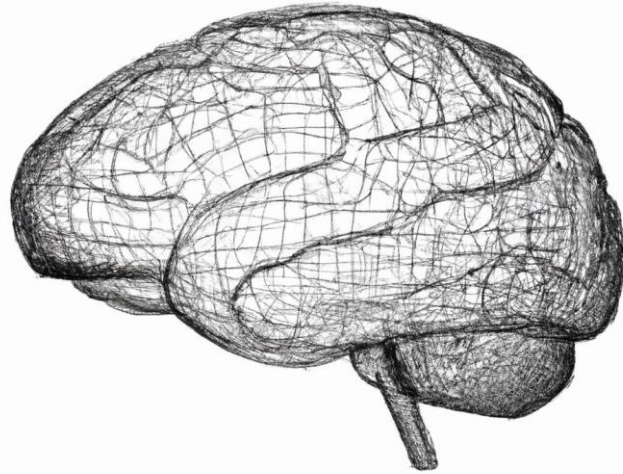
'driver drowsiness and attention warning' means a system that assesses the driver's alertness through vehicle systems analysis and warns the driver if needed;

'advanced driver distraction warning' means a system that helps the driver to continue to pay attention to the traffic situation and that warns the driver when he or she is distracted;

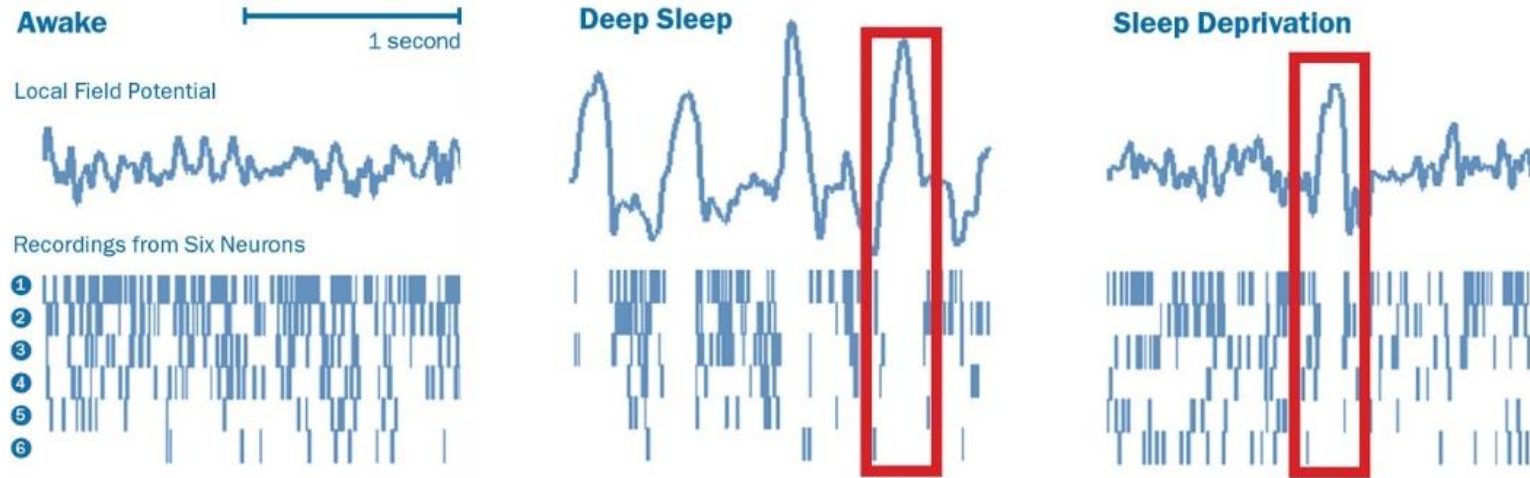
When?

E1. Alcohol interlock installation facilitation	M1-M3 and N1-N2	B 6 July 2022 7 July 2024 for registration and to market
E2. Driver drowsiness and attention warning	M1-M3 and N1-N2	B 6 July 2022 7 July 2024 for registration and to market
E3. Advanced driver distraction warning	M1-M3 and N1-N2	C 7 July 2024 7 July 2026 for registration and to market

The sleeping brain and the sleep/wake continuum



Local sleep during wakefulness

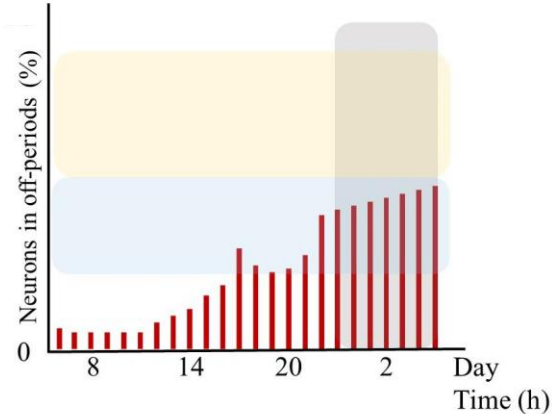
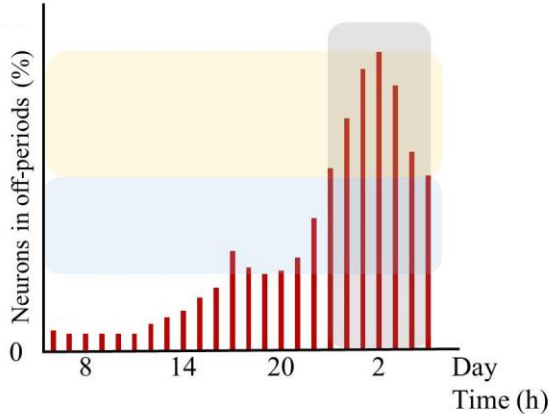
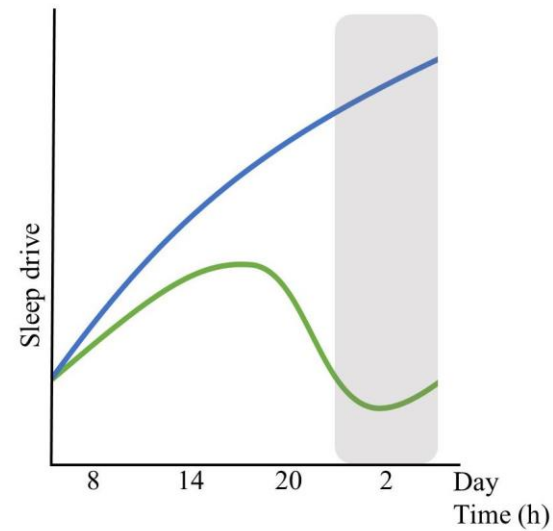
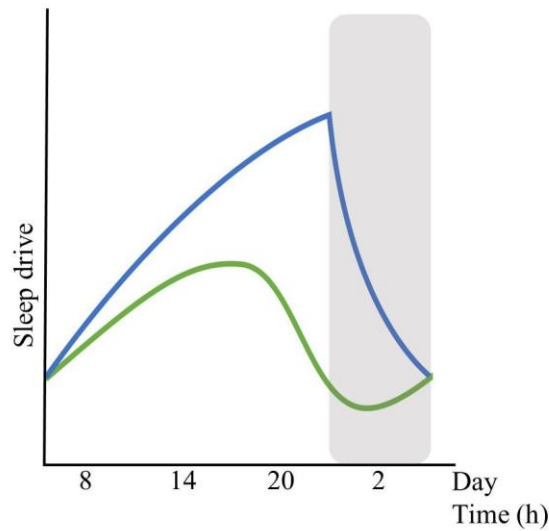


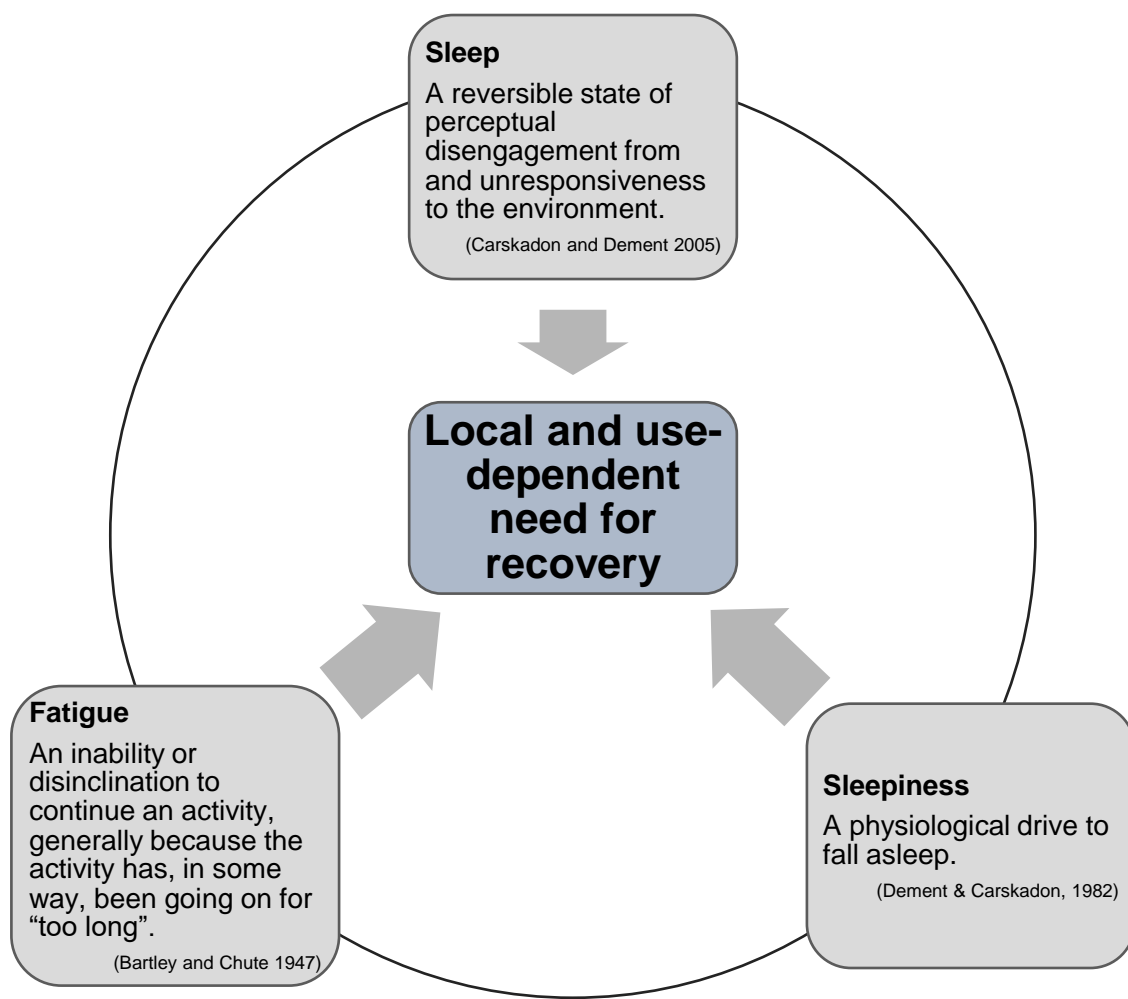
The off-periods, with associated performance failures, may also occur:

1. when the eyes are open.
2. when global EEG suggests alert.
3. when you are responsive.

Vyazovskiy (2011), Nir (2017)

Extent of brain areas displaying sleep features





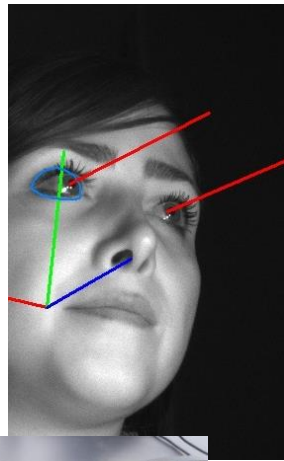
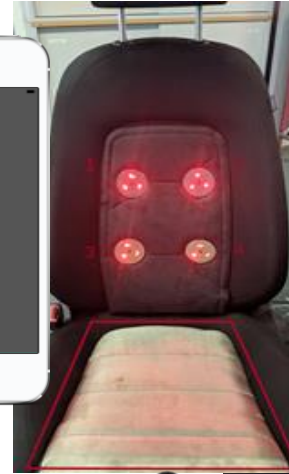
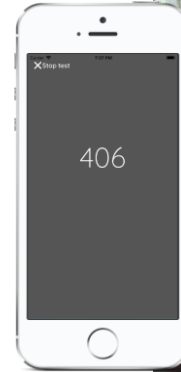
Measuring sleepiness

Subjective sleepiness indicators

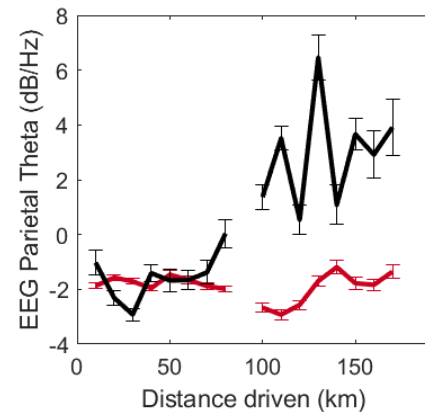
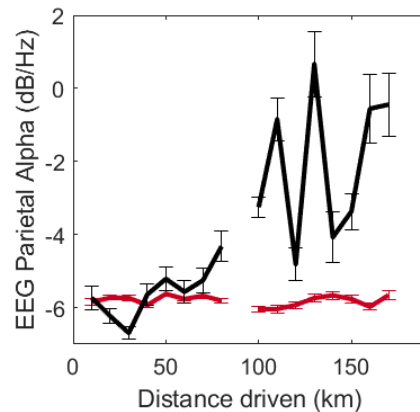
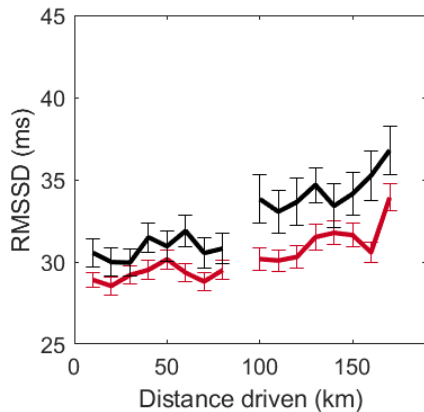
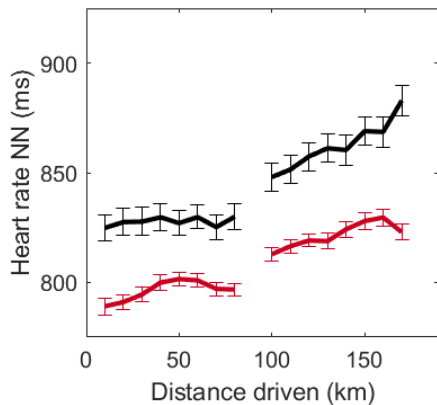
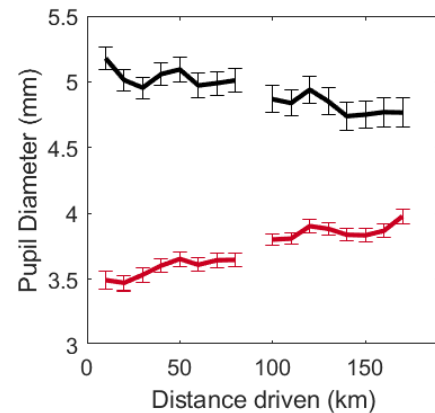
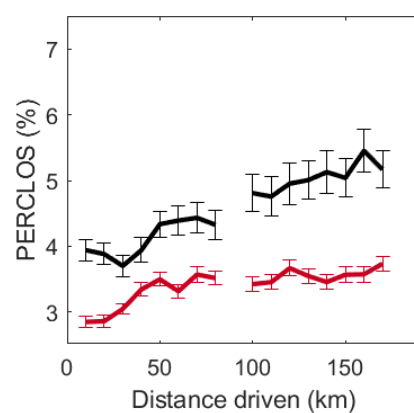
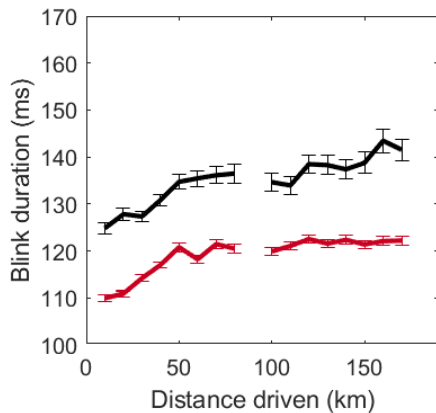
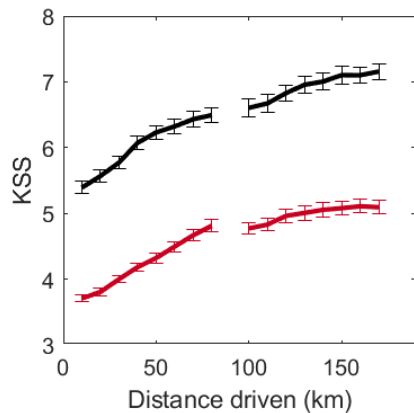
- Self-ratings
- Observer ratings

Objective sleepiness indicators

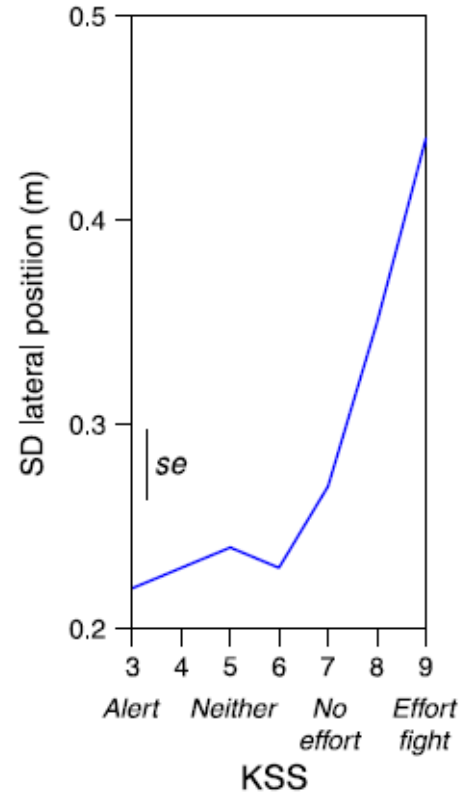
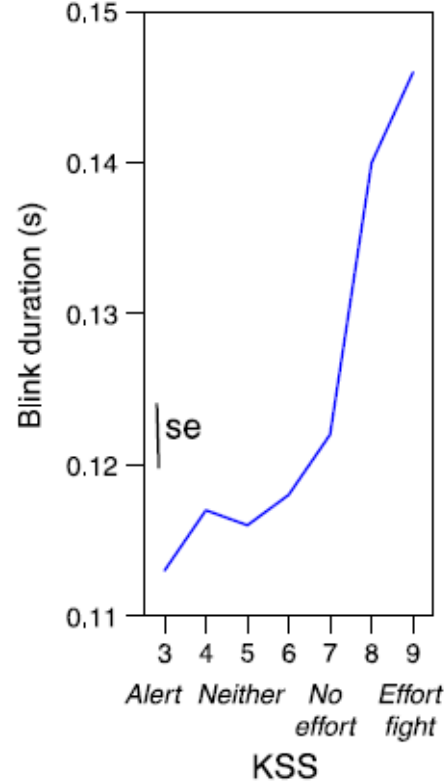
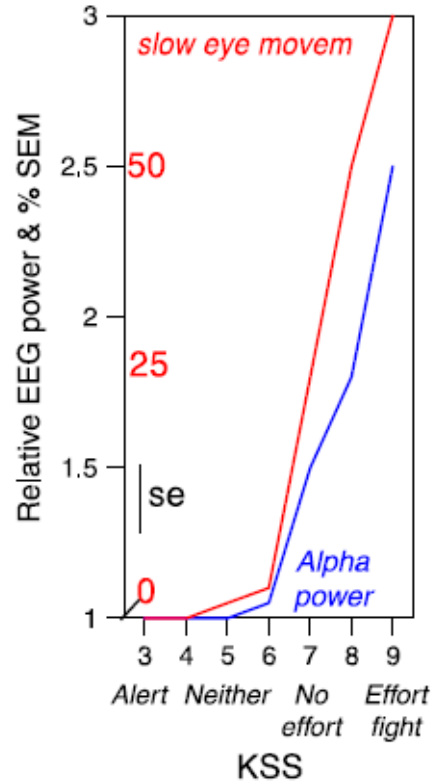
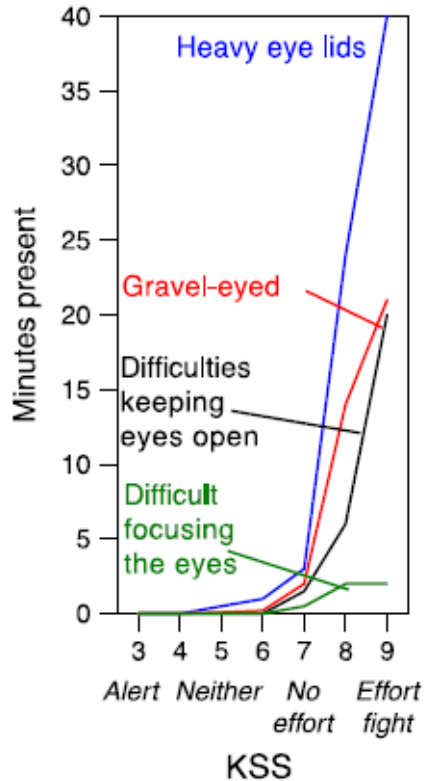
- Performance outcomes (PVT, line crossings, crashes)
- Brain waves
- Eye movements and blink behaviour
- Cardiovascular (heart rate, HRV, blood pressure)
- Respiration
- Temperature



Typical outcomes



KSS and its relation to other measures



Local sleep and the sleep/wake continuum is changing how we look at sleepiness, sleep and alertness.

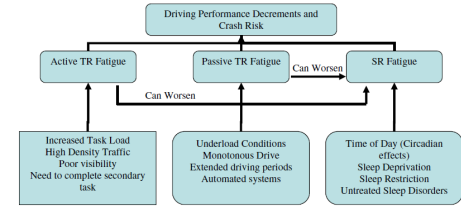
Difficult to objectively measure sleepiness for a certain individual at a certain time.

Physiology does not always agree with subjective/behavioural sleepiness indicators.

An observed physiological change can be due to a state change (which state?), confounding factors, or measurement related issues.

Subjective sleepiness ratings are today our preferred measure of sleepiness.

Countermeasures



Examples of countermeasures at a pre-crash level

Strategic	Tactical	Operative
Fatigue management systems	Driver support system (feedback – warning)	Rumble strips
Hours of service regulations	Road signs	Driver support systems (warning & intervention)
Information/Education	Parking areas	
Strategies for planning	Route guidance to parking areas	
Fit for duty test		
Enforcement/Control		

Rumble strips → -25% less sever and killed persons on MV and 2-lane rural roads

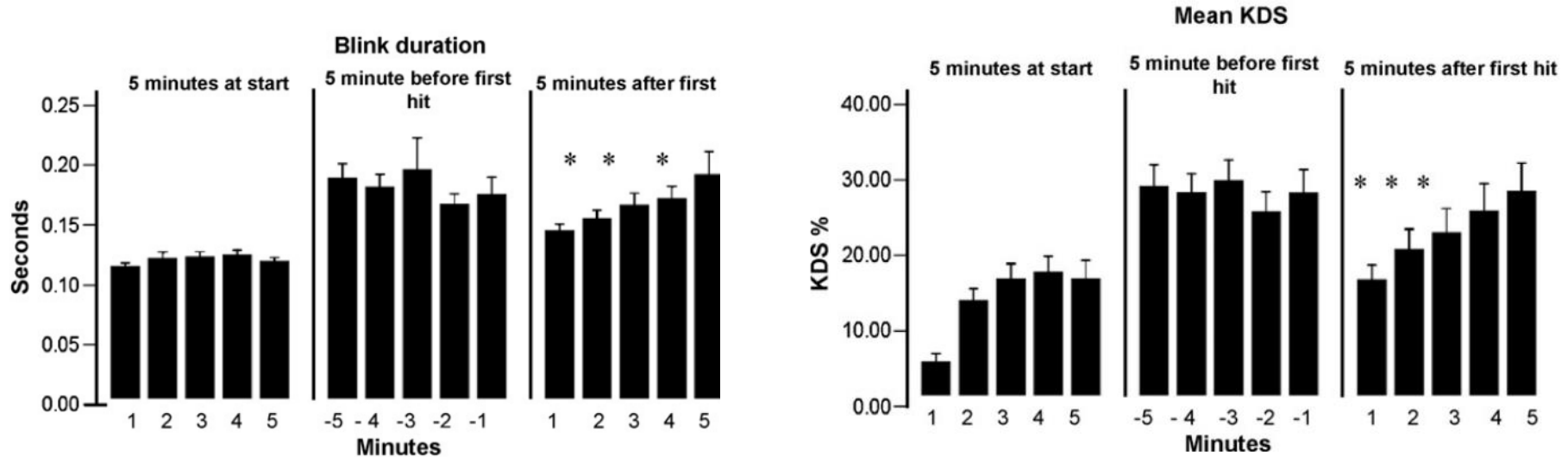


Anund and Vadeby, 2022

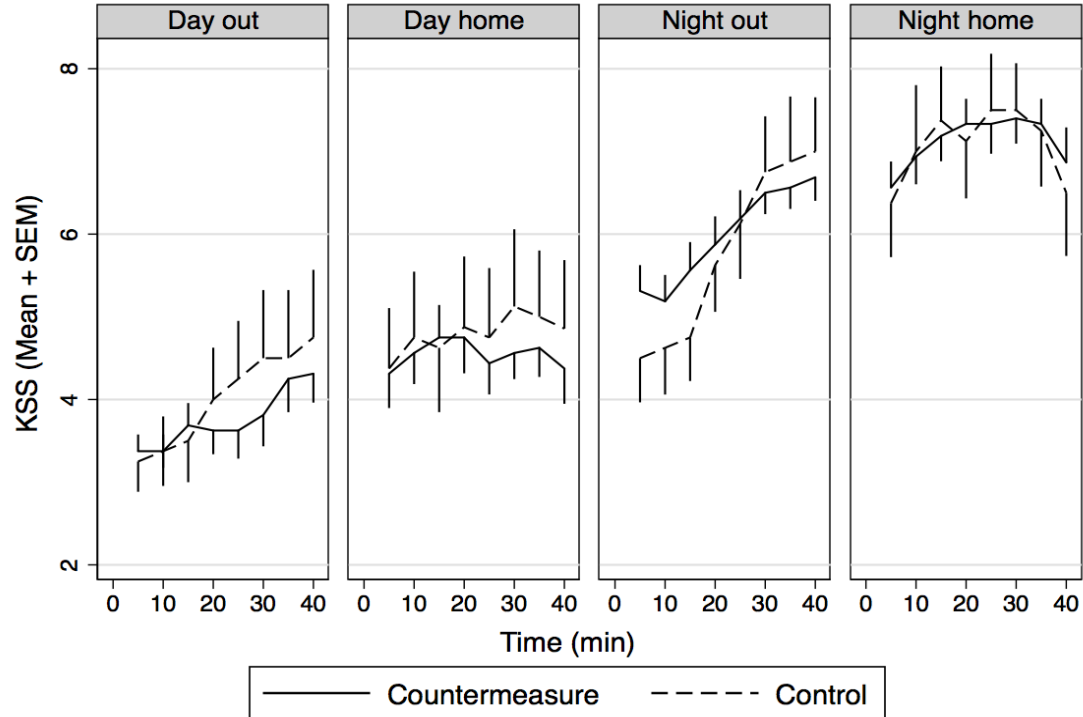
The effect of rumble strip hit

KSS were significantly higher before the hit (KSS average = 8.1; S.D. = 1.02) compared to in the beginning of the drive (KSS average = 6.7; S.D. = 1.11)

However, the drivers rated themselves even more sleepy after the hit compared to before the hit (KSS average = 8.33; S.D. = 1.02).



Radio and open window do not help sleepy drivers

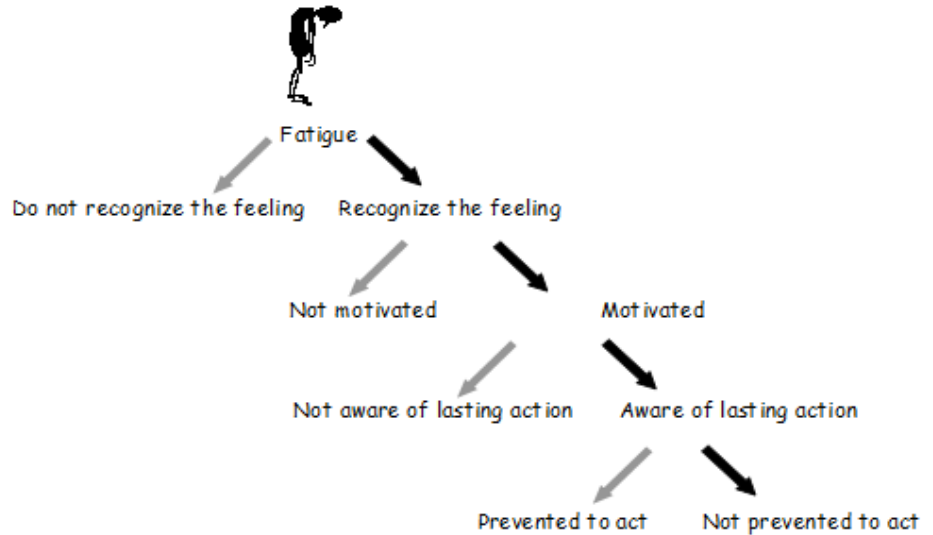


In summary, drivers know they are fatigued, but can not foresee the sleep onset.

The only valid countermeasure for sleepiness is sleep.

Fatigue can be counteracted shortly with disruption of boredom or by reducing the overload (break).

Opportunity to stop is essential.



For professional drivers a holistic approach is needed



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