Awareness of sleepiness – on the road, in the air, and the link to safety, physiology and other factors

Torbjörn Åkerstedt

In collaboration with Anna Anund, Christer Ahlström, and Carina Fors of the Swedish Road and Transport Research Institute, and many others

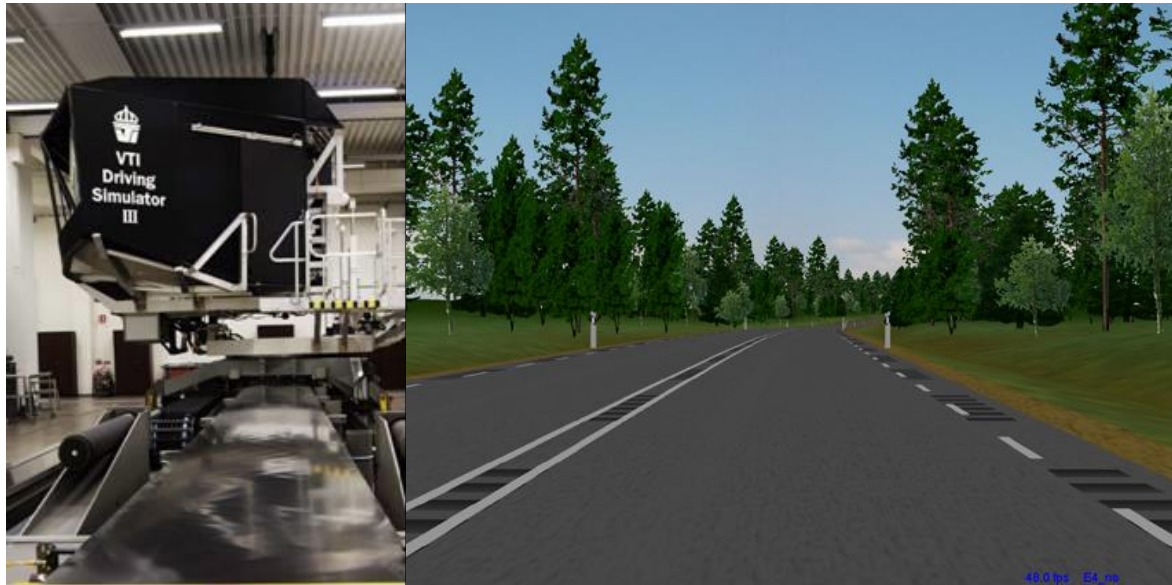# First some points about the studies

Sleepiness ratings
Karolinska Sleepiness Scale - KSS

1	extremely alert
2	very alert
3	alert
4	rather alert
5	neither alert nor sleepy
6	some signs of sleepiness
7	sleepy, but no effort to keep awake
8	sleepy, some effort to keep awake
9	very sleepy, great effort to keep awake, fighting sleep

The driving studies

The simulator

The Swedish Road and Transport Research Institute
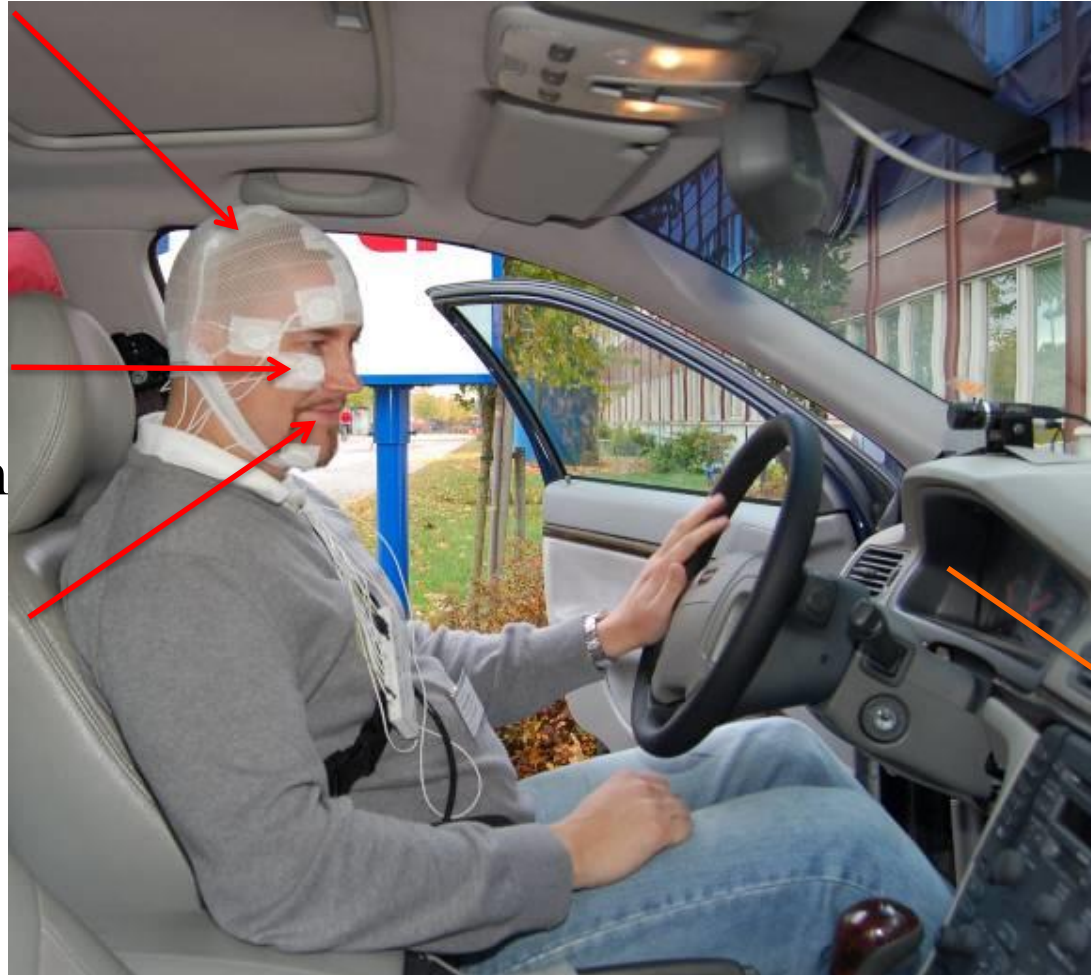
The instrumented vehicle

Comparison: day drive vs night drive (01-05h)

The key variables

EEG –
Alpha/
theta
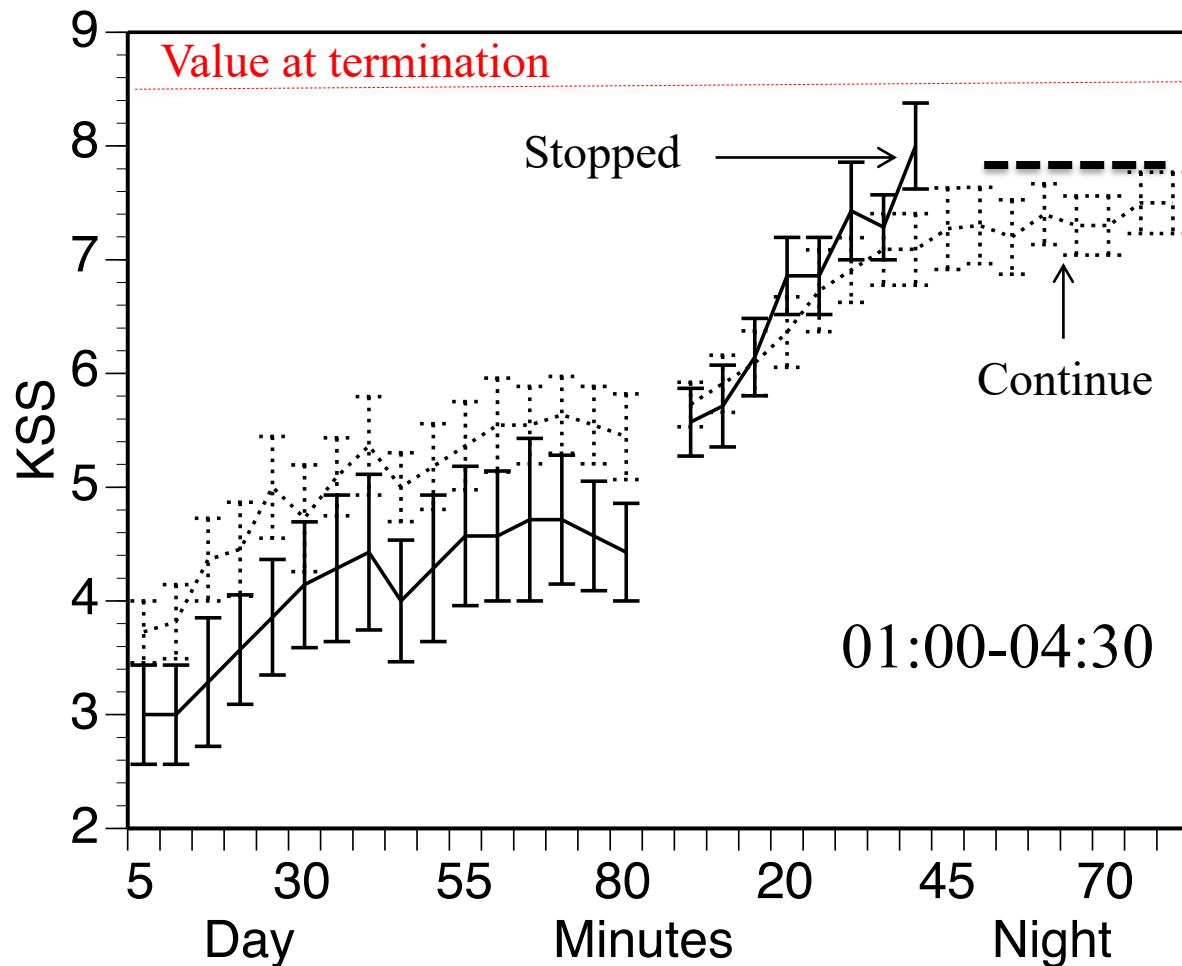activity

EOG
Blink
duration

Sleepi-
Ness
ratings
/5 min

Lateral
variability
Speed
Steering wheel
movement
Line crossings

A detailed example

**What comes before being taken off the road because of dangerous sleepiness**

Åkerstedt T, Hallvig D, Anund A, Fors C, Schwarz J, Kecklund G. Having to stop driving at night because of dangerous sleepiness - awareness, physiology and behaviour. Journal of Sleep Research 2013;22(4):380-8.

Sleepiness KSS

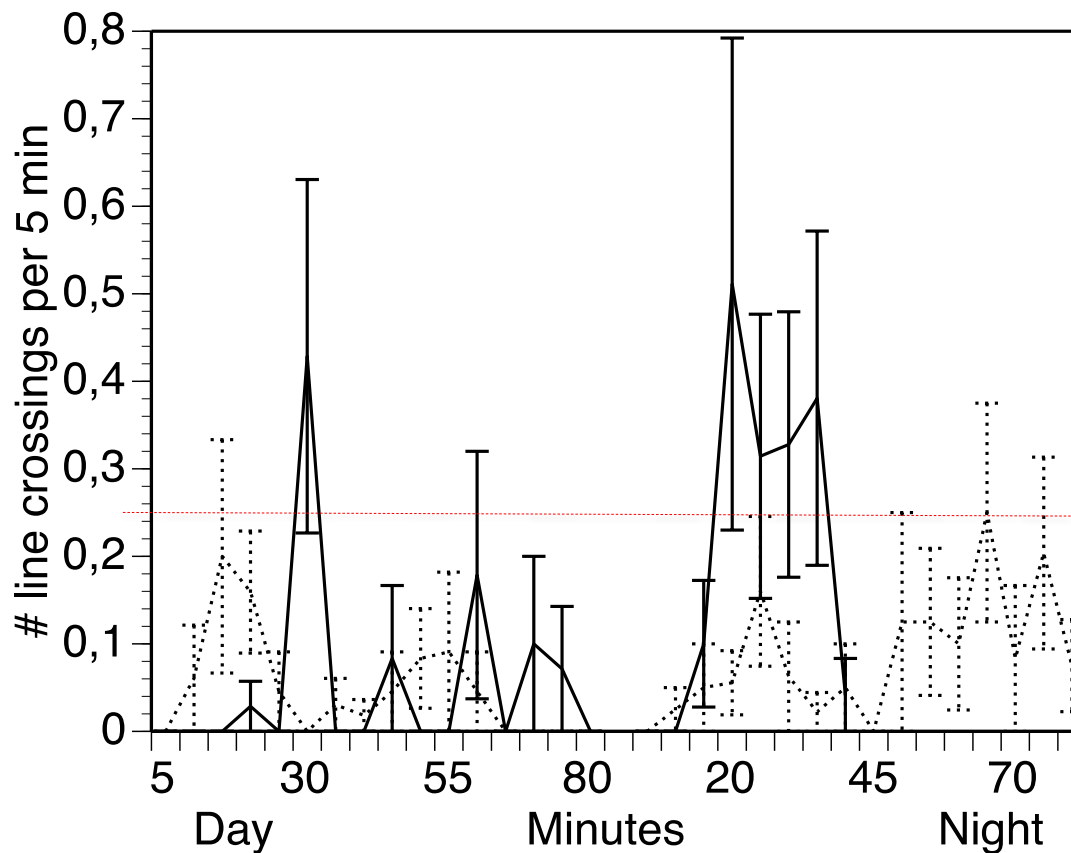Motorway, 42% are taken off the road for dangerous sleepiness
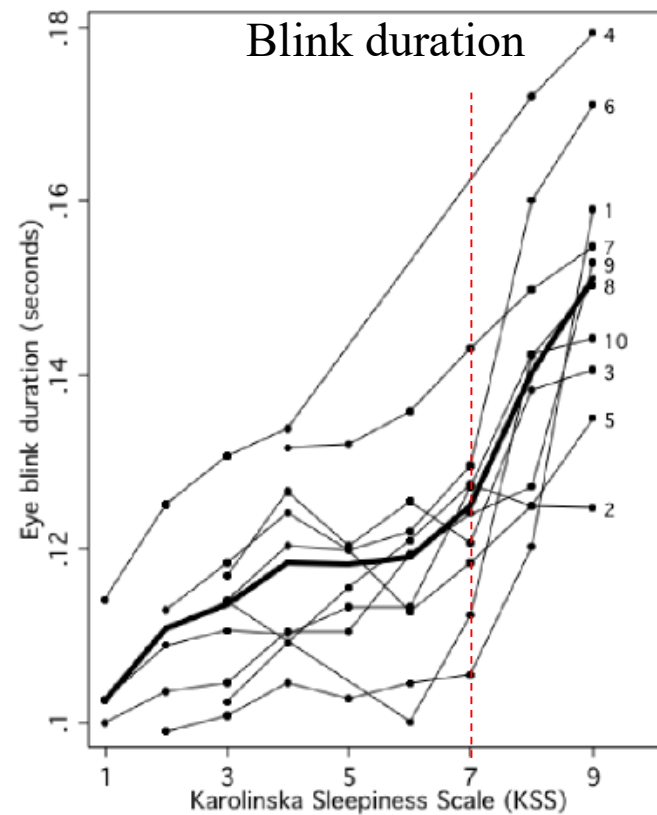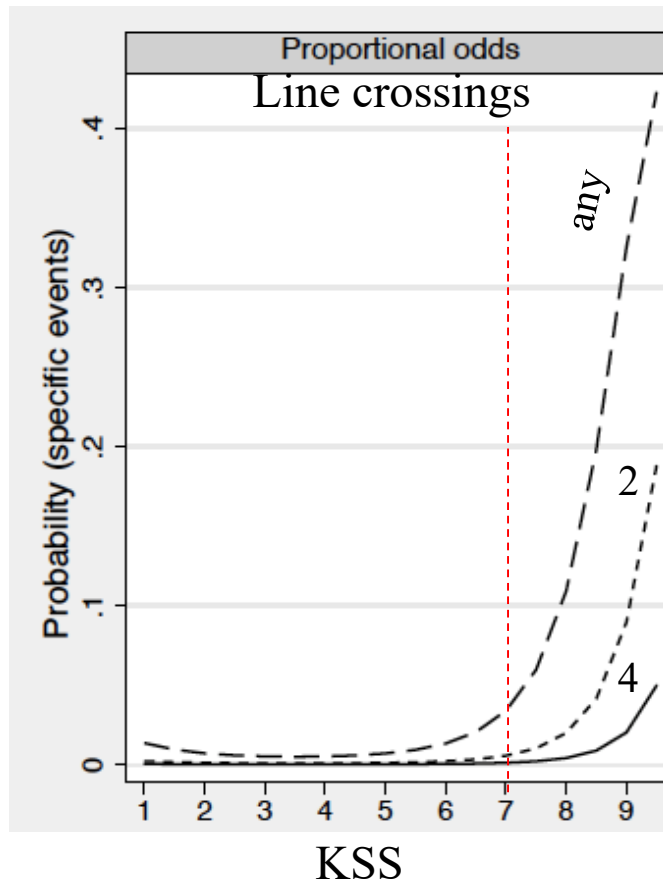
Blink duration
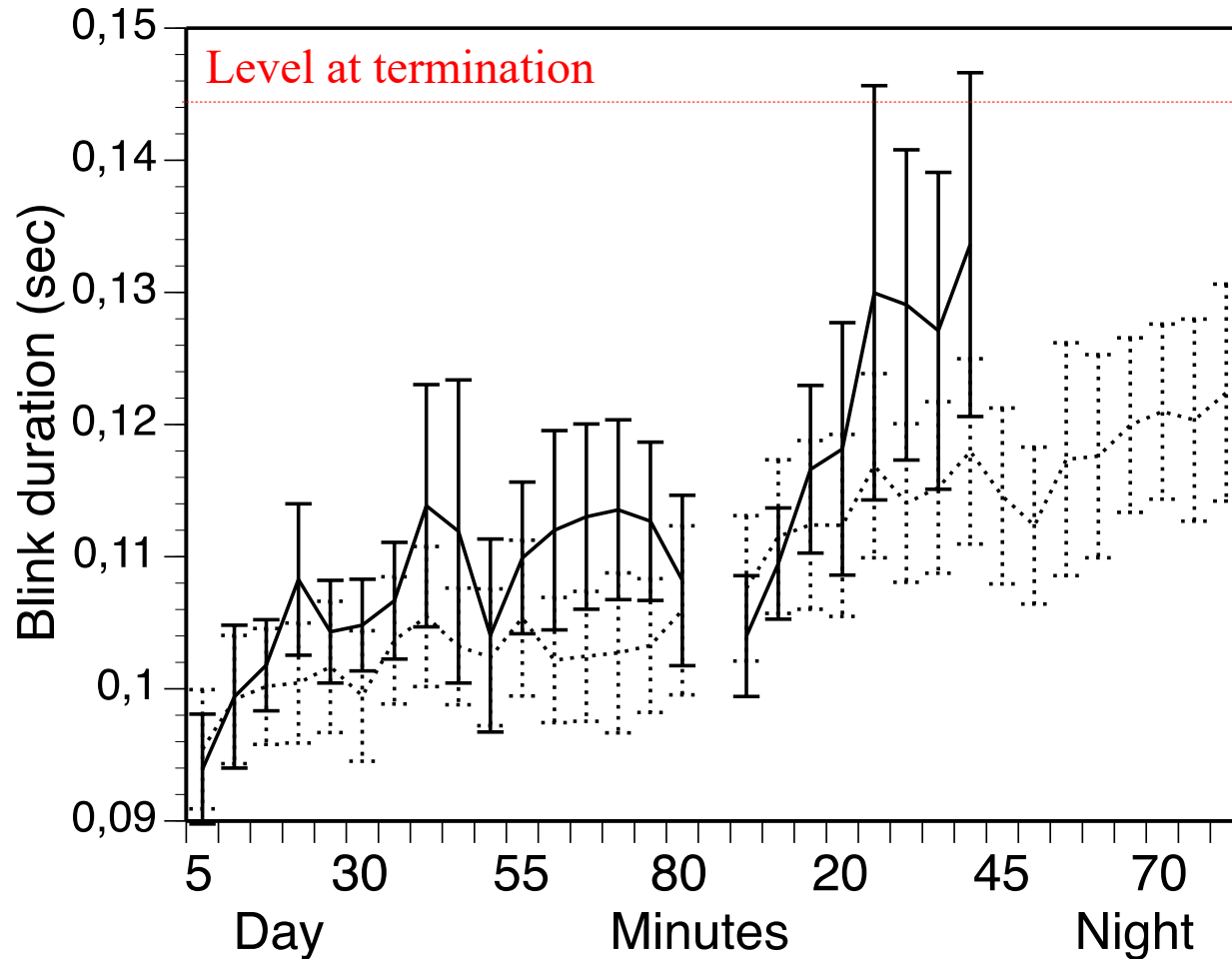
# EEG alpha/theta activity
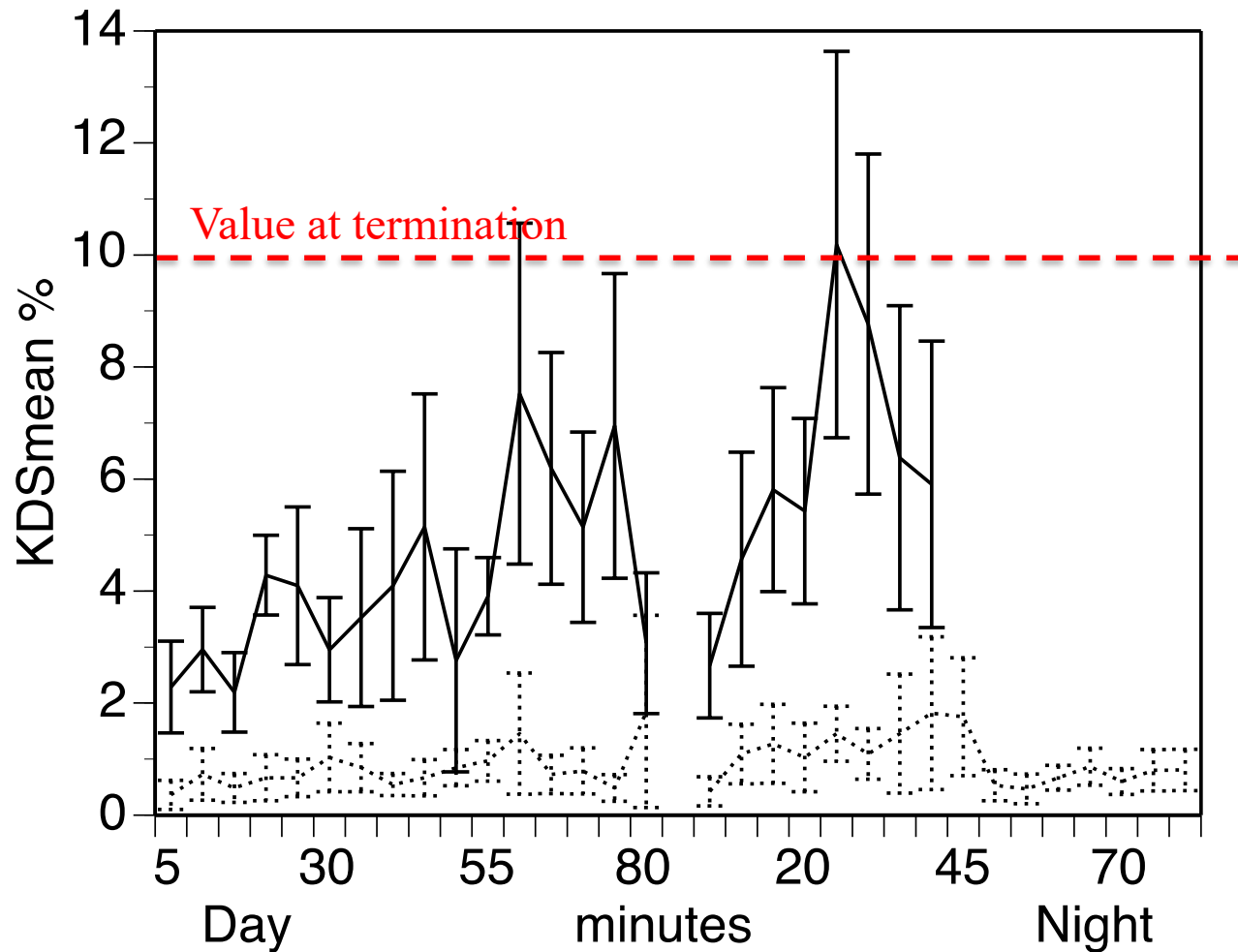
Unintentional line crossings

So, dangerous sleepiness is very common in late night driving on the motorway

Is there a link to other sleepiness symptoms, physiology or driving performance?

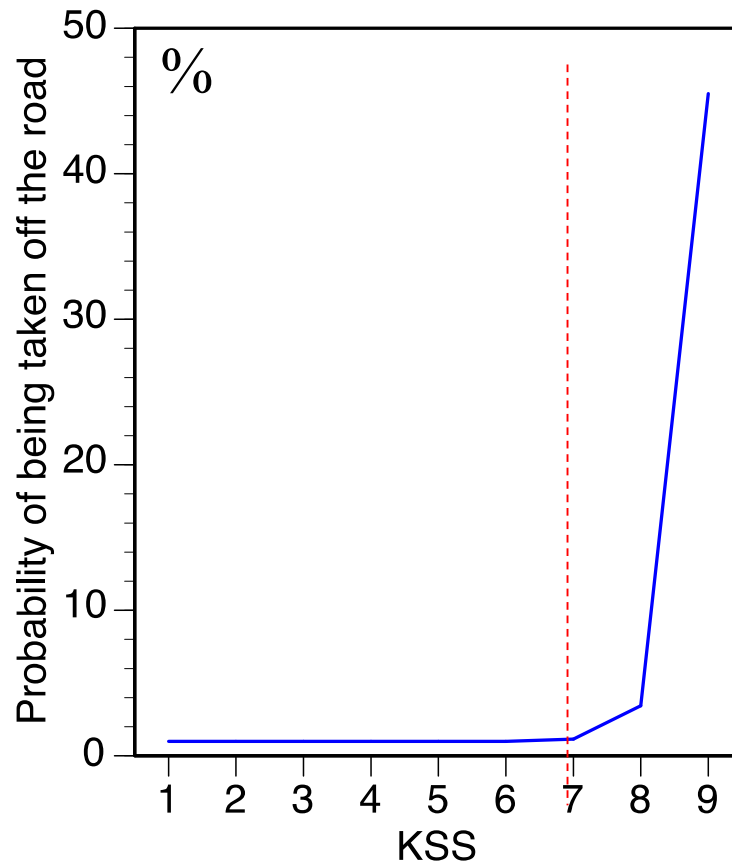# KSS vs line crossings and blink duration – night drive in simulator

Ingre et al 2006

KSS and the probability of a line crossing within 5 minutes – real driving
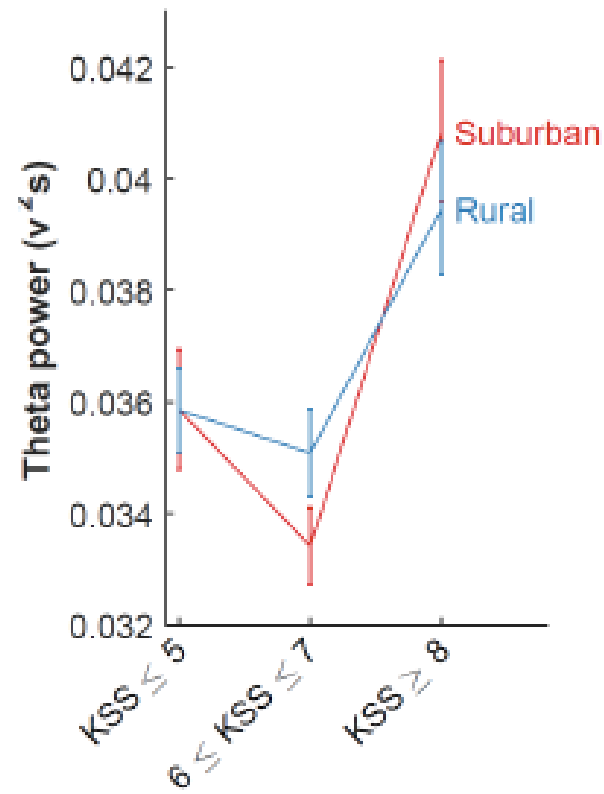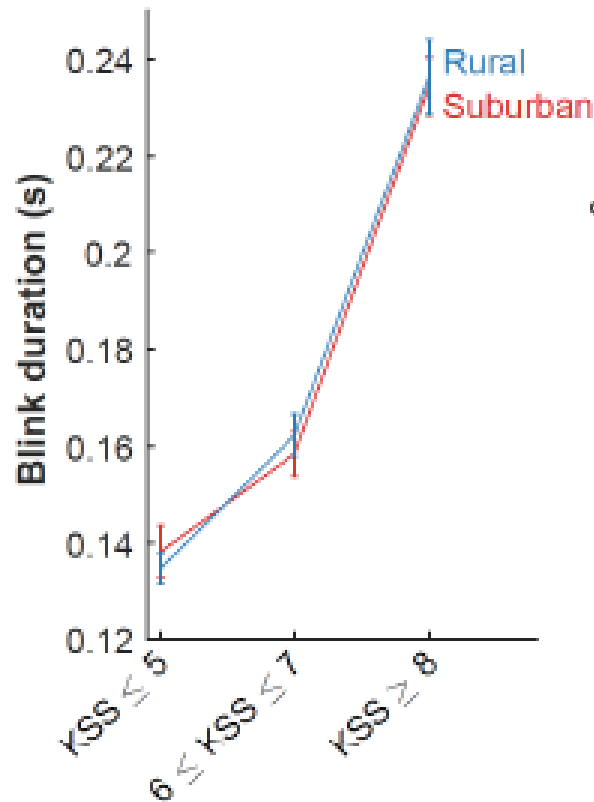

Night drive

Hallvig et al 2014
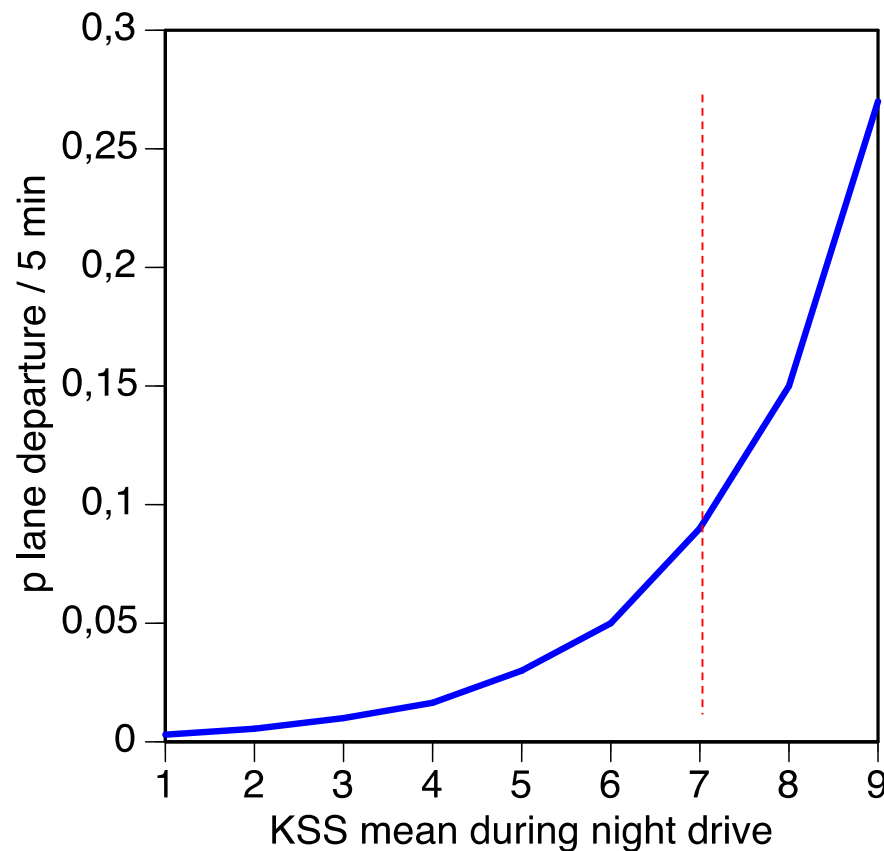
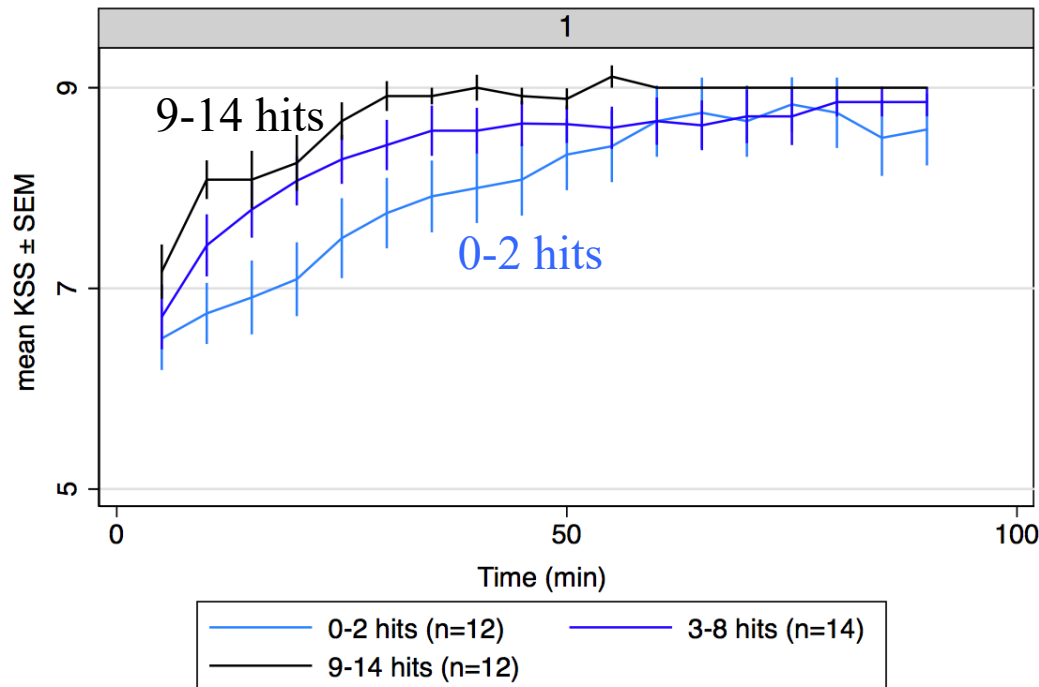# Probability of being taken off the road and immediately preceeding KSS – real driving

Night drive

KSS and blink duration & theta power – night drive in simulator

N=30

Ahlström et al. in prep

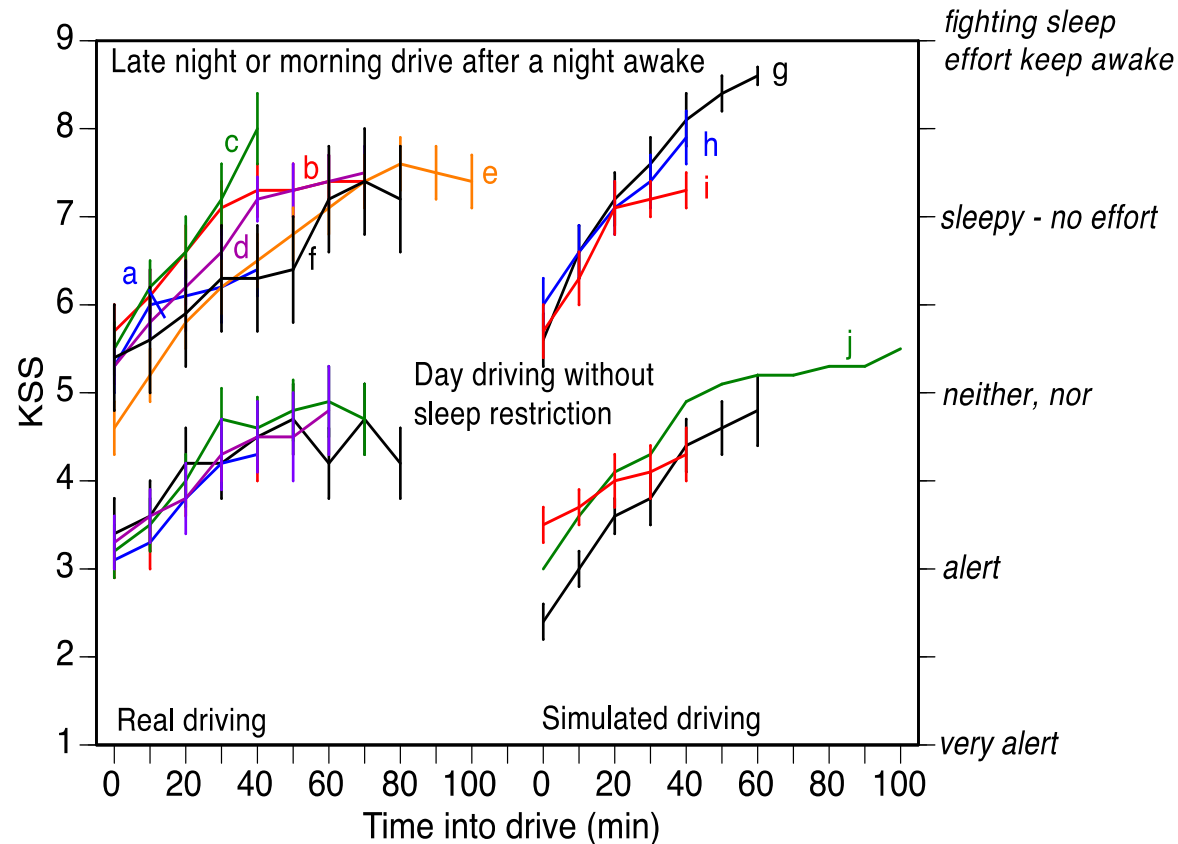# *Between* groups sleepiness in three groups differing in rumble strip hits during a drive (simulator)

N=45
Morning drive after night shift

Anund et al 2007

So, there is a steep rise in risky driving at KSS 8&9 – within and across individuals
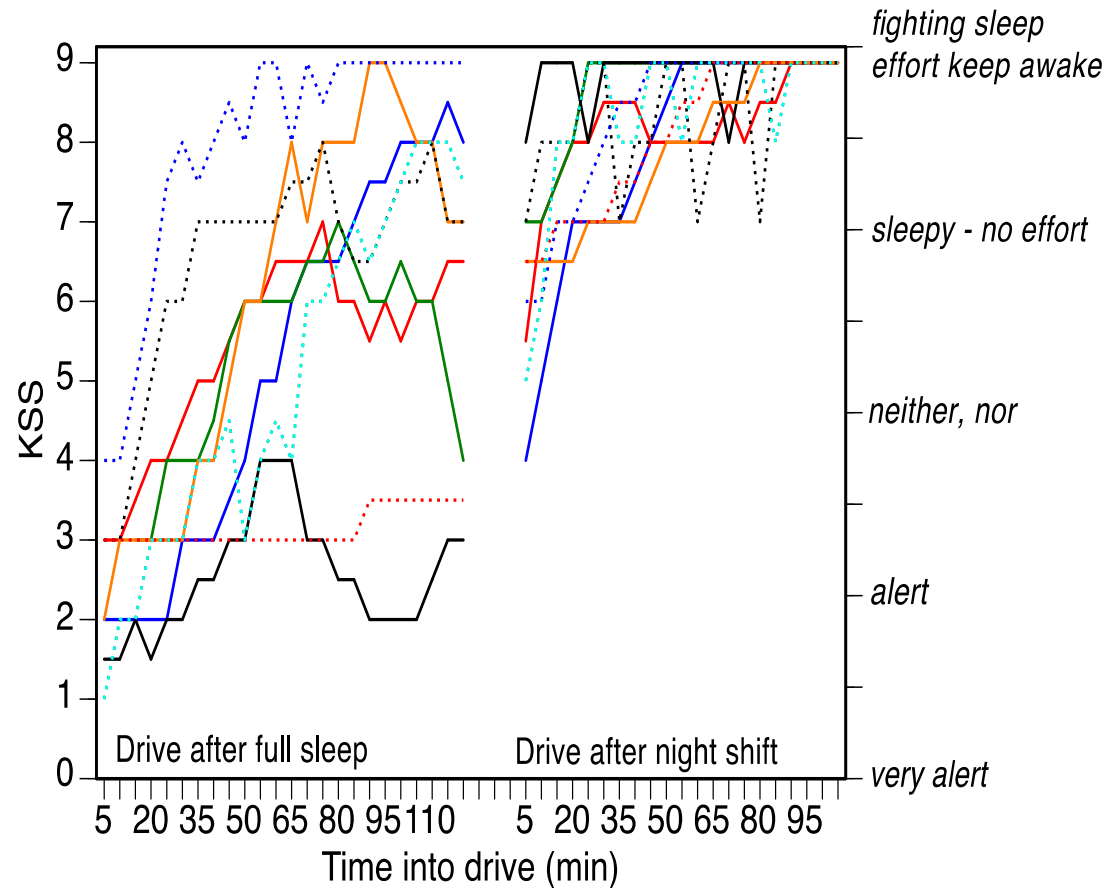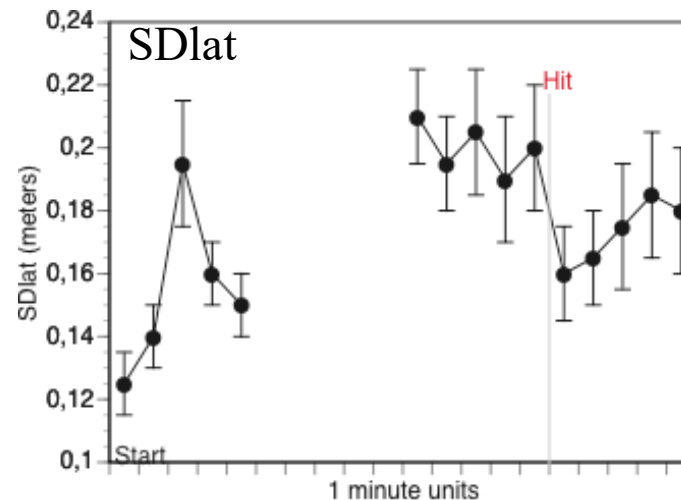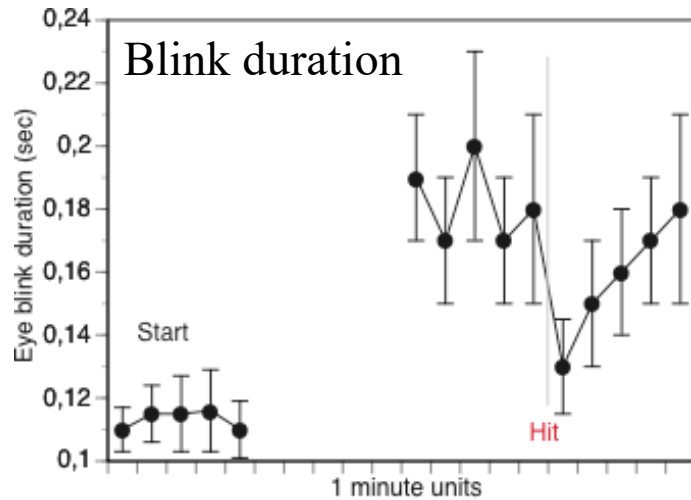
Consistency

KSS consistency across driving studies

Consistency across individuals
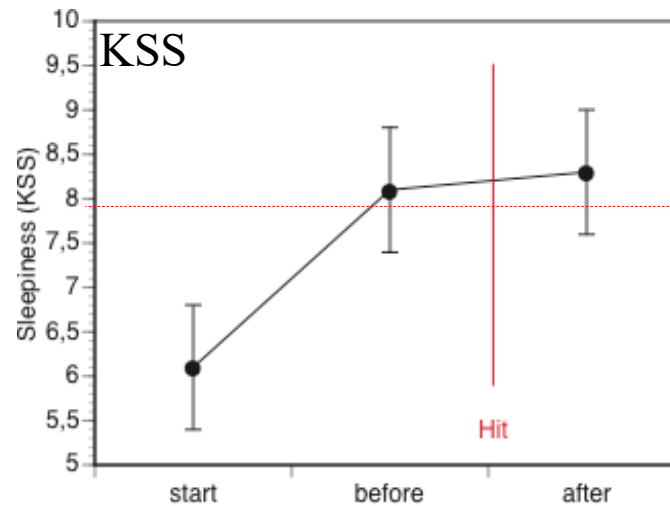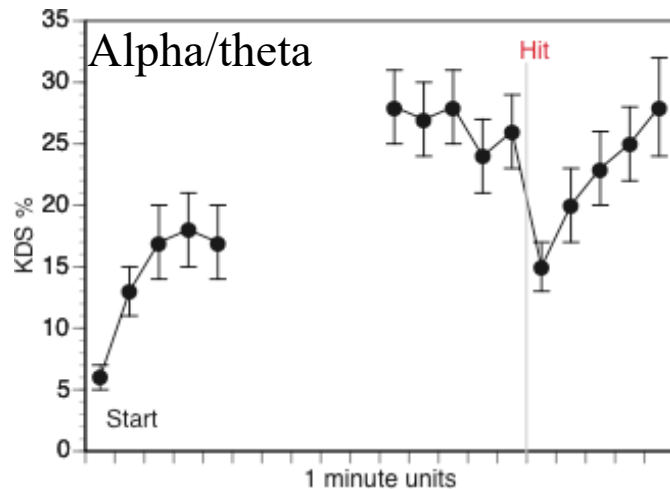# - KSS at 08:00h after a night shift – simulator

Åkerstedt et al 2014

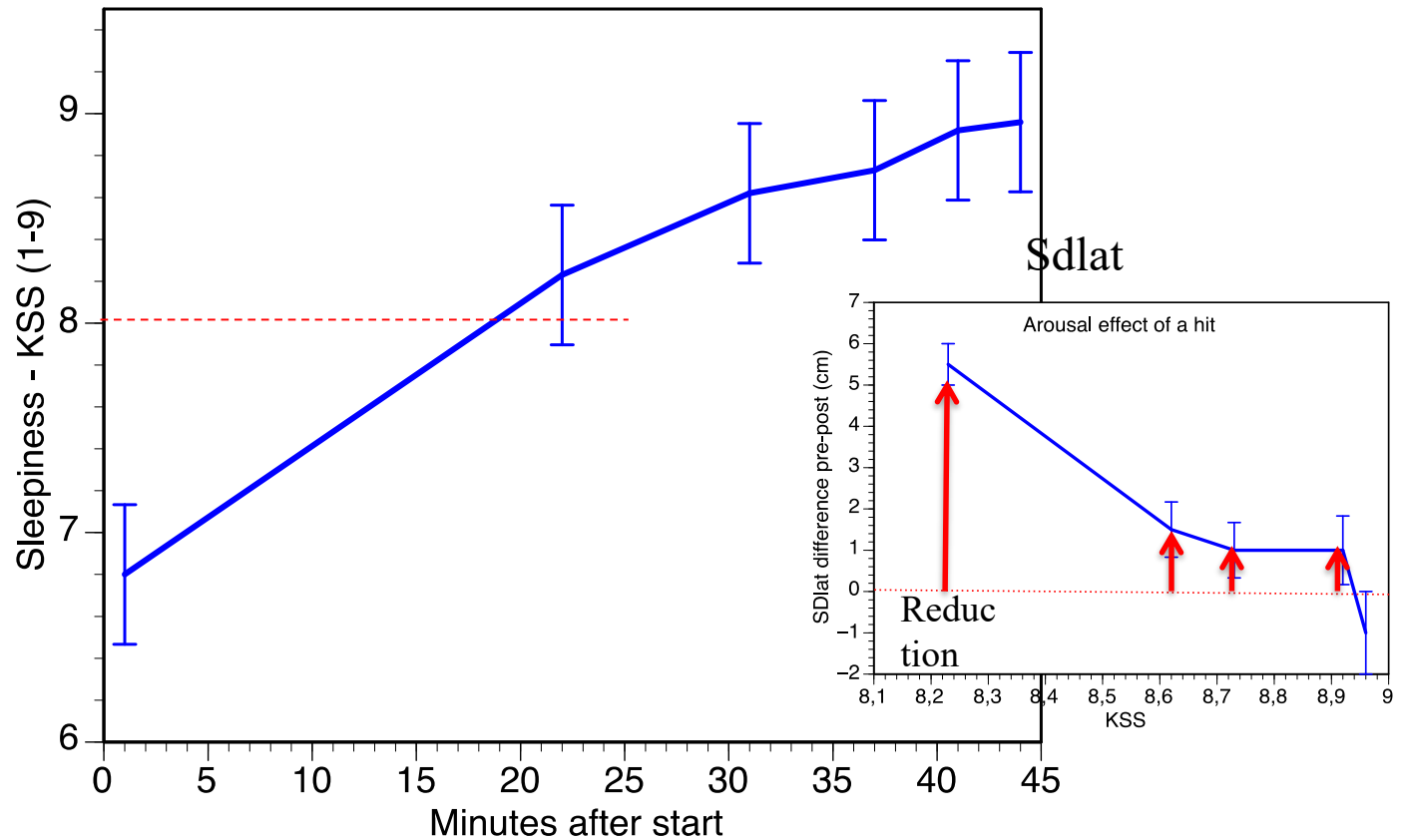# The relentless nature of sleepiness

Hitting a rumble strip while driving the simulator home after a night shift
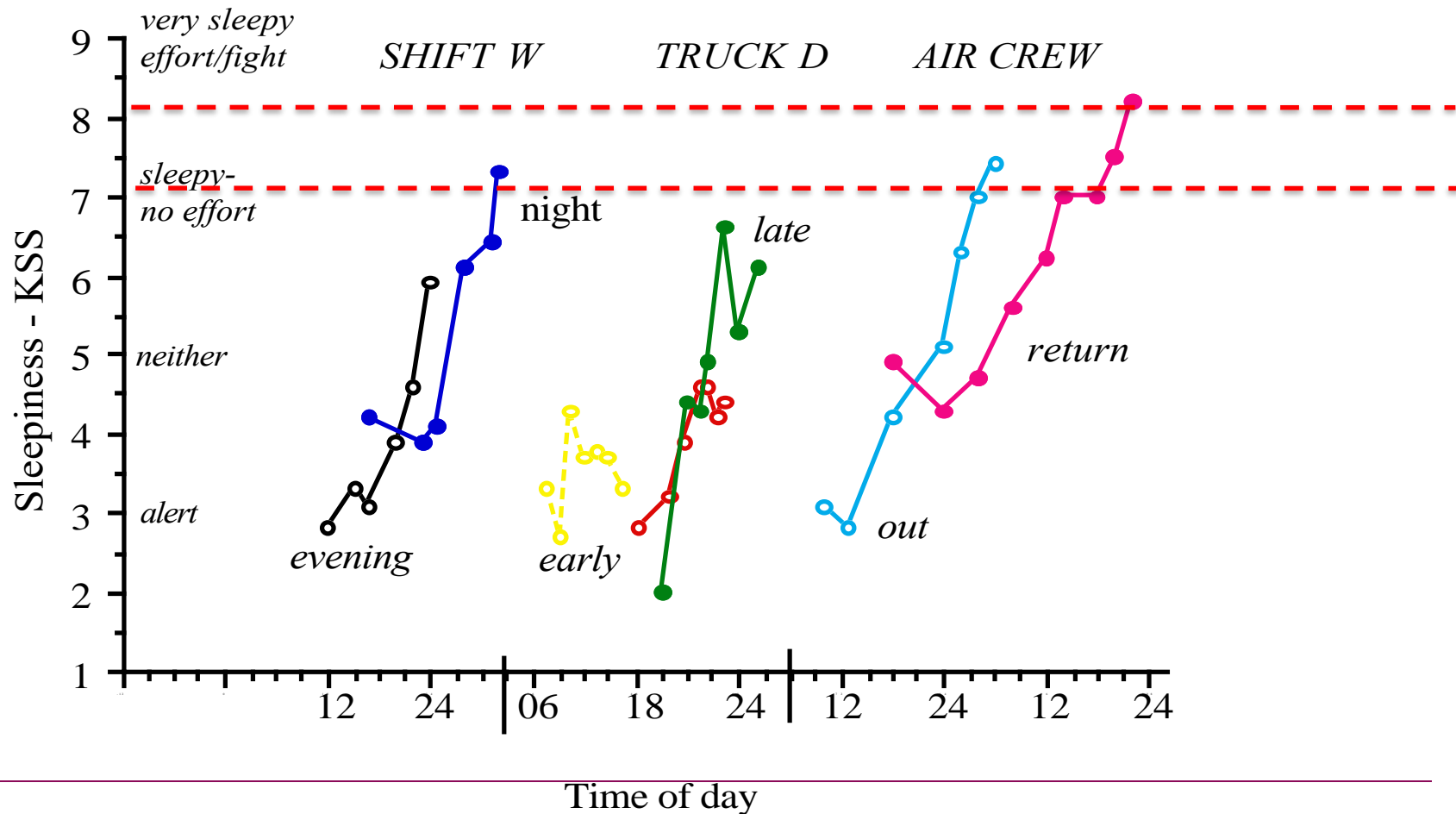

N=45; 90min

Anund et al 2007
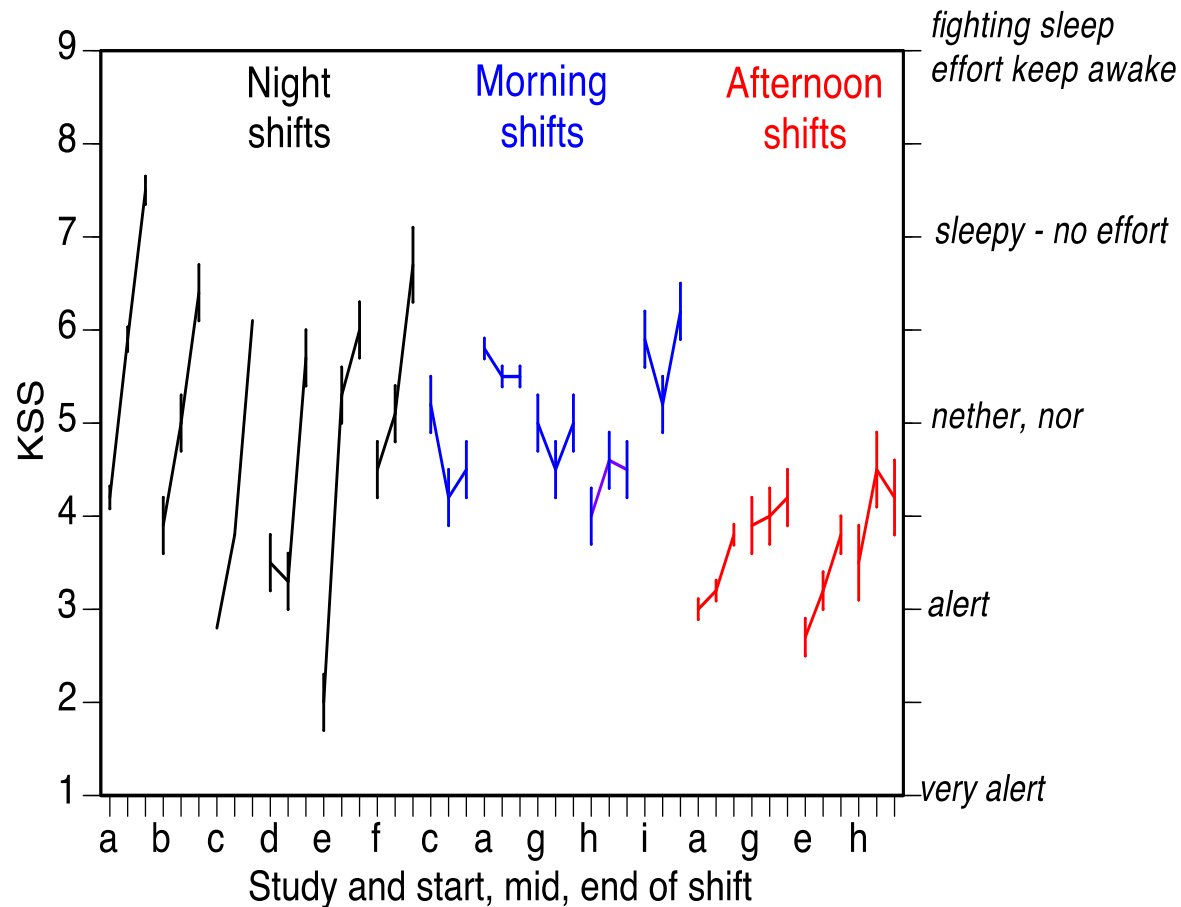
But, the hits keep occurring
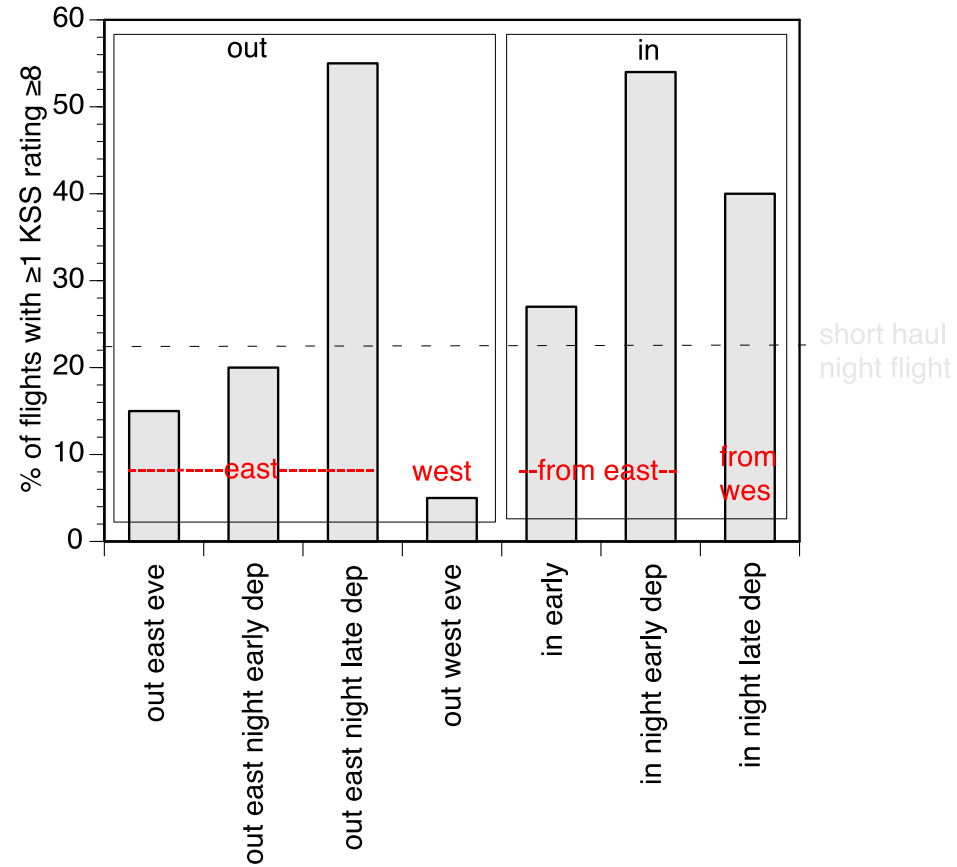
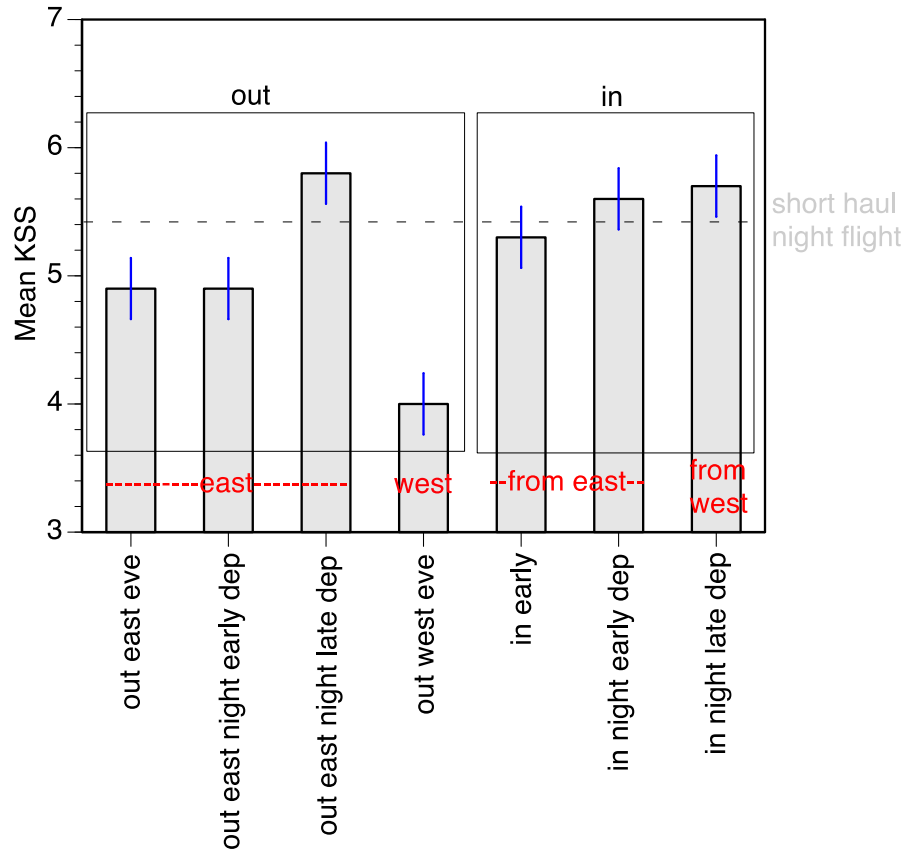# So, sleepiness is relentless

(Work) schedules

Night work in occupational groups

3-shift workers – different studies

Long-haul flights (8-11h), pilots
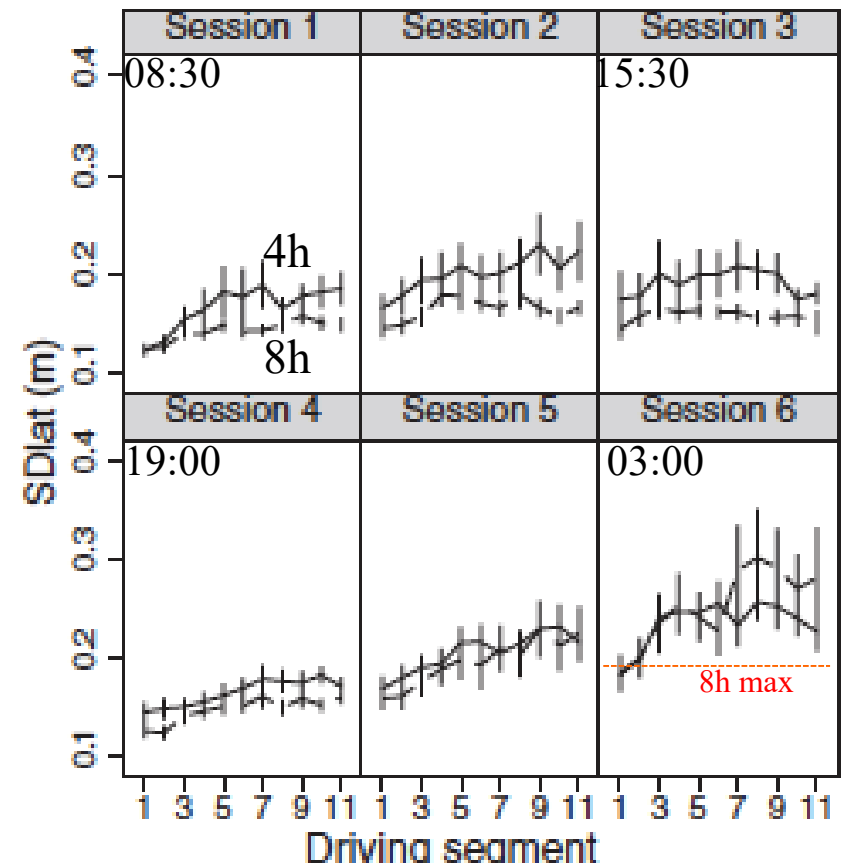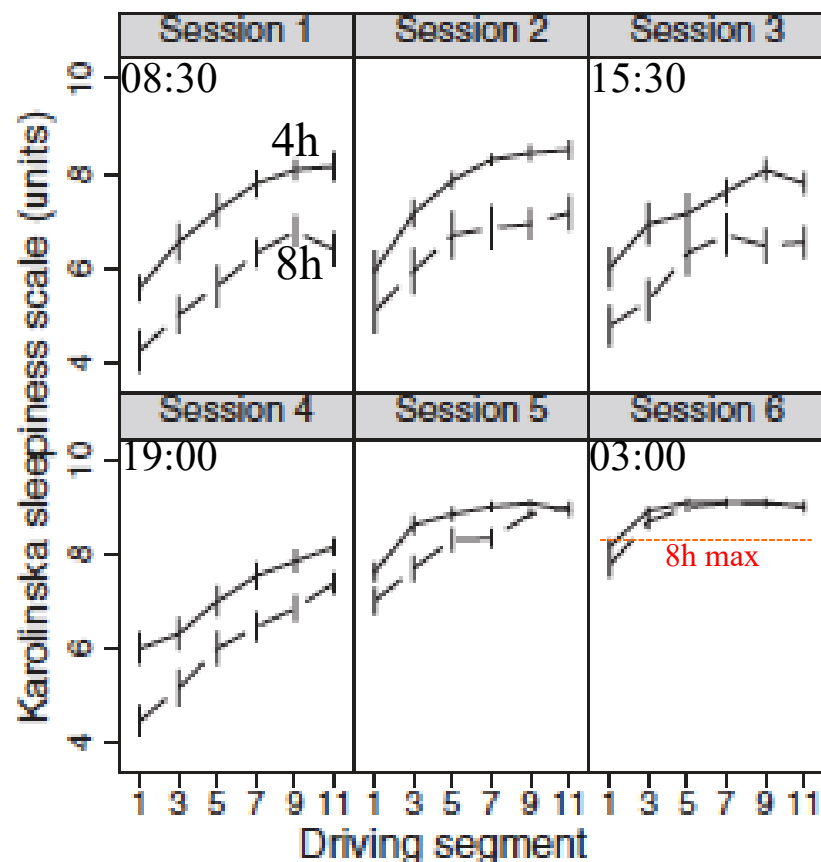
Is 4 hours of sleep enough? Or 8 hours?

N=15
Simulator

Åkerstedt et al 2010

So, late night work is very conducive to sleepiness

Other influences

Work or not?

N=500
1 week
Different
occupations

Åkerstedt et al 2017
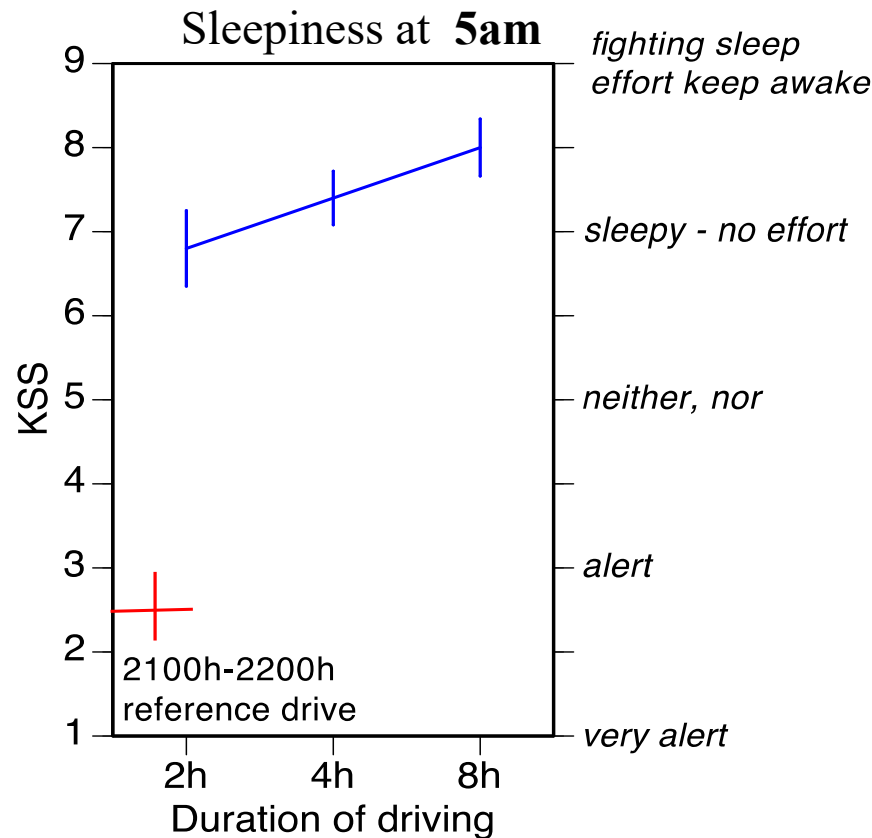
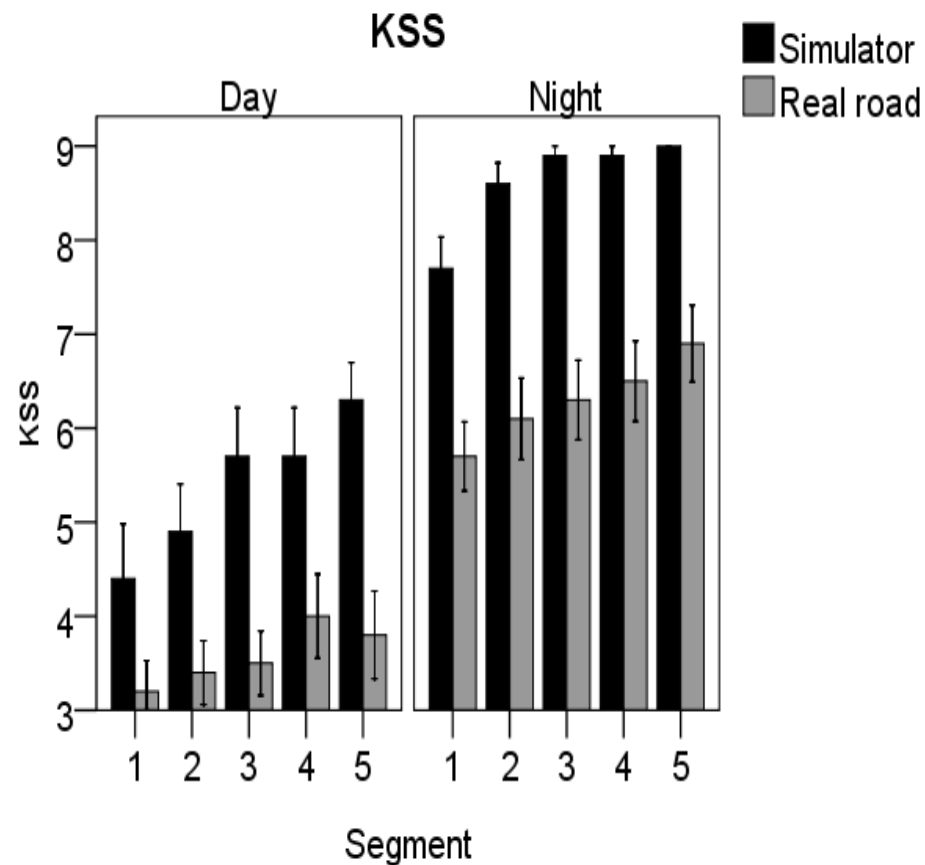# A break? – truck drivers during the night on the highway
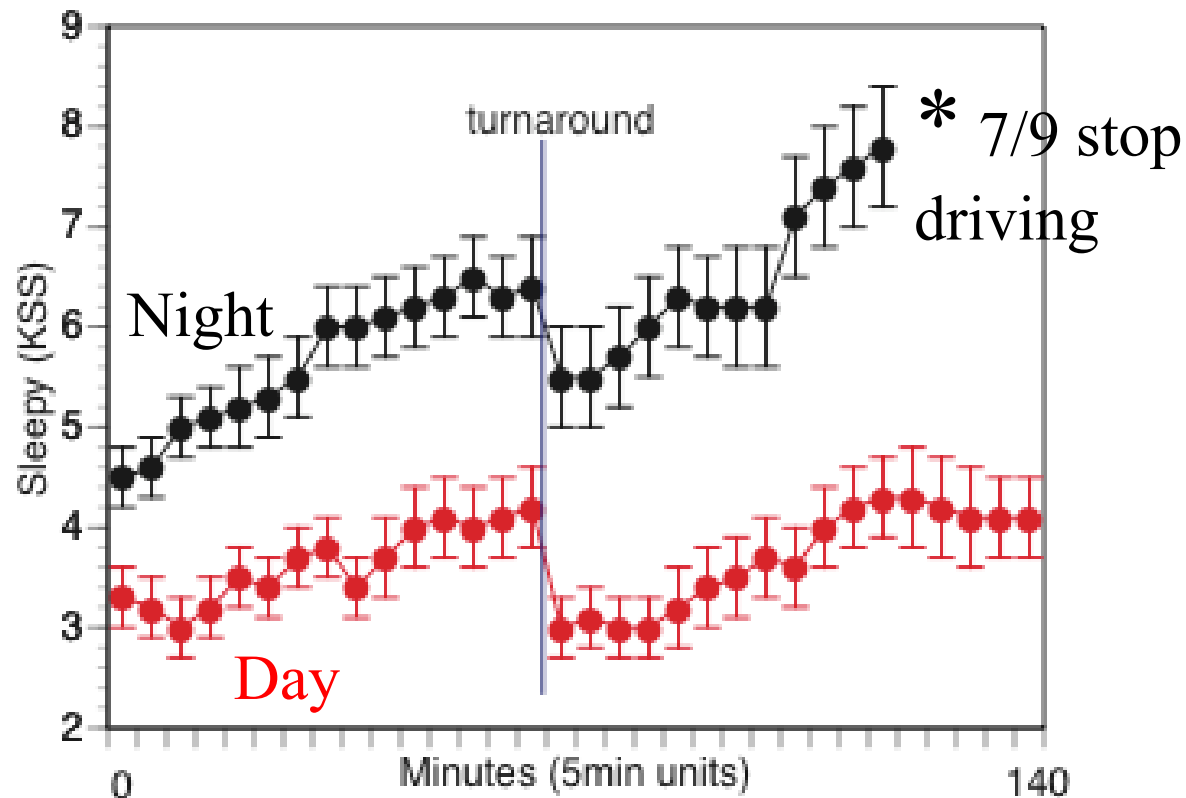
N=10 (truck drivers)

Duration of drive (real road) and sleepiness –
the only study controlling for time of day, time awake and prior sleep

Sleepiness at **5am**

fighting sleep
effort keep awake

sleepy - no effort

neither, nor

alert

very alert

KSS

2100h-2200h
reference drive

Duration of driving

Sagaspe et al 2008

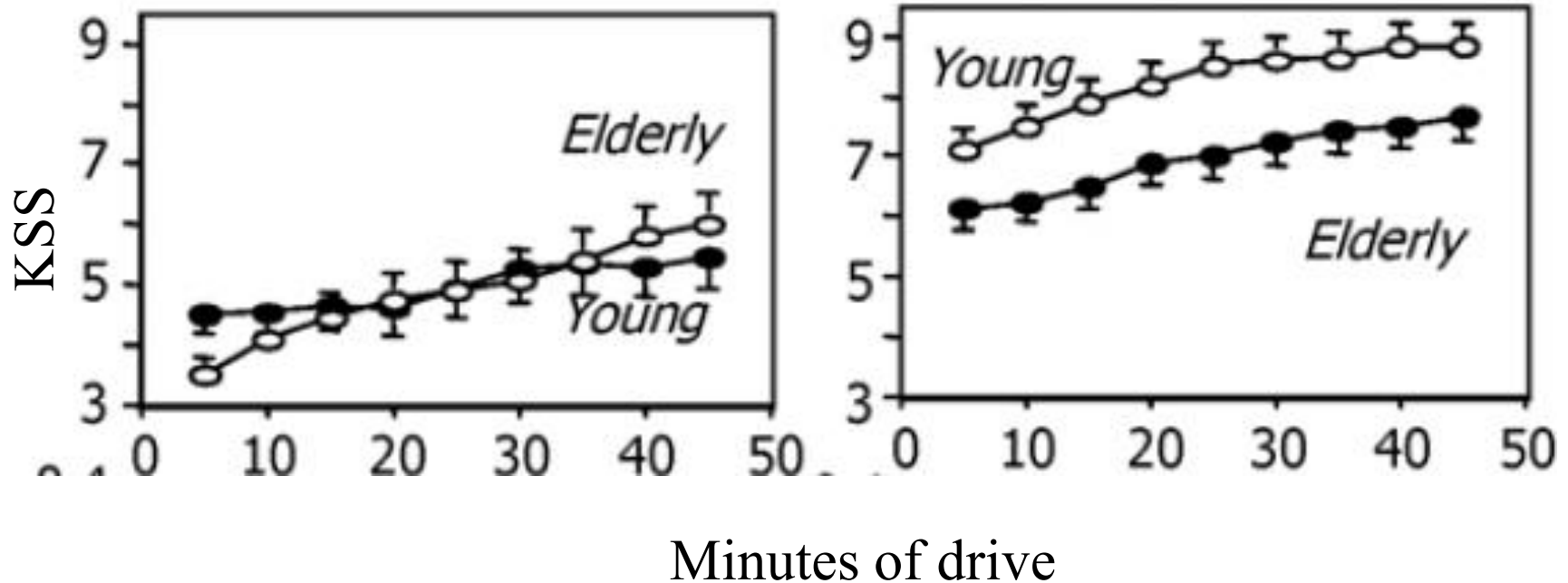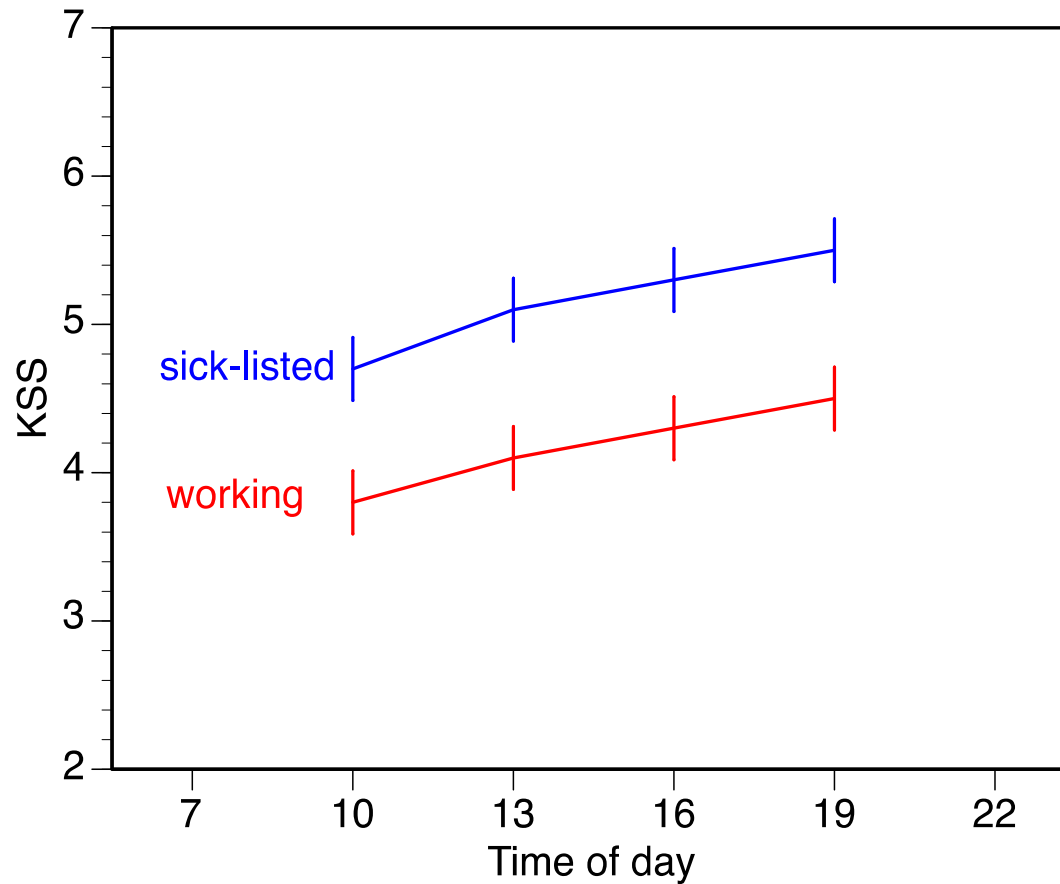# The simulator vs real driving (stimulation?)

N=10

Hallvig et al, 2011

Age and KSS during night driving in simulator

N=20
21 and 59 years

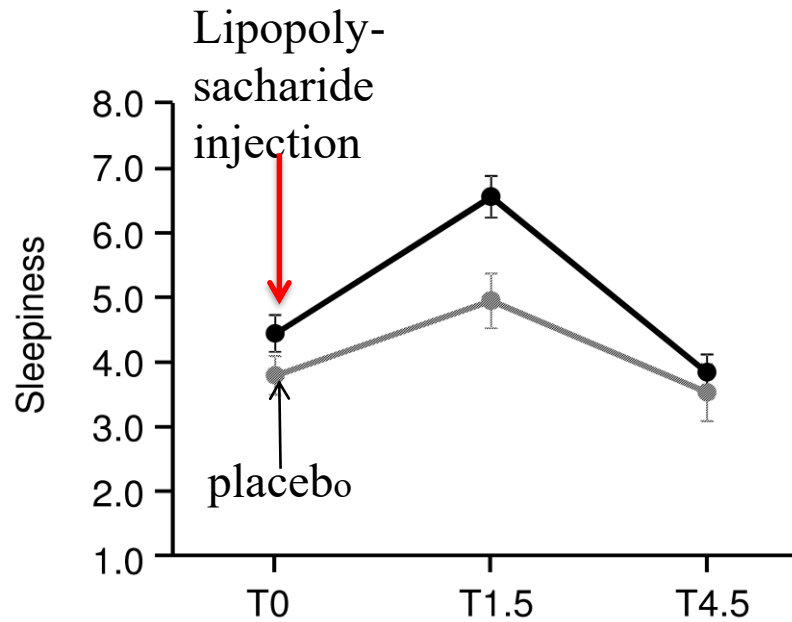Minutes of drive

Lowden et al 2009

Sick listed?

N=37 (of 800) 1 week with 3-hourly ratings

Experimentally sick?

Andreasson et al., in prep
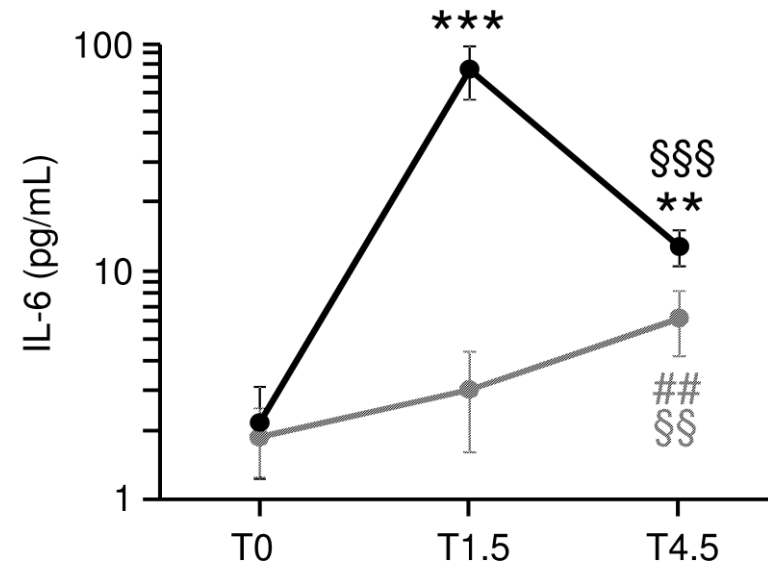
So, more than sleep/wake timing affect sleepiness

Summary pattern
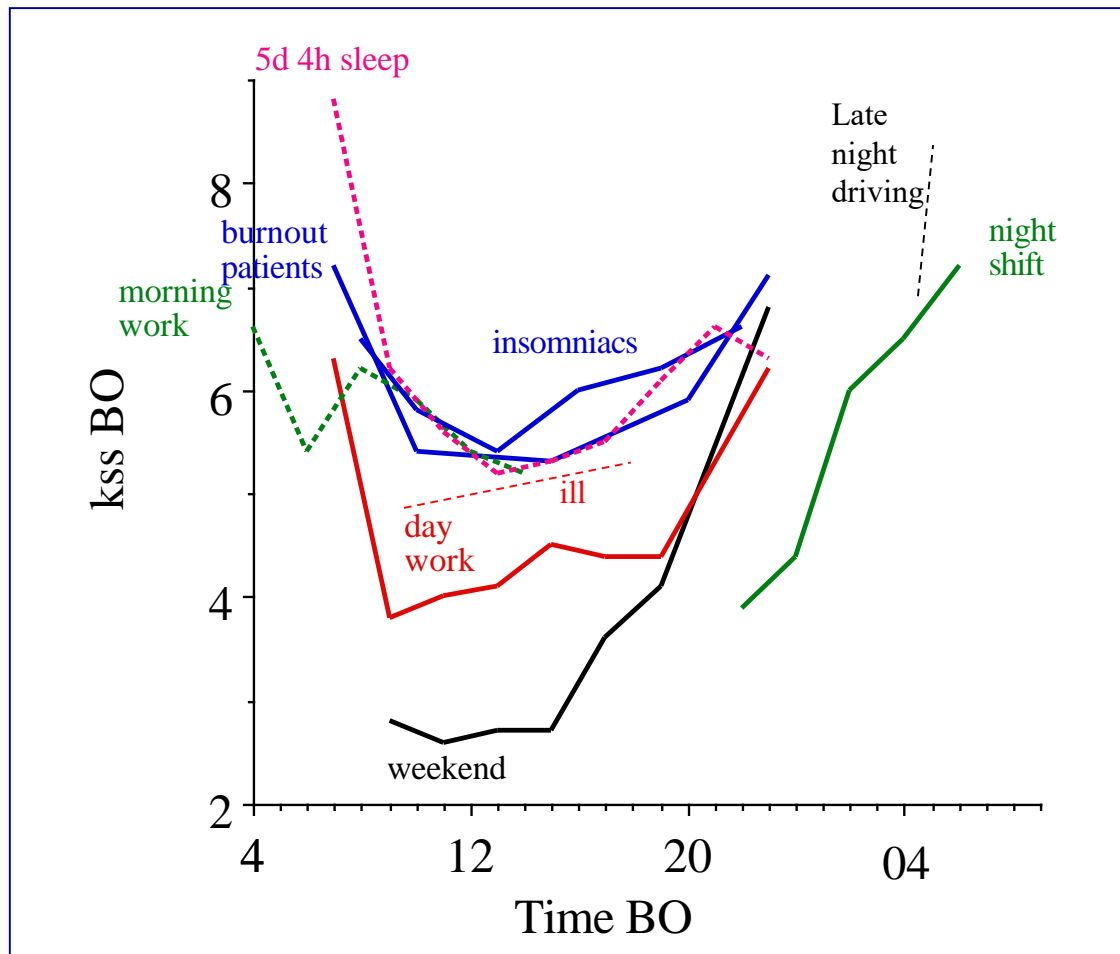
Conclusions

- Individuals are quite aware of their sleepiness level
- High sleepiness is closely related to risk behavior and sleep related physiology
- A key risk situation is late night work/activity
- But, time on task, boredom, being ill, being young, and others will exacerbate
- 8h of prior night sleep will not prevent late night sleepiness risk