Daytime Sleepiness - Risk Profile, Causes & Preventive Options

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www.stz-eyetrial.de

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… travelling in uncharted waters

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… high relevance

Overview

- The problem, causes, consequences
- Prevention
  - Technical solutions
  - Individual
  - Regulatory

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Problem Daytime Sleepiness

- 30 % of the German population report frequent problems with daytime sleepiness
- Decreased quality of life
- Important cause of accidents

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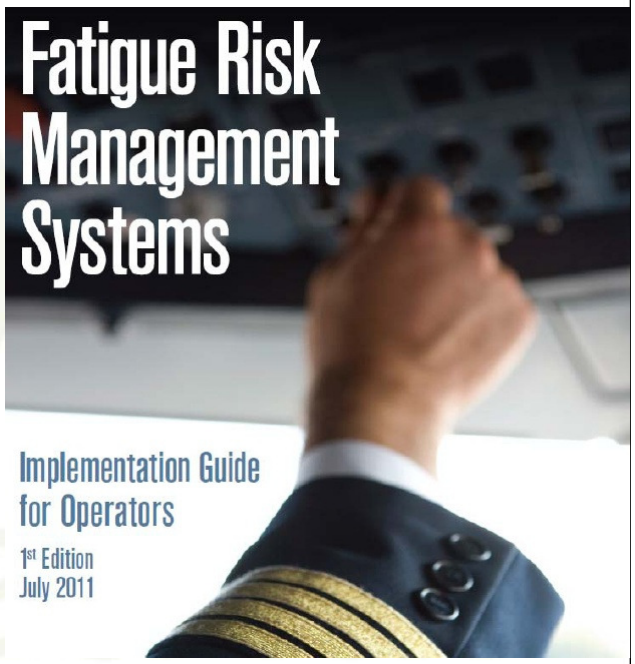
Sleepiness in Aviation

- Exceptionally high risk for fatal accidents
- Unphysiological working schedules e.g. in pilots and crew
- Jet lag
- Every 2. pilot reports unvoluntary sleep attacks (Balpa)
- Ground: monotonous tasks for operators and regulators 24/7



Sleepiness

is different from

Fatigue

Sleepiness

- related to poor quality of quantity of night sleep

Fatigue

- Psychological problem or related to stress or physical
- Not related to night sleep quality or quantity
- E.g. in insomnia, depression, multiple sclerosis

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Sleepiness

is different from

Fatigue

- Someone who is fatigued must not necessarily be sleepy
- Sleepy subjects often suffer from fatigue, too

Obstructive sleep apnea syndrome (OSAS)

Obstructive sleep apnea syndrome (OSAS)

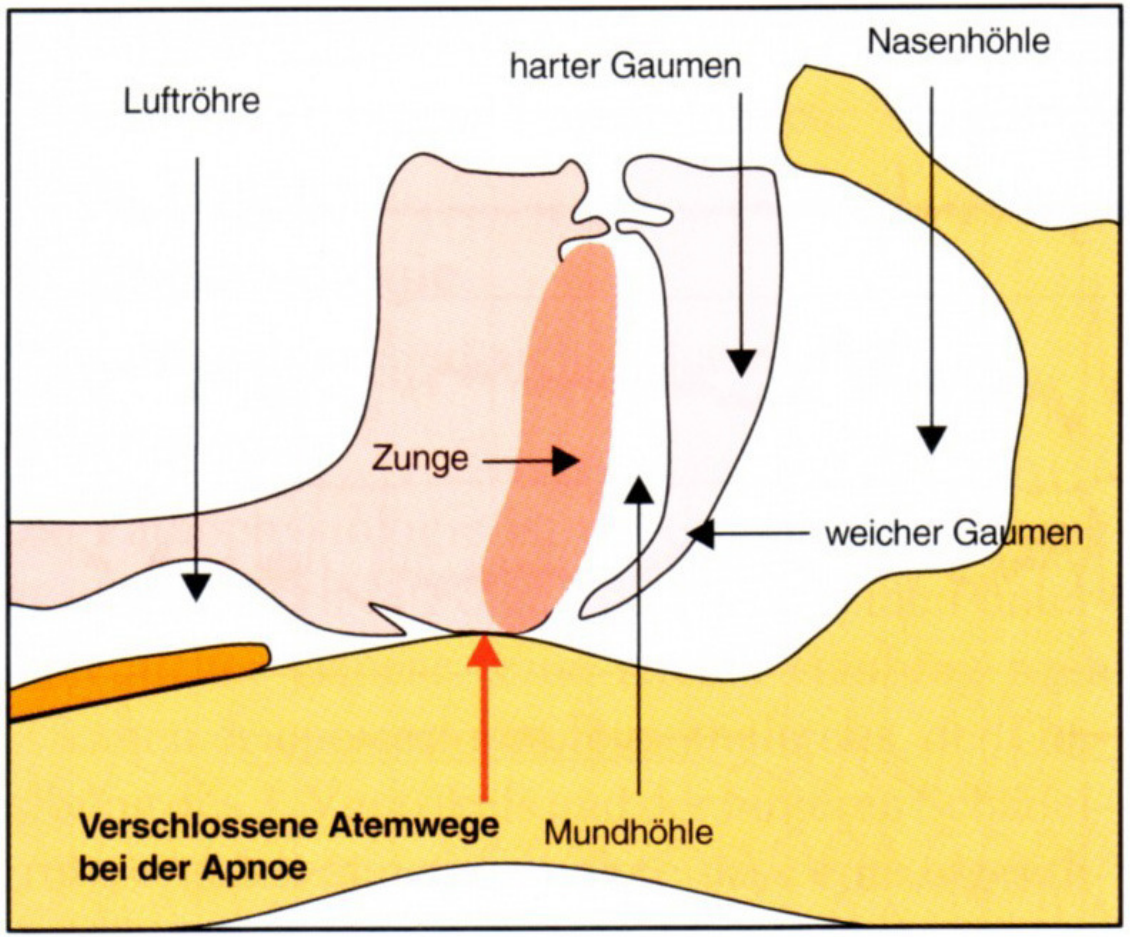

Abb. 3.2: Funktionelle Veränderungen in Rückenlage als pathophysiologischer Teilmechanismus beim OSA.

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Breathing arrest destroys sleep

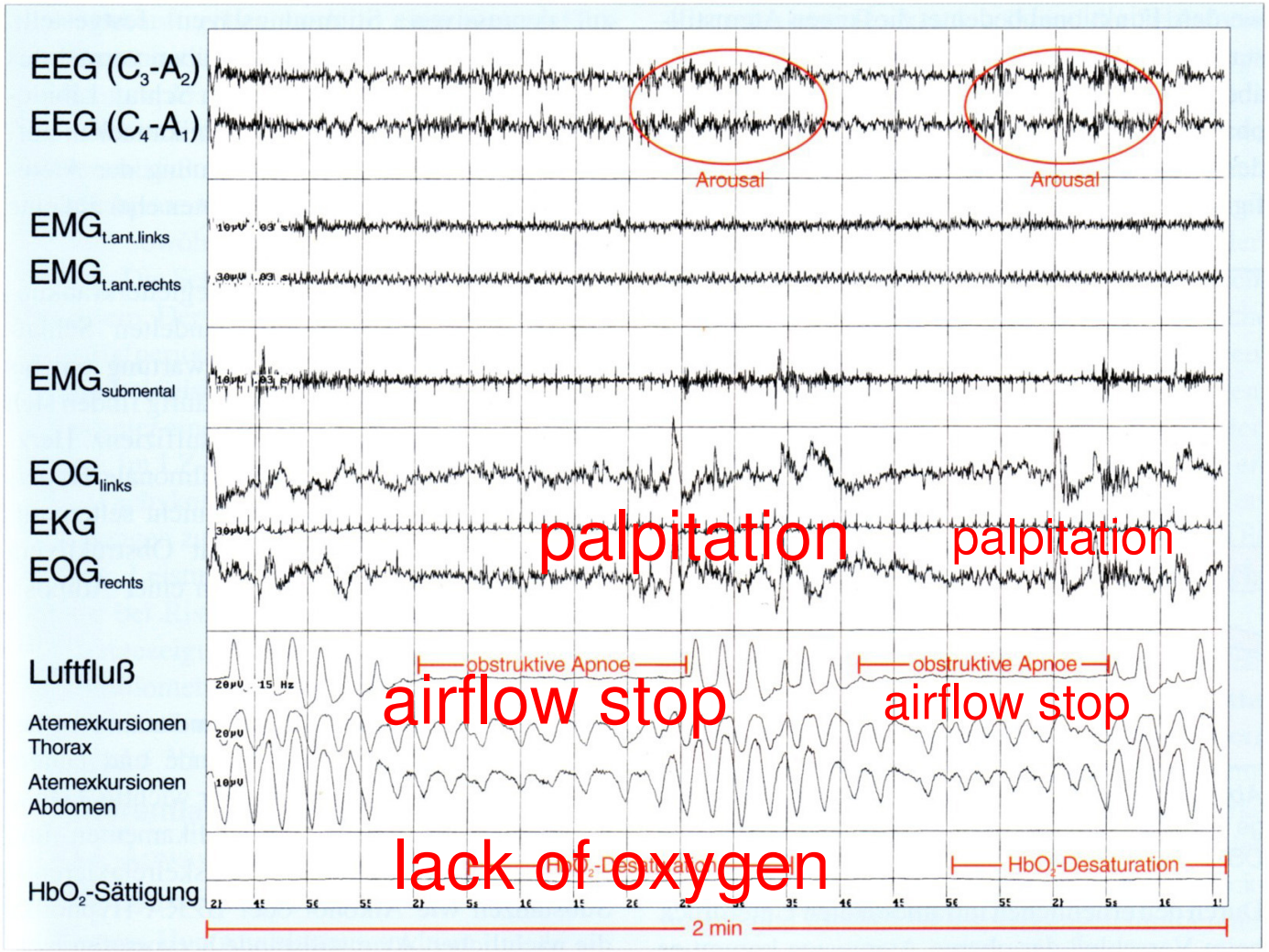

Abb. 3.1: 2-Minuten-Darstellung einer Polysomnographie bei einem Patienten mit obstruktivem Schlaf-Apnoe-Syndrom. Die Markierungen zeigen 2 obstruktive Apnoen mit konsekutiver HbO_2-Desaturation und terminierenden Arousalreaktionen (EEG).

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Consequences / complications

- Hypertension
- Stroke, heart attach
- Small vessels damage
- Eye diseases
- Hypoxy brain damage
  - Daytime sleepiness, attention impaired
- Depression
- Erectile dysfunction
- Poor quality of life

Accidents

EU-project IMMORTAL – Task R1.1:
Estimating accident risks associated with ageing, illness and disease – (Meta analysis: 62 trials)

Relative Riscs for traffic accidents by diseases

- Visual impairment general **1,09**
- Alkoholism **2,00**
- Sleep apnea, narcolepsy **3,71**

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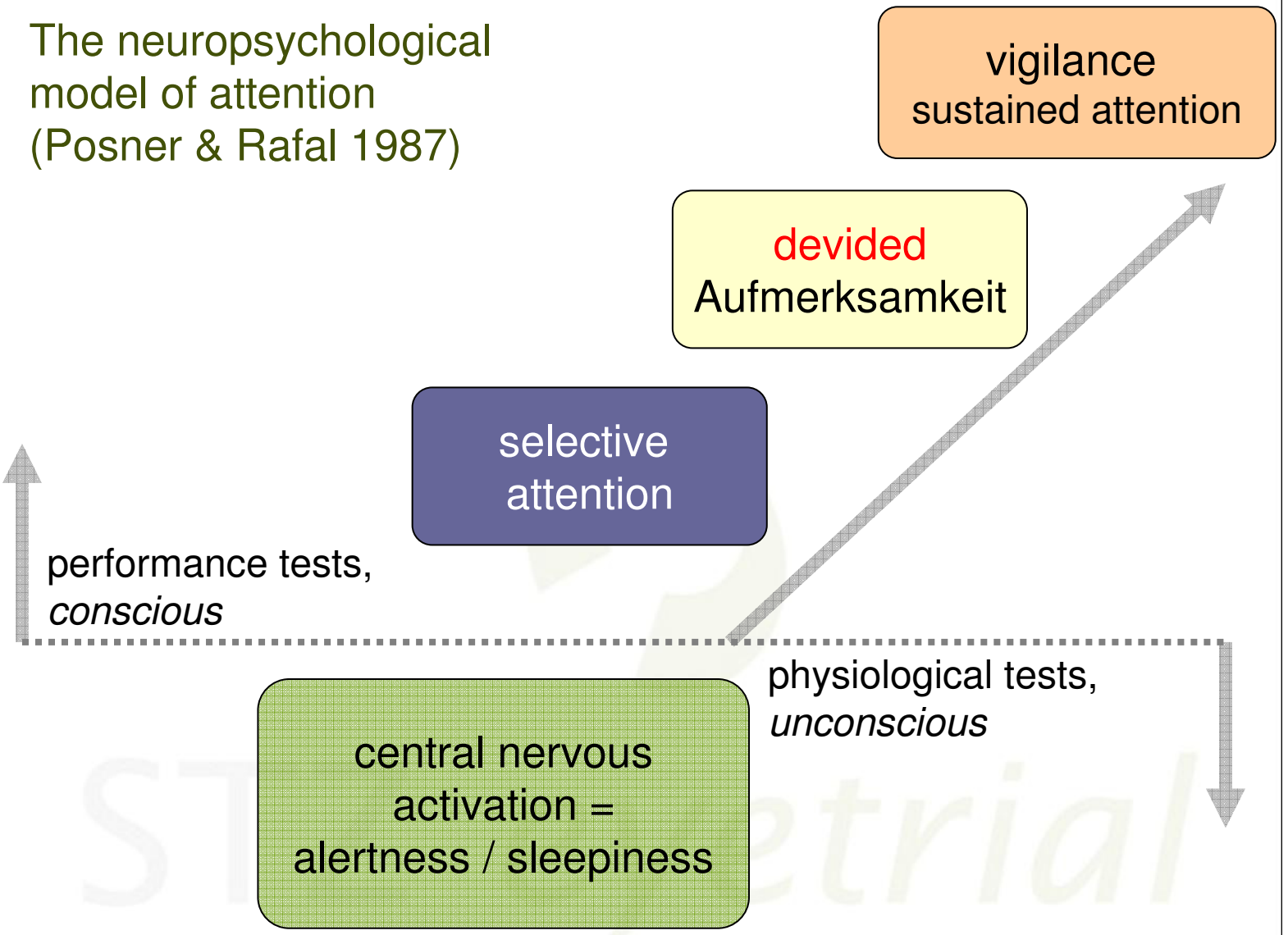
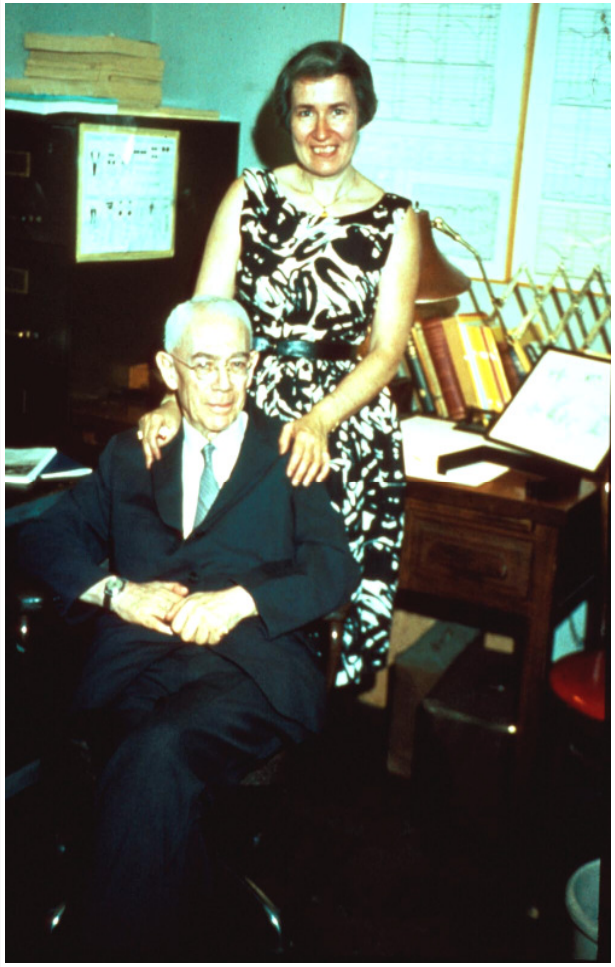
What is sleepiness?
How can we measure it?

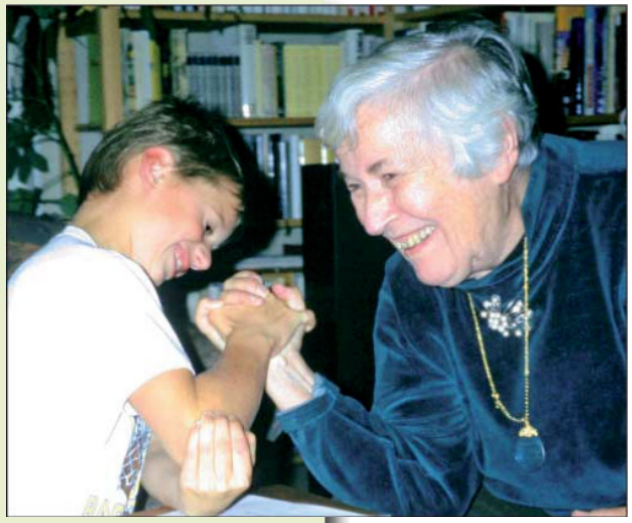
The neuropsychological model of attention (Posner & Rafal 1987)



First description of pupillary sleepiness waves - 1963



- "Such "fatigue waves" and a steadily declining pupil size almost always will be encountered eventually when the subjects remain quietly in darkness for lengthy periods without anything to do. This was sometimes forgotten ..."
  (Irene Loewenfeld, The Pupil, 1999)



Irene Loewenfeld 1995, † 2009

PST – the hi/story

$$PUI = \frac{1}{(N-16)\cdot \Delta t} \cdot \sum_{i=2}^{\frac{N}{16}} \left| d_i - d_{i-1} \right|$$

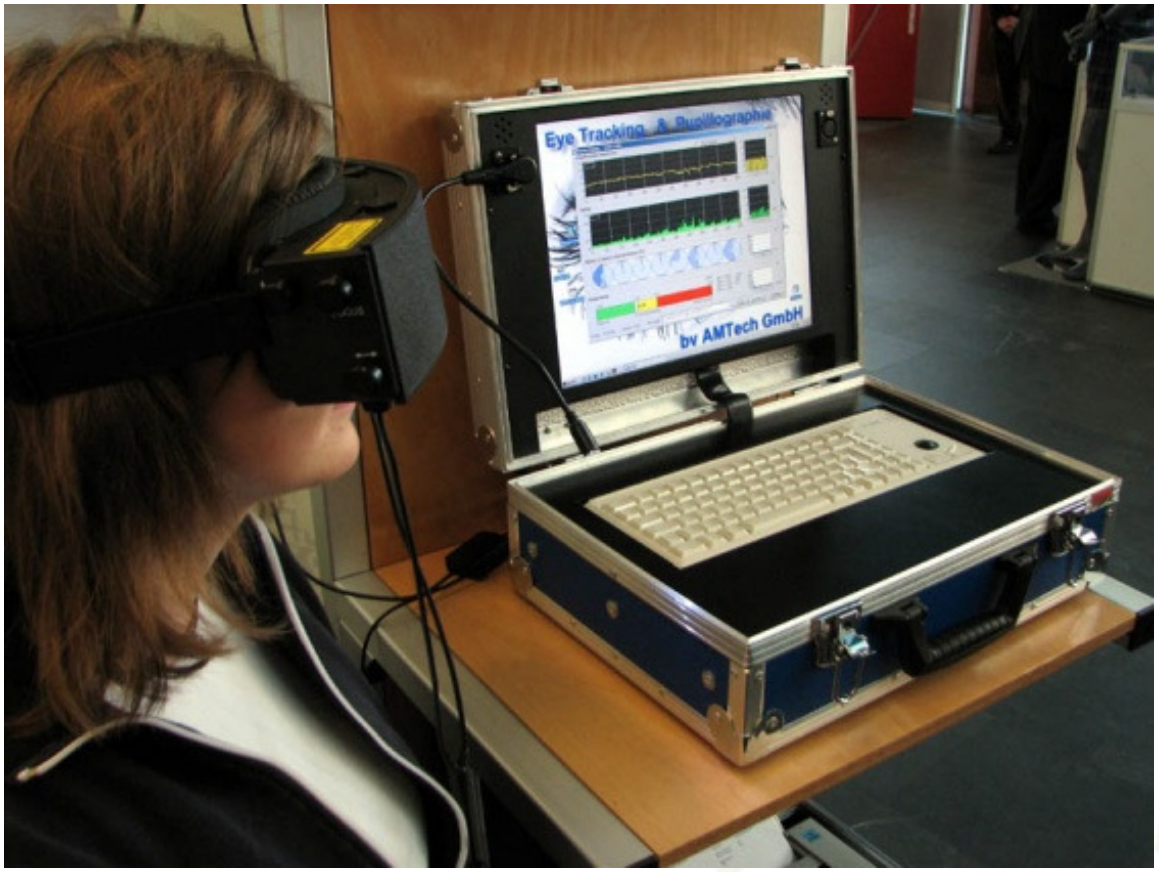
- start of development 1993
- grants: *Fortüne* and DFG
- UKT Patent since 1997
- Licence by AMTech since 1997

Method
Pupillographic SleepinessTest (PST)

Foto: AMTech

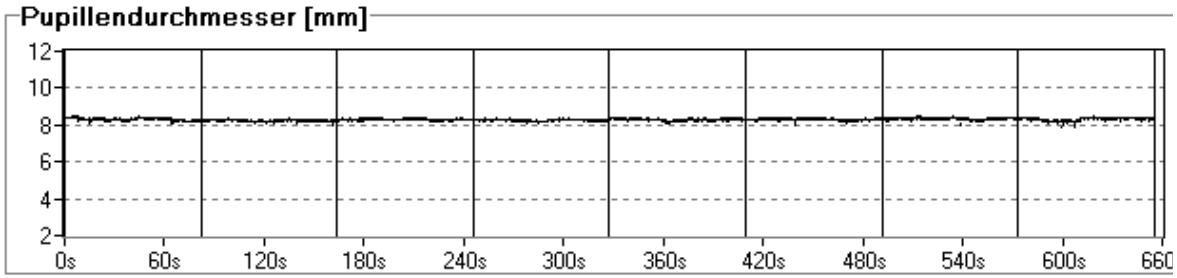
- Infrared Video Pupillography (25 Hz)
- 11 Minutes
- Automated Analysis
- Parameter
  - Pupillary-Unrest-Index (PUI)

The mobile Version: Fit-for-duty, F2D



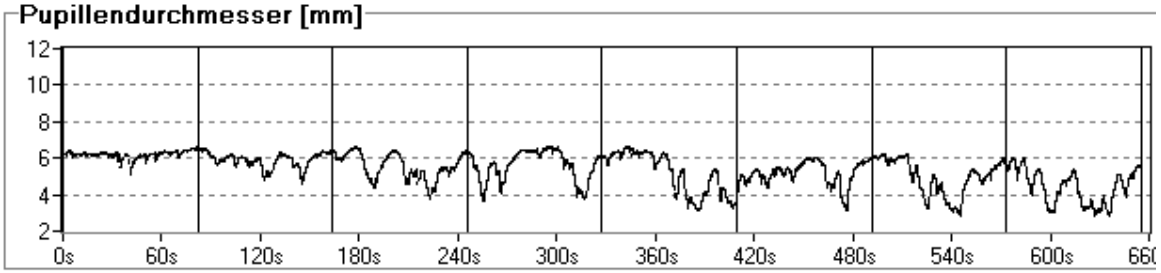
- Parameter
  - Relative Pupillary-Unrest-Index (PUI)

Typical findings



PUI
4,3 mm/min

alert



PUI
17,4 mm/min

sleepy

Outcome: Pupillary Unrest Index, PUI (mm/min)

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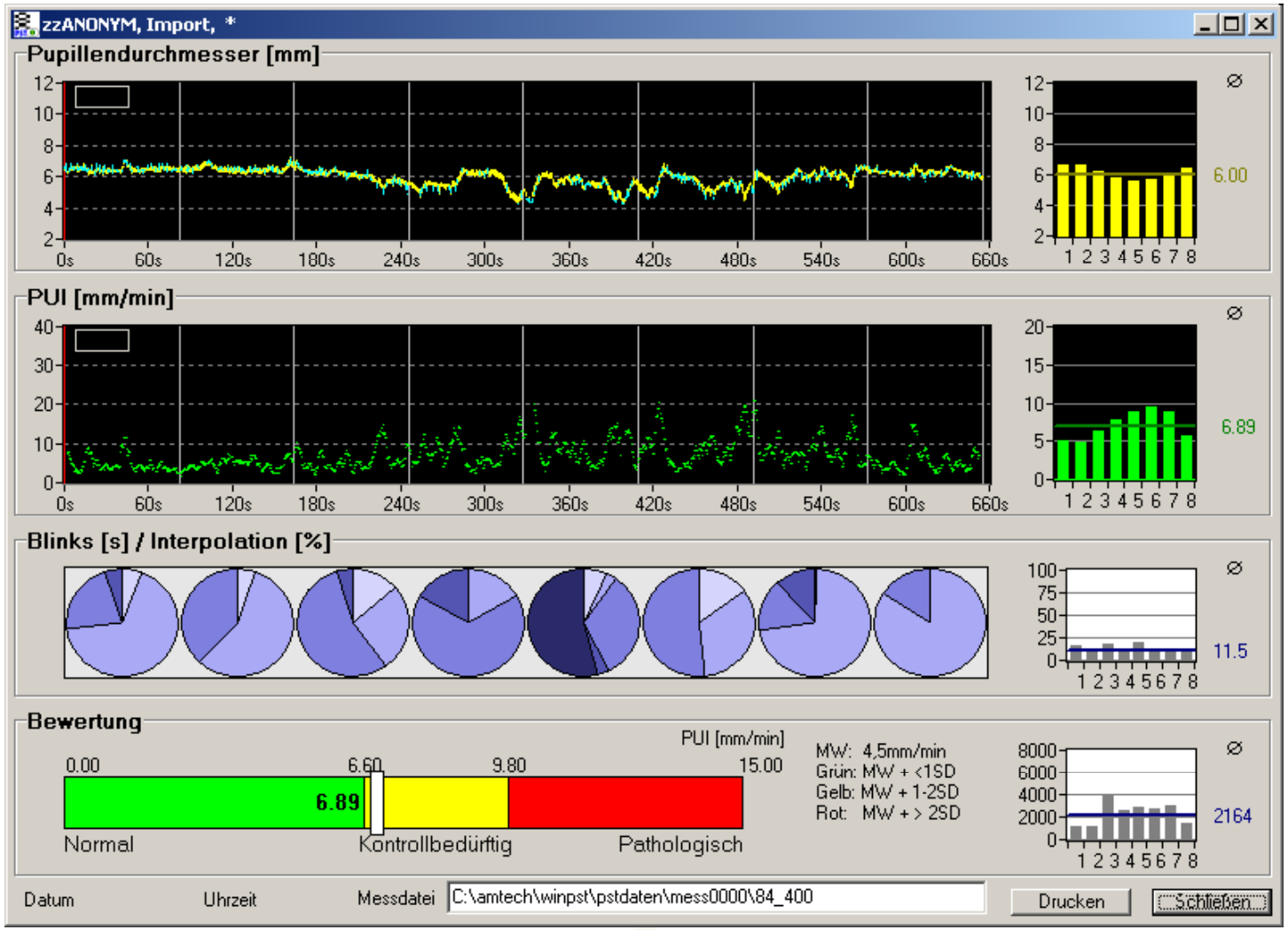

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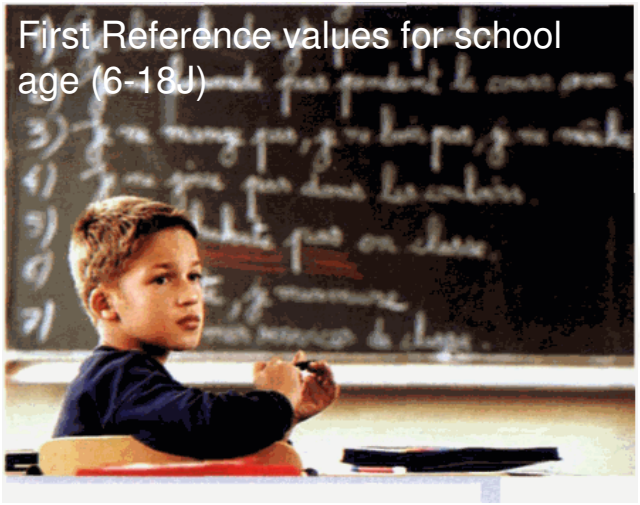
Current applications of pupillography

Sleep Medicine („sleep lab“)

Occupational Medicine



First Reference values for school age (6-18J)

Oberösterreich 1180 truck and bus-drivers: 22,5% excessively sleepy

Sleepiness in the workplace

- Miners
- transportation
- Flight crews

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Sleepiness in miners at extended shift durations

U-Bahn - Erweiterung Arge Olympiapark, München

ZÜBLIN

Study Design

Construction site: 12 hrs shift duration with 10 hrs + 2 hrs break (?), distributed freely

Day shift 1 week – night shift 1 week – week off

6 a.m. until 6 p.m. 6 p.m. until 6 a.m. –

- each day 4 miners 3 tests
- 1 miner per 4 teams

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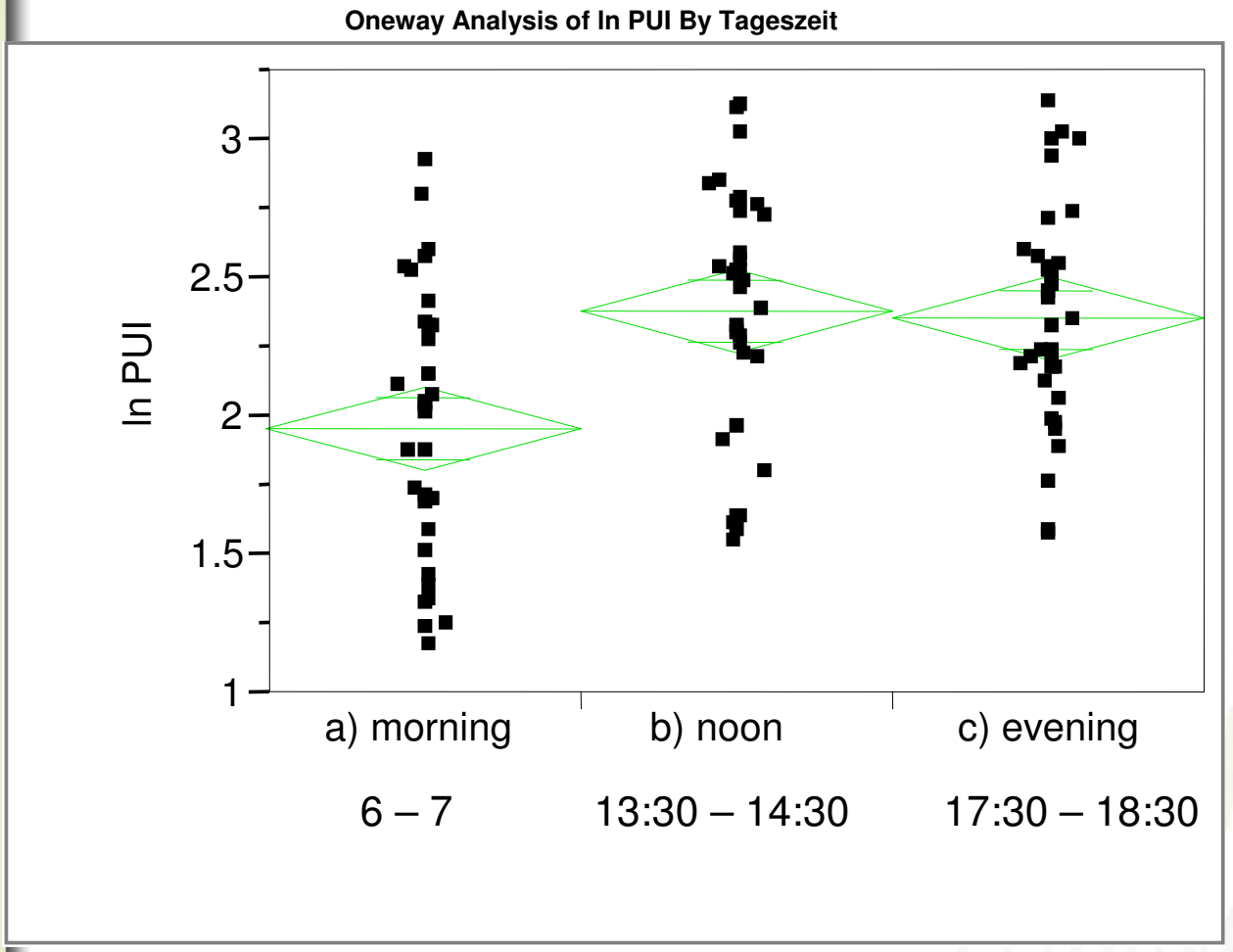
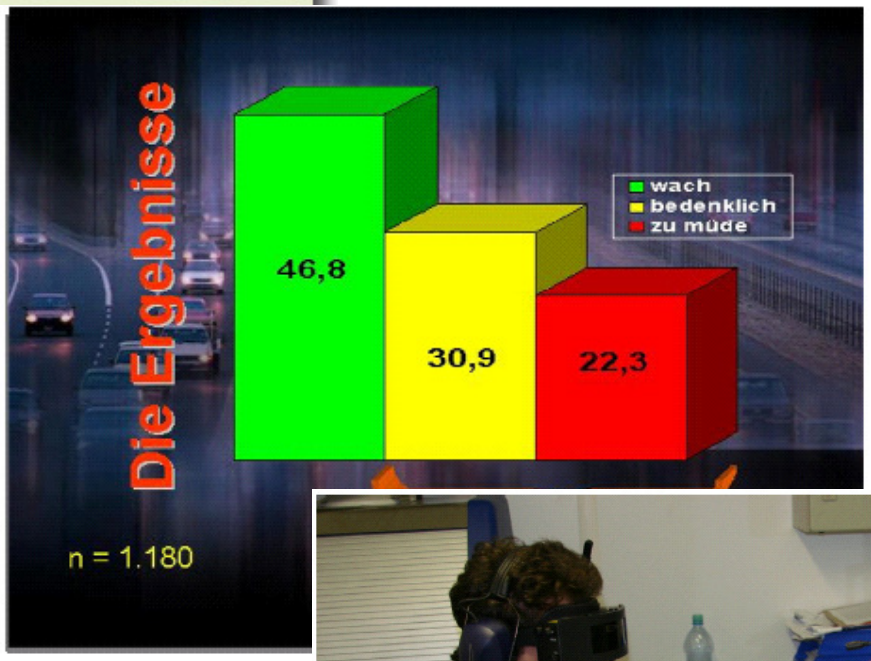
After 8 hours shift duration already 50% of miners are excessively sleepy!



Truck- and Busdrivers in Oberösterreich (N= 1180)



M. Walzl.
Pupillometrische
Untersuchungen
auf Müdigkeit
bei Berufskraftfahrern.
Linz 2007.

Contact:
Robert.Hagen@ooe.gv.at

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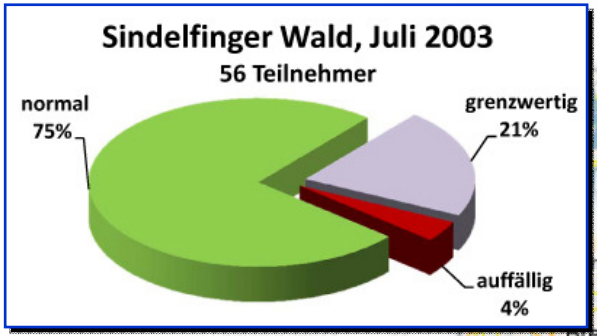

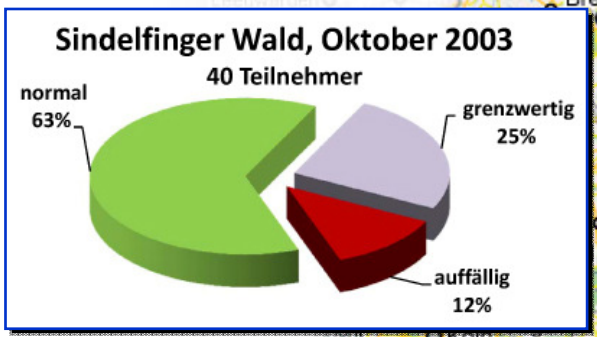

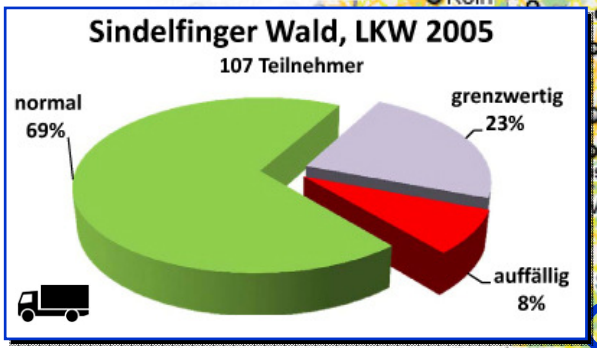

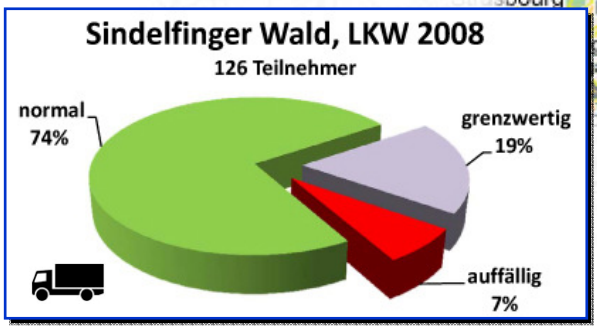

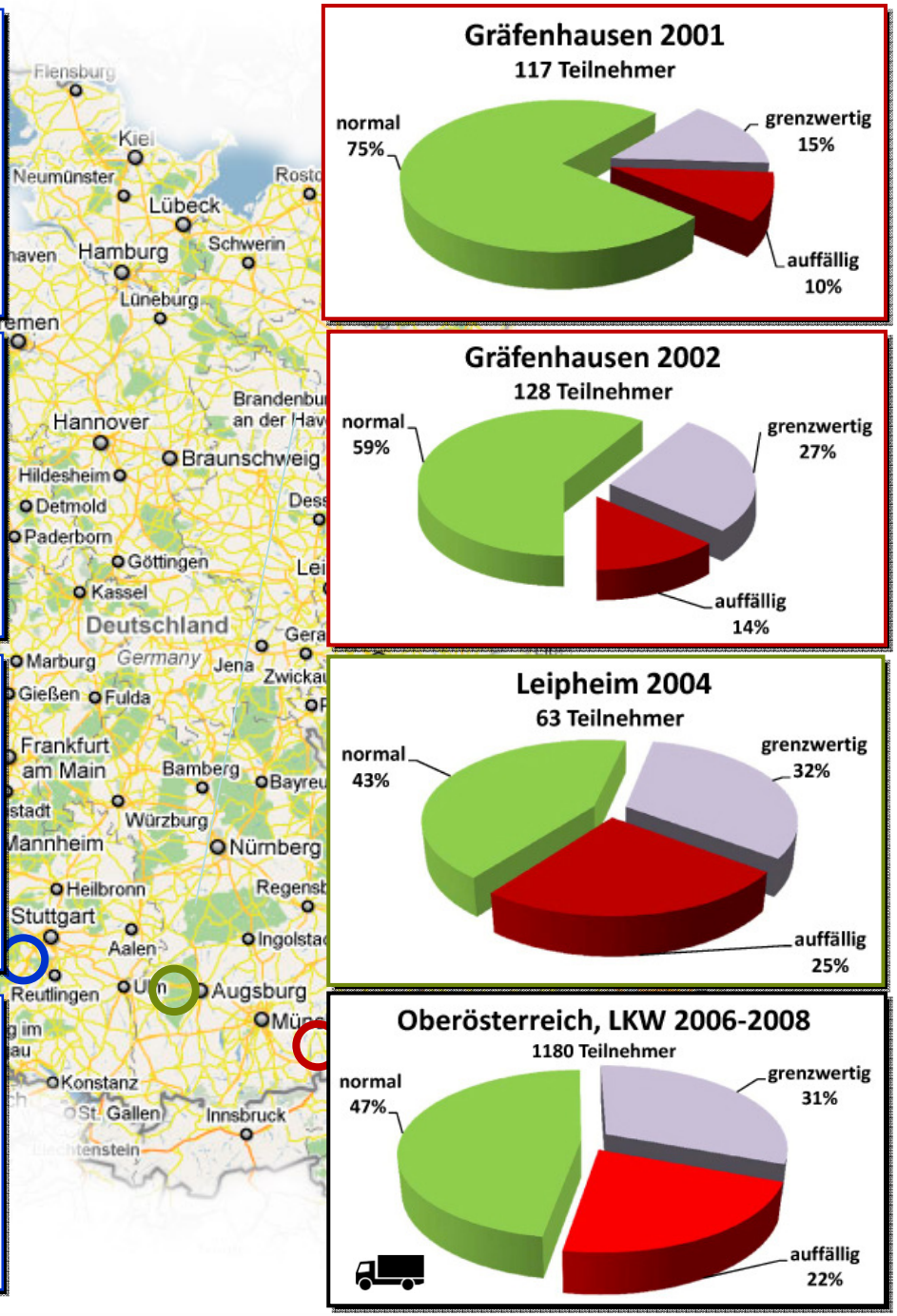

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Investigating Crew Fatigue during long-haul flight

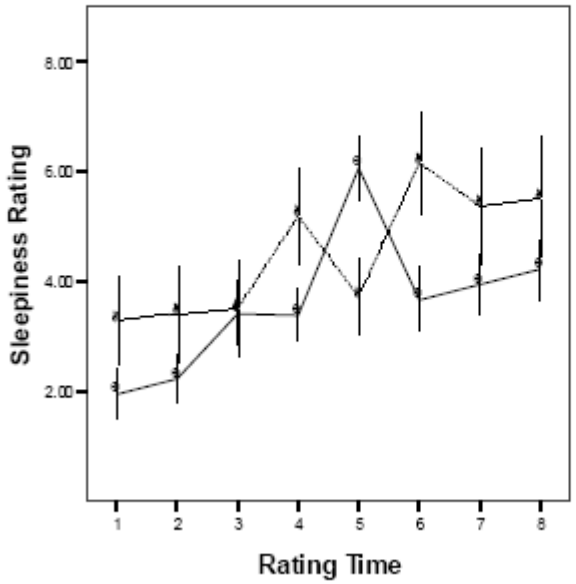
The Karolinska Sleepiness Scale (KSS)

This scale asks people to rate how sleepy they feel right now[20]. Any of the values from 1-9 can be ticked, not only those with a verbal description.

1 = extremely alert
2
3 = alert
4
5 = neither sleepy nor alert
6
7 = sleepy, but no difficulty remaining awake
8
9 = extremely sleepy, fighting sleep

Figure B3: The Karolinska Sleepiness Scale (KSS)

Figure B4 shows KSS ratings from 25 flight crewmembers across ultra-long range flights from Singapore to Los Angeles. [21].



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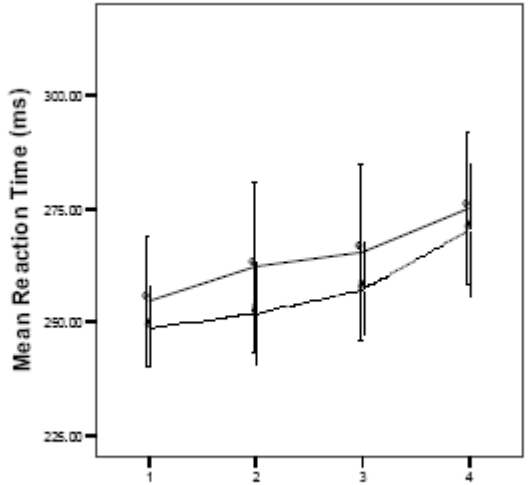

Figure B7: Mean Reaction Time on the PVT Task on Flights from S Los Angeles

Solid line – data for the command crew

Dotted line – data for the relief crew

Figure B11: Polysomnographic recording in flight

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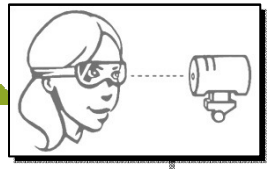
Prevention of sleepiness-related accidents

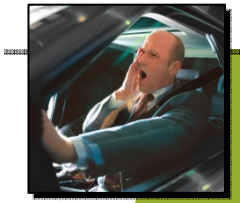
Public / Government
•Preparation of streets



Medicine
- Early detection and treatment of sleep disorders in professional transportation

Police
- traffic controls
- PST feasible

Personal responsibility
of individuals



Automobile industry
- vehicle based (Assistenzsysteme)

Individual countermeasures: only a power nap can fight sleepiness!

... and caffeine

Referenzen, z.B.:

Horne JA & Foster SC (1995) *Sleep Research* **24,** 437

Horne JA & Reyner LA (1995) *J Sleep Res* **4**(S2), 23-29

Horne JA & Reyner LA (1996) *Psychophysiology* **33,** 306-309

Horne JA & Reyner LA (1999) *Sleep Research Online* **2** (Suppl 1), 678

Reyner LA & Horne JA (1997) Psychophysiology 34, 721-725

Reyner LA & Horne JA (2000) Psychophysiology 37, 251-256

LeDuc PA (2000) Military Psychology, 12, 249-266

Is the PST feasible in a traffic control by the police?

Method:

• Traffic control at road house associated with voluntary trial participation
In 137 LKW-Fahrern
• 6 weeks
W 1, 3 and 5 from 10:00h -16:00h and Wo 2, 4 and 6 from 4:00h -10:00h

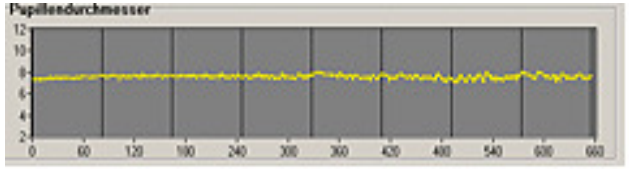
Subjective data:
•Questionnaires
•Stanford sleepiness scale (SSS)
•Epworth sleepiness scale (ESS)

* *Peters, T., Grüner, C., Durst, W., Hütter, C., Wilhelm, B. Sleepiness in Professional Truck Drivers Measured with an Objective Alertness Test during Routine Traffic Controls: Submitted to International Archives of Occupational and Environmental Health*

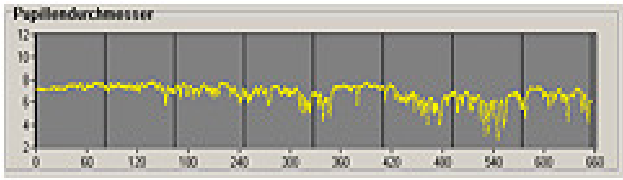
Results & Discussion

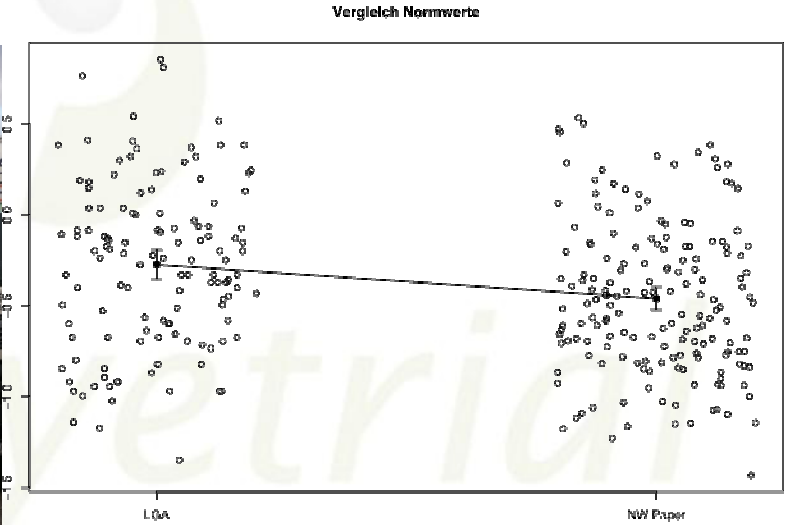
- Percentage of excessive sleepiness 7%
- This means 3.000 sleepy truck drivers per day at the „Stuttgarter Kreuz“
- High proportion (99 von 137) of drivers had consumed caffeine in the hours before the recording
- Limitiation Selection
  - Drivers of large companies
  - Reality: majority sel-employed or SME (higher pressure)

Alert



Sleepy





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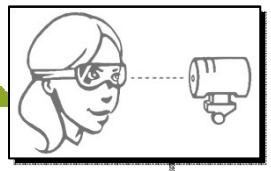
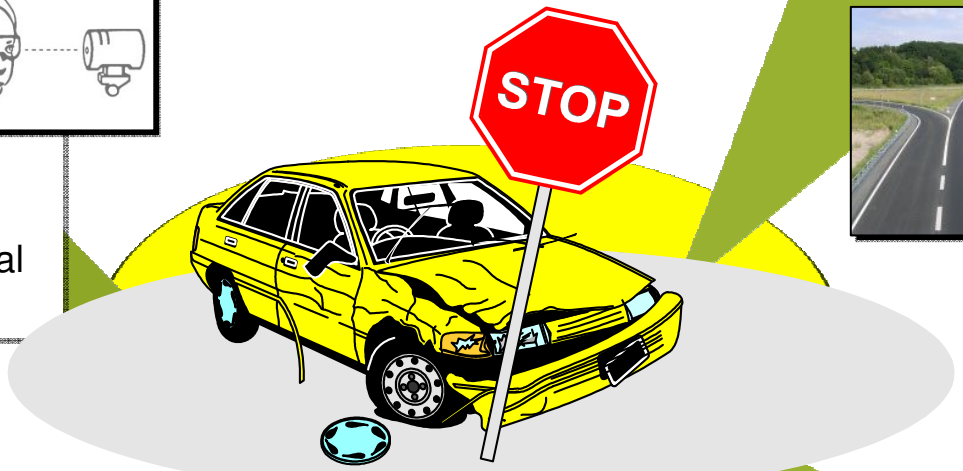
Prevention of sleepiness-related accidents

Public / Government
•Preparation of streets



Regulatory
- Early detection and treatment of sleep disorders in professional transportation



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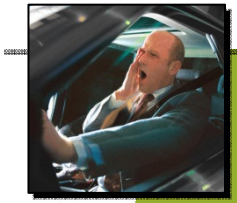

Automobile industry
- vehicle based (Assistenzsysteme)

First steps

M. Orth
S. Kotterba
B. Wilhelm
M. Huetten

- *„Leitfaden Schlafapnoe G25“*
  - Limitations
    - Non-binding
    - Subjective reports critical (Scale, Questionnaire)
    - Body measures (waste-hip ratio) critical
    - No new methods
  - Motivation
    - Changes FeV Anl. 4 and 5

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NEW!

Begutachtungs-Leitlinien zur Kraftfahrereignung

Kapitel 11.2 Tagesschläfrigkeit

Stepwise diagnostics

Condition: monotony, e.g. highway, min. 0,5 hrs

Sleep medical Qualification

Recommended addition

- Test run
- Sleepiness/alertness test
- Vigilance test

Medical History, Epworth sleepiness scale
+ sleepiness/alertness test

Evaluation of daytime sleepiness

Next steps for regulatory countermeasures for sleepiness-related accidents in professional drivers

- Coming into force winter 2013/14

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What is important to avoid sleepiness related failures and accidents in aviation?

- Alertness management
  - Duration of time-on-duty
  - Duration of Rest periods
  - Individual chronotype
- Opportunity for power naps

Rechte: Ralf Roletschek

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Fatigue Risk Management Systems FRMS

- **Information** about basic functions of sleep and alertness
- **Training**
  - individual behaviour and managment
  - duty rosters

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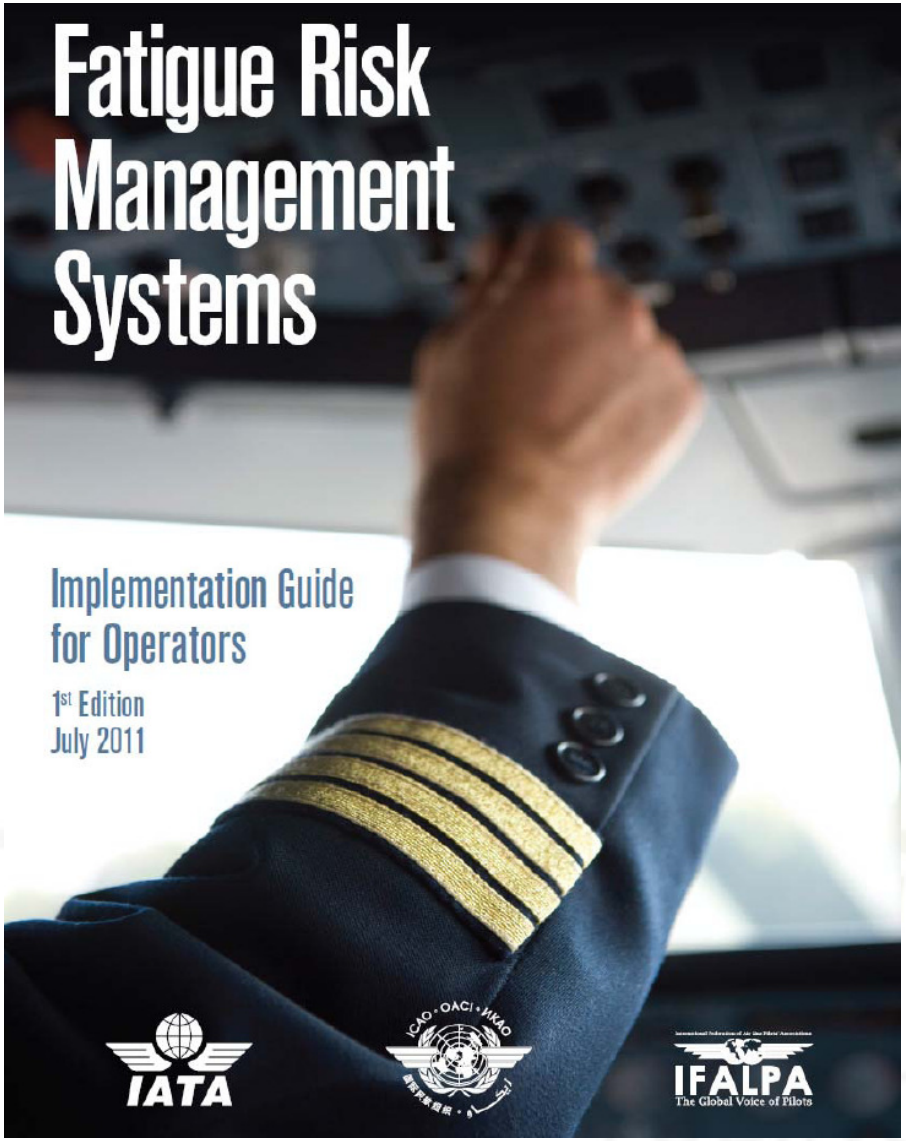
FRMS



recommendable reading for more details…

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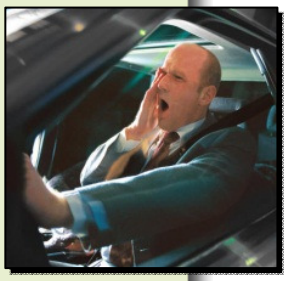

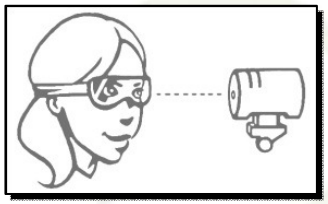

More information about sleep and sleepiness: www.dgsm.de