

HAZARDS OF SLEEPINESS

Pupillography detects daytime sleepiness

- Shortened version for EAGOSH Website -

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Sphere of Competence II

Autonomous Nervous System and Safety Studies



PST= Pupillographic Sleepiness Test

PUI= Pupillary Unrest Index



The Hazards of Sleepiness

... underestimated for a long period of time



The Hazards of Sleepiness

- little research about the problem
- difficult assessment
 - subjective scales
 - questionnaires
 - performance tests



Sleepiness at the Wheel

- about 25 % of all fatal highway accidents due to sleepiness at the wheel
- peaks of traffic accidents at times of chronobiological low performance level: early morning hours (predom. young drivers) and early afternoon (predom. elder drivers)
- 40 % of all fatal traffic accidents happen during the night from friday to sunday



Sleepiness at the Wheel

- many accidents are related to work: drivers of lorries, goods vehicles, company cars
- many sleepiness-related accidents happen during night shift work, driving home afterwards
- sleepiness does not occur spontaneously without warning



Sleepiness at work

- with fatal consequences like ...

- Exxon Valdez
- Harrisburg
- Bhopal
- Challenger
- Tschernobyl



Sleepiness at work - often has consequences

- subjects involved in work accidents report more sleep complaints than others

Kecklund G et al (1998). Sleep disorders and industrial accidents. Journal of Sleep Research, 7: 131



Why and how use the pupil?



PUPILLARY OSCILLATIONS IN DARKNESS

- Reflect (tonic) central nervous activation
- provide objective, quantitative assessment of daytime sleepiness



Pupillographic sleepiness test (PST)



The „Story“ of the PST



Photography

- first description of sleepiness-induced oscillations by Löwenstein & Lowenfeld 1963
- only anecdotal



The „Story“ of the PST

- Idea and start of development 1993
- Supported by fortune and DFG
- Patent by UKT 1997
- Licensed by AMTech 1997
- Introduction into Sleep Research and Sleep Medicine since 1995
- New golden standard for the objective assessment of daytime sleepiness



Pupillographic sleepiness test (PST)

How does it work?



PST: Setting

PST see also
<http://www.amtech.de>

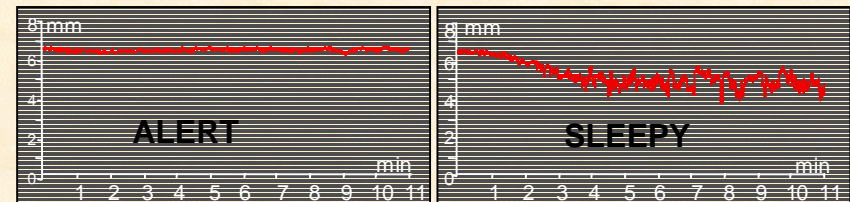
- 11 minutes sitting
- head fixated on chin rest
- darkness
- quiet
- clinical conditions:
 - 4 h before
 - no caffeine, nicotine, alcohol



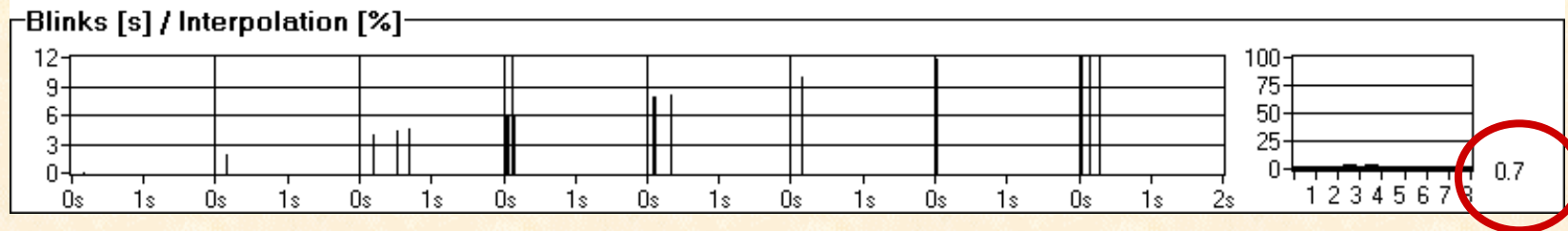
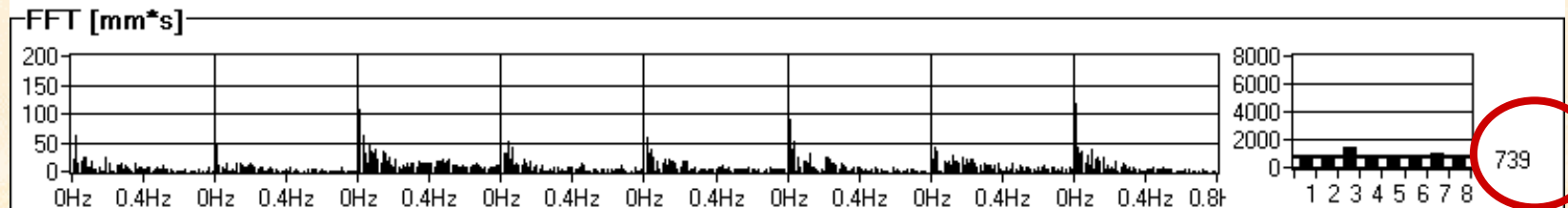
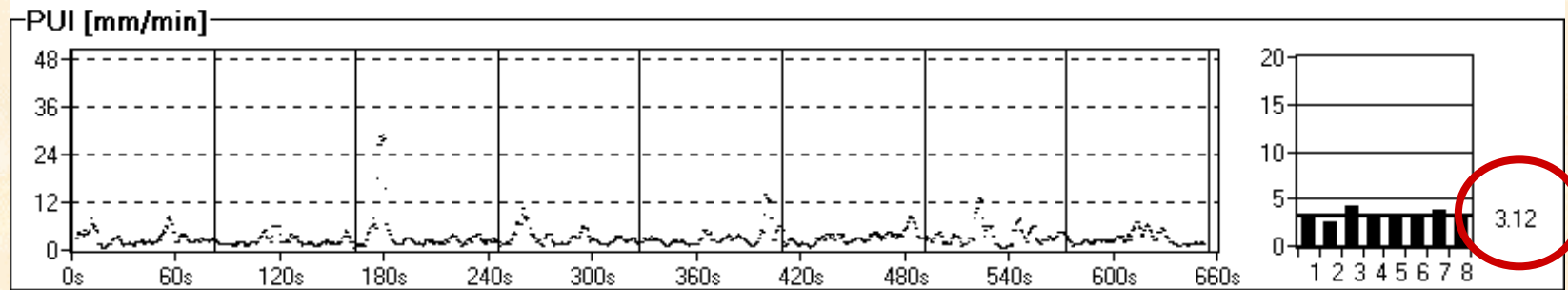
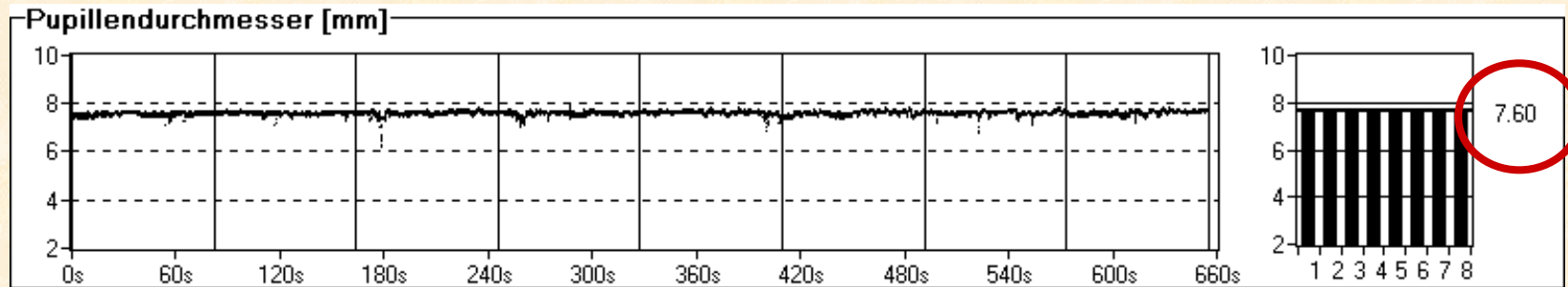
PST: Method of recording

Photography

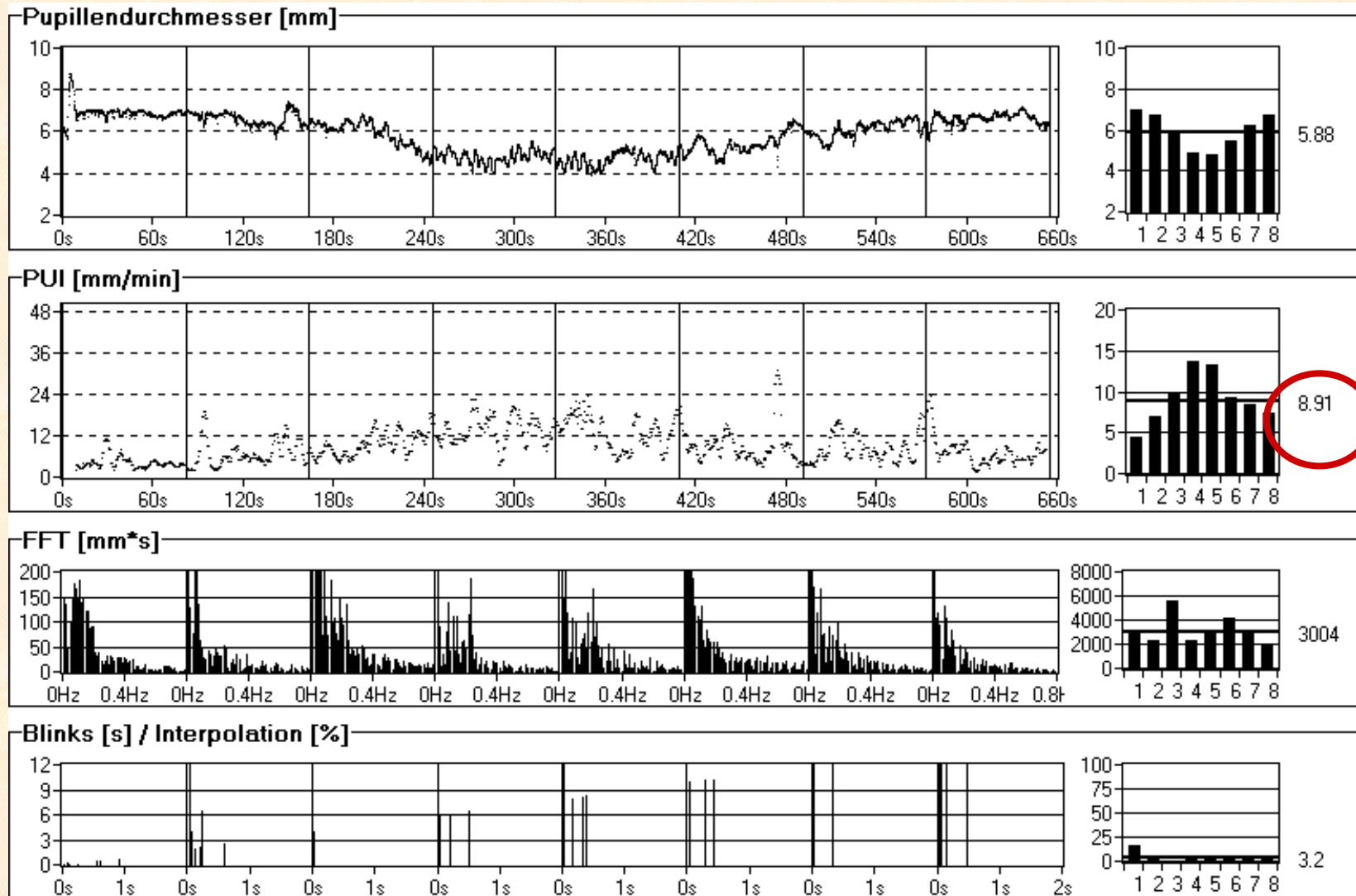
- Infrared Video Pupillography
- Automated Analysis
- Parameter: Pupillary- Unrest-Index (PUI, mm/min)



ALERT



SLEEPY



Test quality criteria of the PST

- ✓ Standardization
- ✓ Validation
- ✓ Normal values
- ✓ Specificity/Sensitivity
- ✓ Objectivity
- ✓ Economy

Weeß H-G, Sauter C, Geisler P, Böhning W, Wilhelm B, Rotte M, Gresele C, Schneider C, Schulz H, Lund R, Steinberg R und Arbeitsgruppe Vigilanz der DGSM: Vigilanz, Einschlafneigung, Daueraufmerksamkeit, Müdigkeit, Schläfrigkeit -Diagnostische Instrumentarien zur Messung müdigkeits- und schläfrigkeitsbezogener Prozesse und deren Gütekriterien. Somnologie 4, 20-38,2000

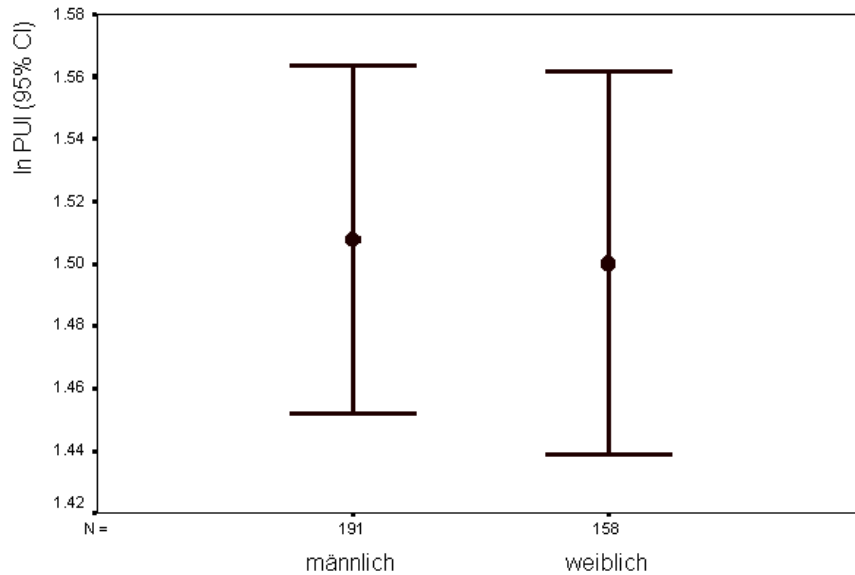


Normal value range: Percentiles of normal subjects 20 - 60 years (n=349)

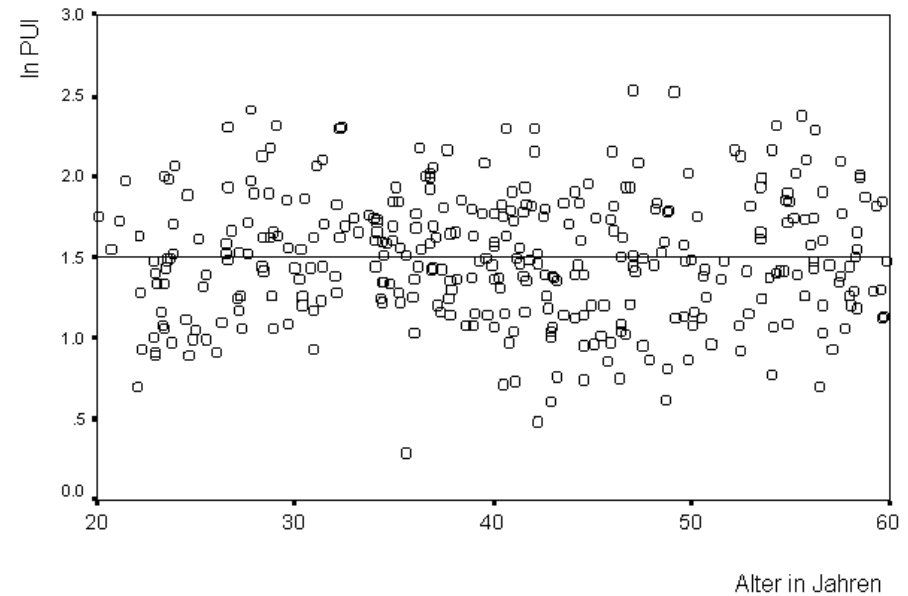
	Wertebereich	MW-2SD	MW-SD	MW	MW+SD	mean+2SD
	In PUI/ [mm/min]	0,73	1,11	1,50	1,89	2,28
Umgerechnet auf PUI:	Perzentile	2,3%	15,9%	50%	84,1%	97,7%
	PUI [mm/min]	2,07	3,05	4,50	6,64	9,80



PUI does not depend on age or gender



(n=349)



PST

at present used in

- Sleep research and sleep medicine
 - objective assessment of daytime sleepiness in the diagnosis and therapy of sleep disorders
 - Clinical pharmacology
 - drug-induced sleepiness
-
- *traffic medicine*
 - *industrial medicine*



The PST Highway Project No 1 and 2 (Road house Gräfenhausen, A5)

- First objective studies investigating driver sleepiness in Germany

*initiated by H-G Weeß
Sleep Lab Pfalzlinik*



The PST Highway Projects

- Spring 2001
- Summer 2002
- three medical centers
- 24 hours
- supported by
 - AMTech
 - Praxis, ZDF
 - Stern TV, RTL



The PST Highway Projects: methods

- Recruiting drivers at the gas station / while parking

Photography

- Questionnaire
- PST-recording in four containers



The Highway Projects: Questionnaire

Photography

- Pittsburgh Sleep Quality Index
- subjective alertness and subjective ability to drive
- Specific questions
 - Car type
 - driving characteristics
 - time at the wheel
 - breaks
 - planned route ahead



Results

Demographics No1

- n = 156 car- and truck-drivers:
 - n = 39 truck-drivers
 - n = 117 car-drivers
- Gender:
 - n = 31 women
 - n = 125 men
- Age range: 18 - 69 years
- Mean age: 40,78 (\pm 11,37) years



Results

Demographics No2

- n = 164 car- and truck-drivers:
 - n = 27 truck-drivers
 - n = 128 car-drivers
- Gender:
 - n = 21 women
 - n = 143 male
- Age range: 18 - 68 years
- Mean age: 39,93 (\pm 12,39) years



Pupillary Unrest-Index

classified according to normal value range

- normal $< \text{MW} + 1 \text{ SD}$
- suspicious $\text{MW} + 1 \text{ SD}$ to $\text{MW} + 2 \text{ SD}$
- pathological $> \text{MW} + 2 \text{ SD}$



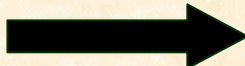
PST at the Road House

- Both studies show considerable differences
- time of the year / temperature
- sample
 - both few truck drivers
 - No 2: many vacationists
 - *classical „start of vacation model“...*



PST at the Road House

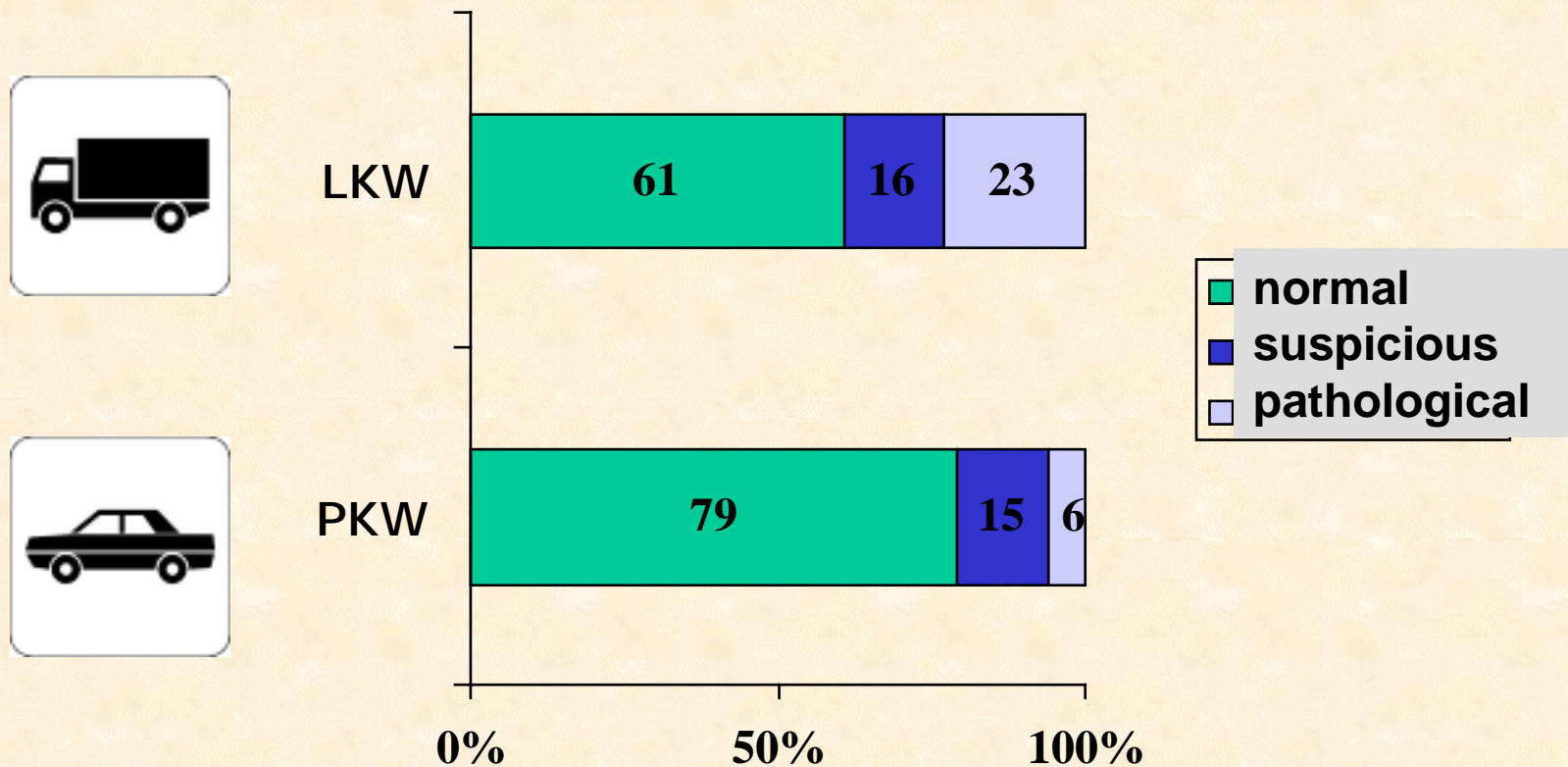
- The classical „start of vacation model“
 - come home late from work
 - pack car late
 - go to bed much later than usual
 - go up much earlier than usual
 - reach destination early
 - avoid crowded roads

 *partial sleep deprivation*



Sleepiness at the wheel (No1)

PUI-values in car- and truck-drivers



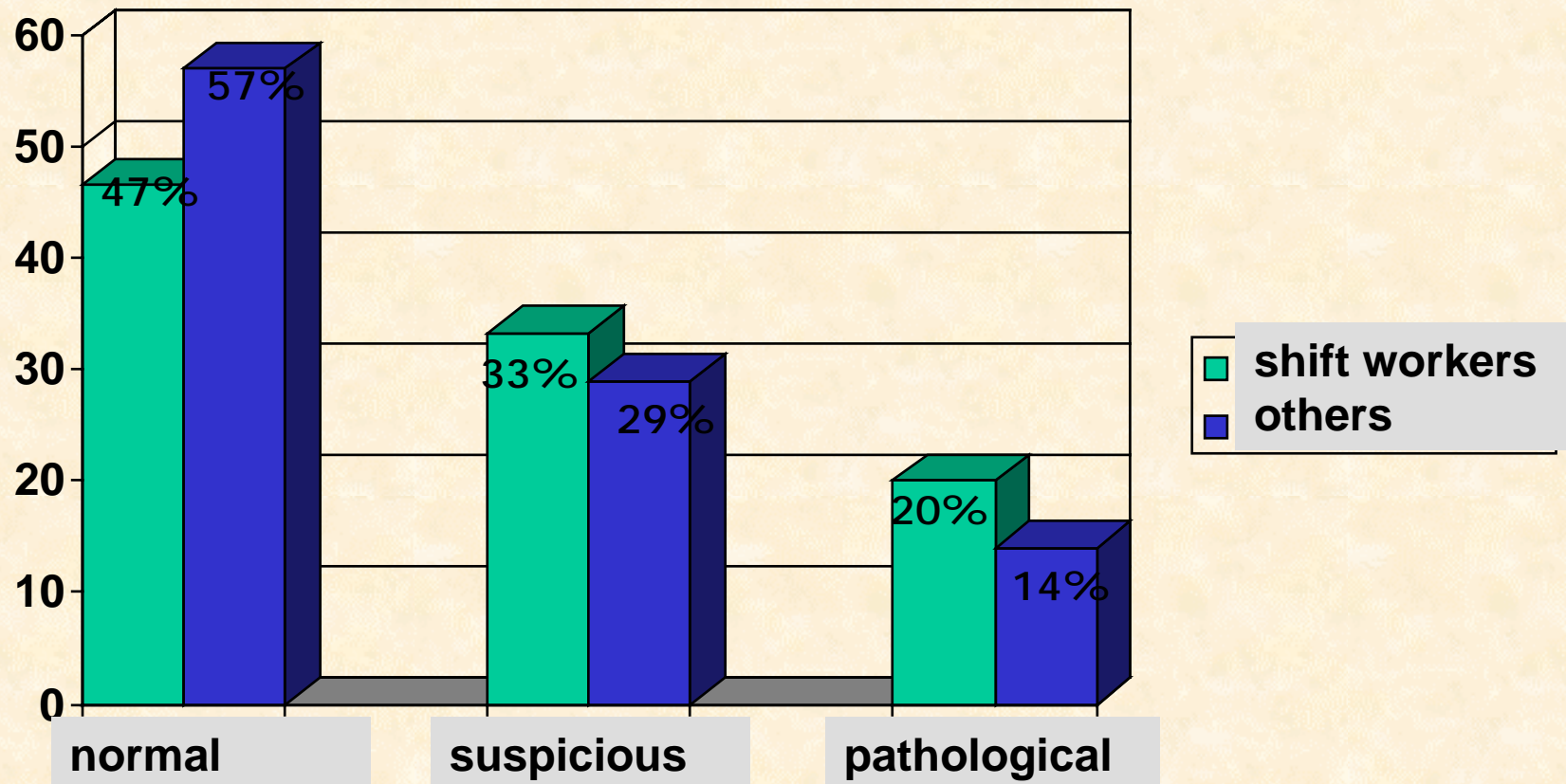
Weeß, Binder and Steinberg 2002

EAGOSH Meeting November 2002



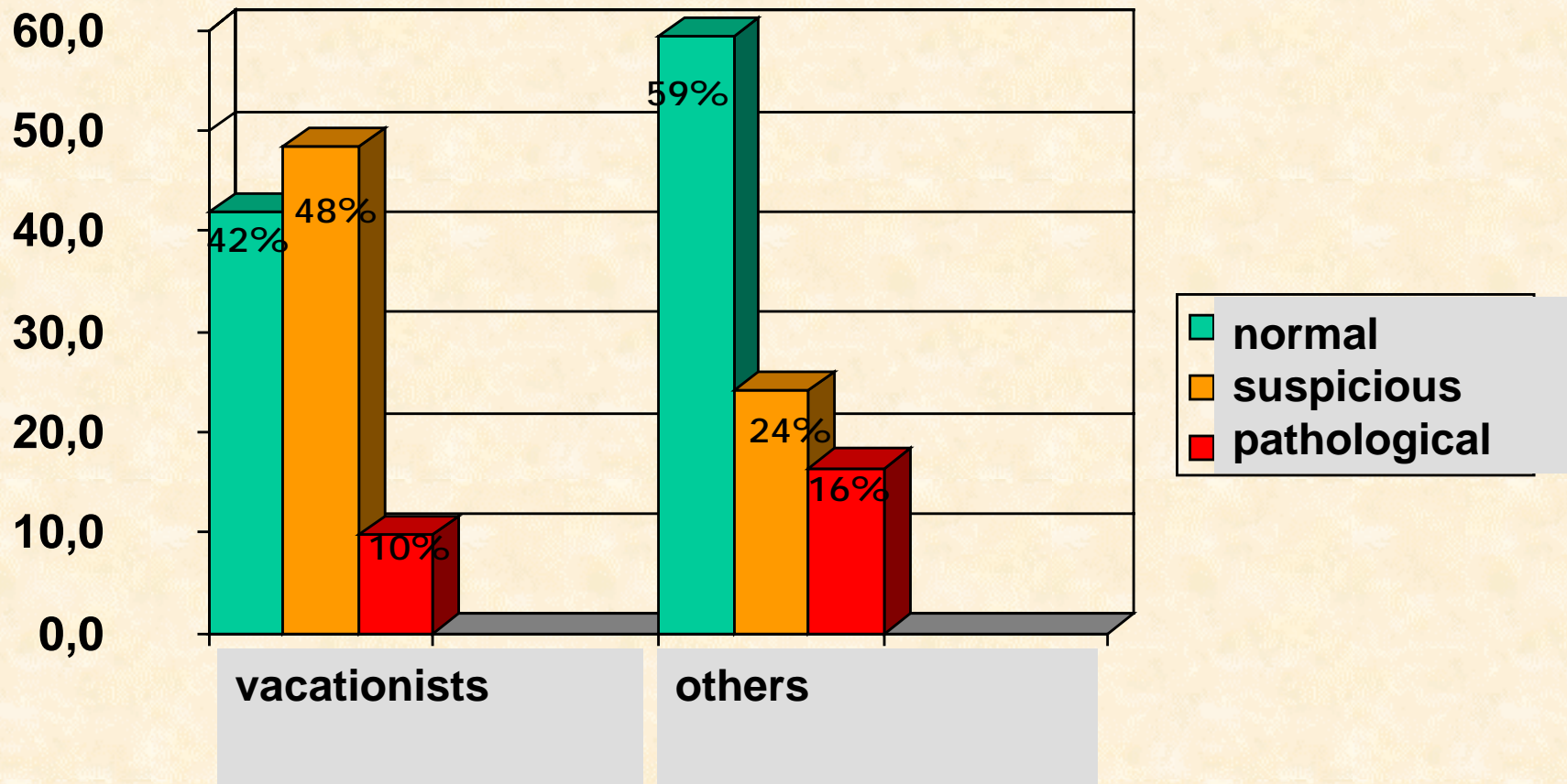
Sleepiness at the wheel (No 2)

A comparison of shift workers vs others



Sleepiness at the wheel (No2)

Vacationists vs others



Sleepiness at the wheel

Summary

- 25% - 42% of all drivers show significant daytime sleepiness
- In truck drivers, shift workers, holiday-makers the number of severely sleepy subjects is higher
- Sleep duration and sleep quality is not the major underlying reason of the detected sleepiness



Sleepiness at the wheel

Summary (2)

- main reason for sleepiness at the wheel are long hours of operation / long distances
- drivers recognize their own sleepiness but overestimate their ability to drive
- despite excessive sleepiness drivers do not draw the consequences (breaks, naps) but continue to drive for many more miles



Sleepy drivers - WHAT TO DO?

Only a nap helps to fight
sleepiness!

... plus caffeine



Sleepy drivers - WHAT TO DO?

- Reyner LA, Horne JA. Suppression of sleepiness in drivers: combination of caffeine with a short nap. *Psychophysiology* 1997; 34: 721-5
- Horne JA, Foster SC. Can exercise overcome sleepiness? *Sleep Research* 1995; 24: 437
- Reyner LA and Horne JA. Early morning driver sleepiness: Effectiveness of 200mg caffeine. *Psychophysiology* 2000; 37: 251-6



Sleepy drivers - WHAT TO DO?

Photographies

- **A) suspected PUI**
- power nap (10-15 Min)
- caffeine (1-2 cups coffee / Energy drink)
- **B) pathologic PUI**
- change driver
- like A) and stop driving as soon as possible



Sleepiness on the roads

Photography

- the problem is obvious
- can now be measured objectively
- Studies for the optimization of working places in transportation are needed and feasible
- public information and prevention is needed in the interest of safety



Sleepiness not on the ground only

Sleepiness can fly



Fragen? Questions? Quéstions? Frågor? Spørsmål?

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<http://www.dia.de/pupil>

(further publications)

