Assessing impaired attention and alertness in patients with sleep disorders

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Are sleep disorders associated with impaired daytime attention?

Excessive daytime sleepiness (EDS)

Is attention impacted in less obvious ways?

We are often asked to certify occupational fitness and vehicle operating licenses

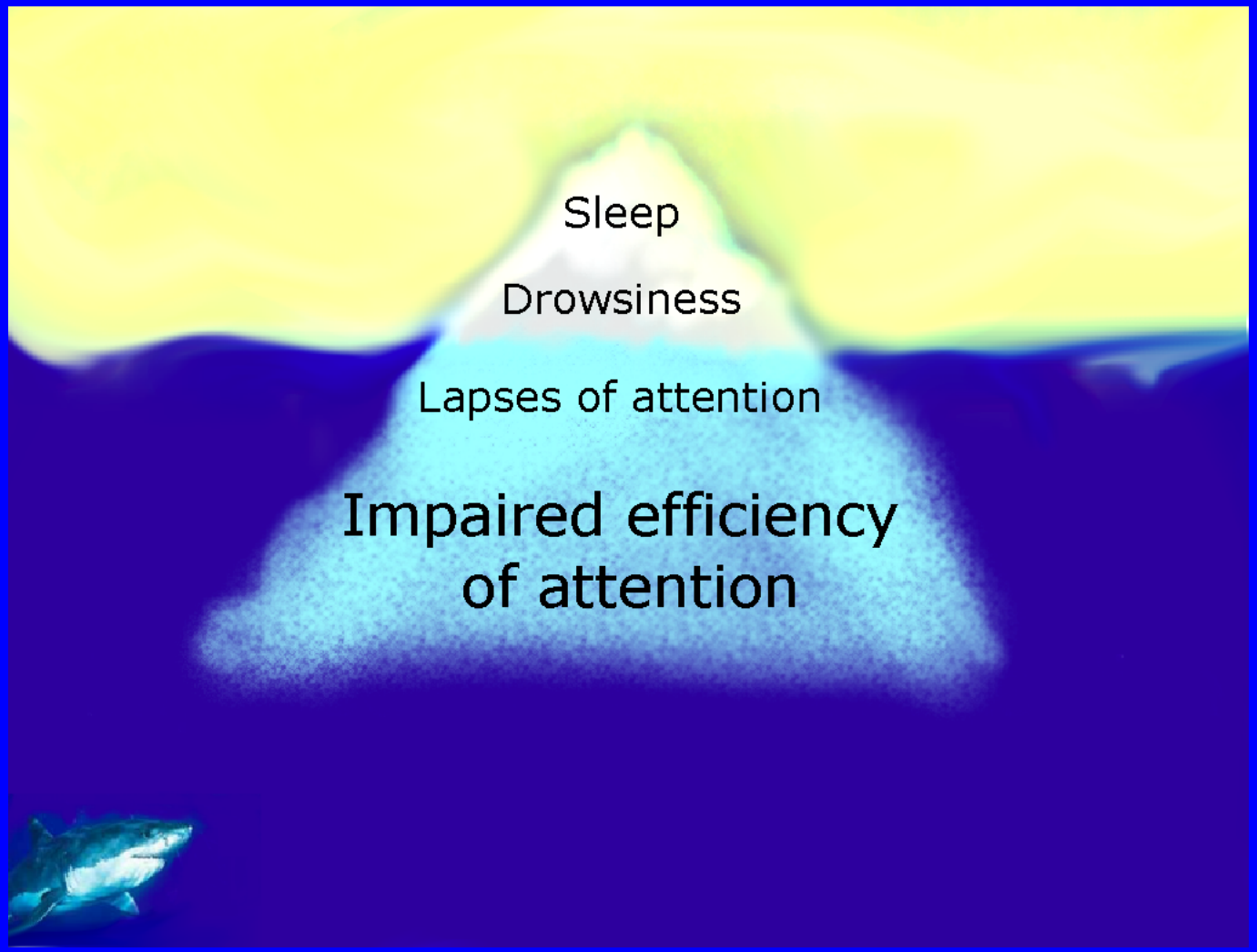
Morbidity associated with sleepiness

- Accidents attributable to sleepiness (Sweden)
  > 15 million Euro ($22 million USD)
  ~1.6 million lost work days annually.

- Driver fatigue ~15 to 30 percent of all motor vehicle accidents

- Sleep disorder ~ 5X motor vehicle accident risk

Iceberg metaphor of risk vulnerabilities



Attention and risk

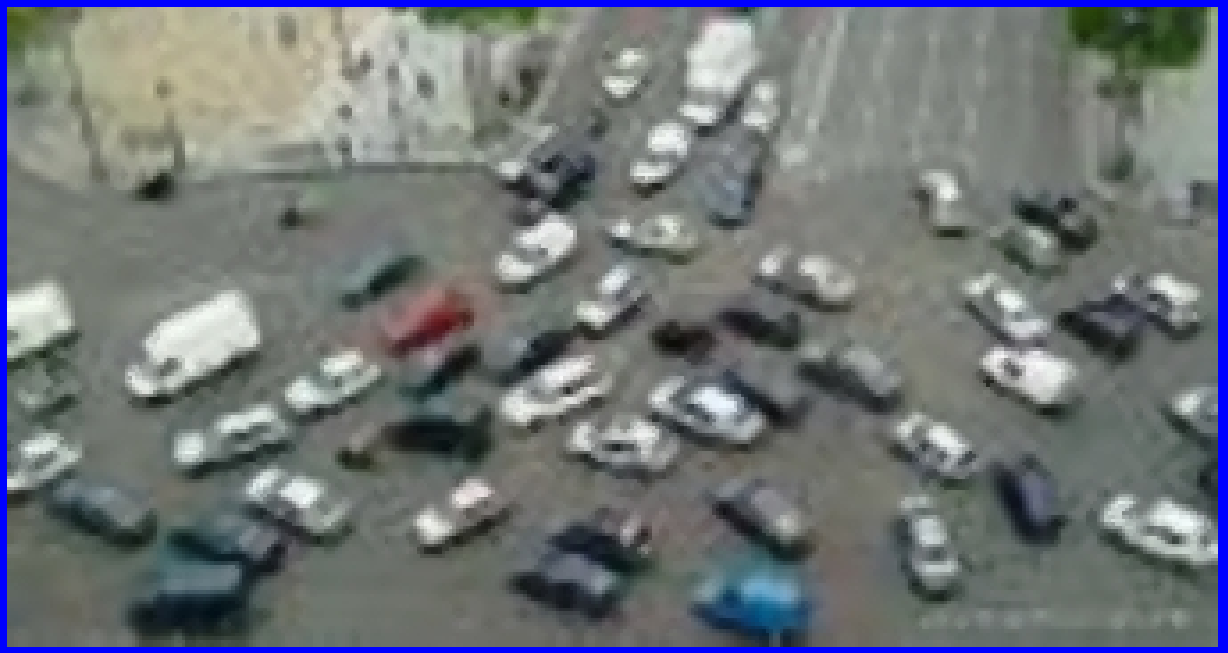
20% of US motor vehicle fatalities occur in traffic intersections ~ attributed to not paying attention.

15 mid-air collisions occur every year ~ simultaneous failure of two pilots to detect each other.

And for every accident that occurs ...

"There are between 3,000 and 40,000 conflicts for each injury accident [depending] on type of conflict, and the severity of the conflict."

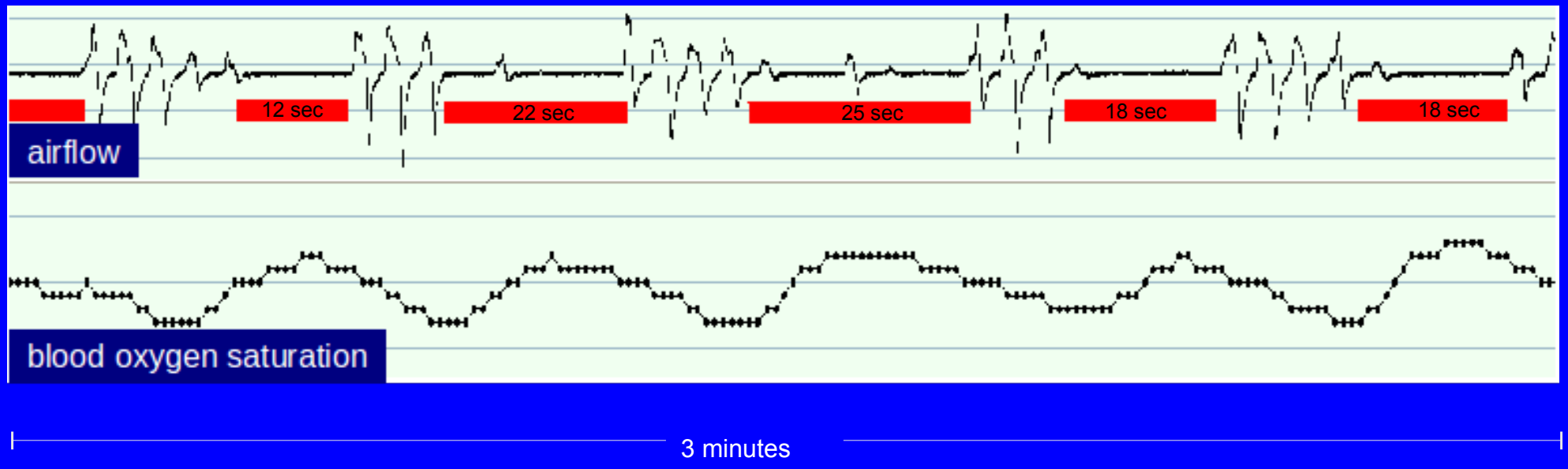
- Lund University, Department of Technology and Society, "Traffic conflict analysis"



L'Arc de Triomphe – Paris *Vive la resistance!*

Prevalent sleep disorder: Sleep Apnea

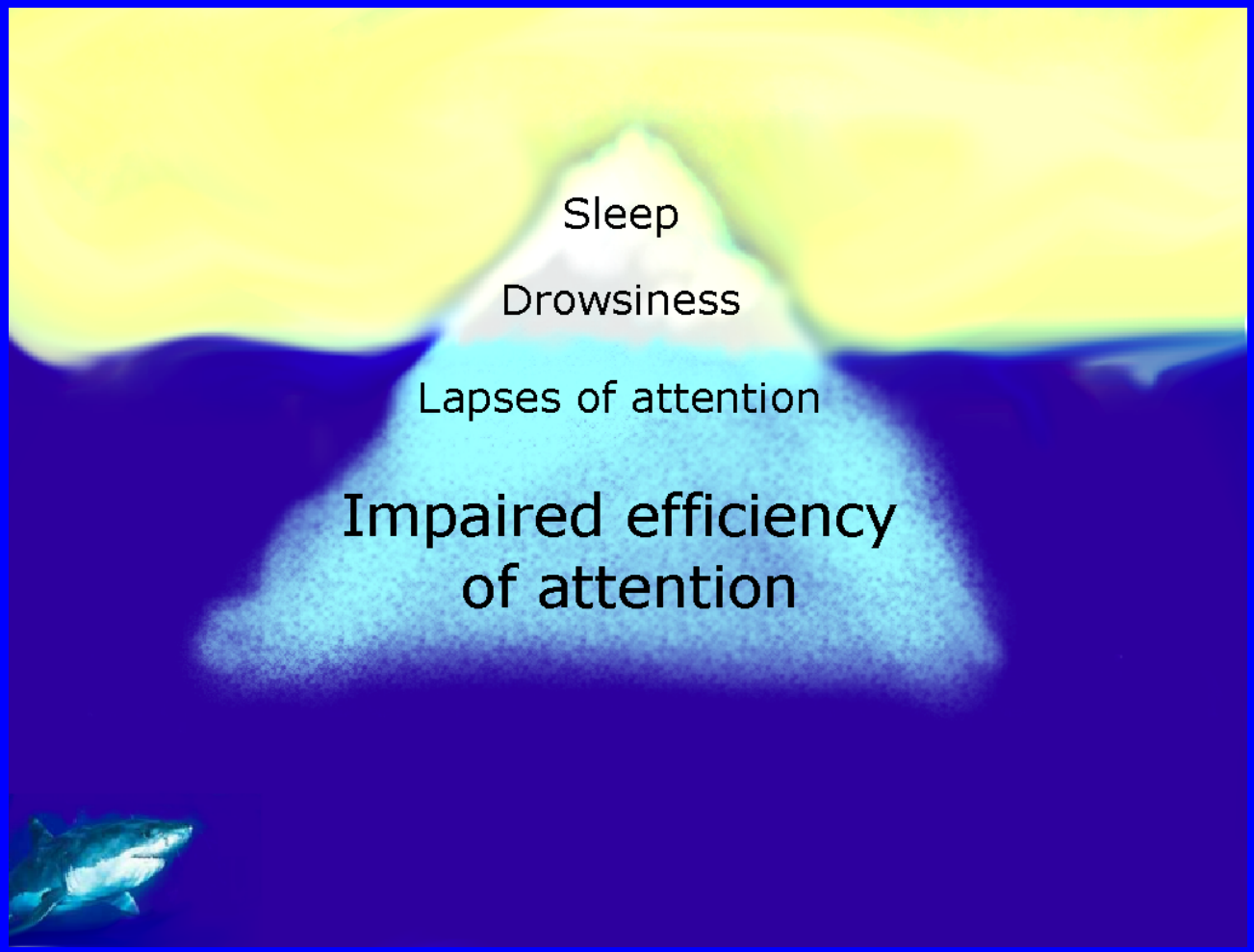
- Episodic occlusions of the upper airway (essentially choking)



- ~20% mid-age men ~8% in pre-menopausal women
- Excessive Daytime Sleepiness (EDS)

Hypothesis:

Sleep disorders may create vulnerabilities lie beneath the surface of what people can easily notice in themselves or observe in others.



Clinical assessment of attention

Nighttime sleep recording prior to daytime tests

- Diagnose / confirm state of sleep disorder
- Confirm adequate sleep (normal for patient)

Daytime laboratory assessment

Neurocognitive function tests

Physiological monitoring

- EEG (brain waves)
- EKG (heart activity)
- EOG (eye movements)

Subjective assessments

Epworth Sleepiness Scale (ESS)

VAS scales of arousal, alertness, stress

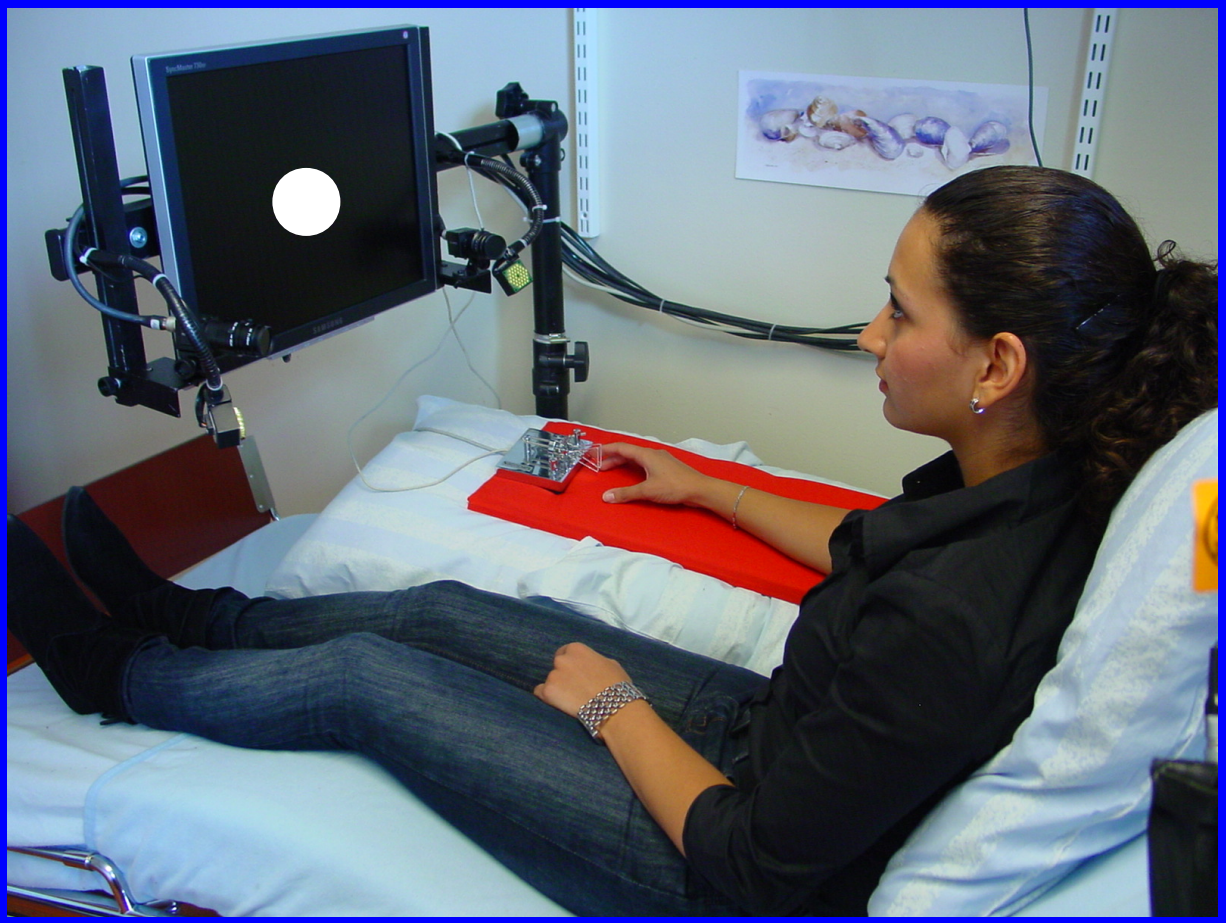
4 tests of neurocognitive function targeting specific functional areas:

- Ability to maintain wakefulness
- Processing of complex visual information
- Psychomotor coordination
- Vigilance: Ability to sustain simple attention

15 -30 minutes duration

Administered both morning and afternoon

Maintenance of simple attention (vigilance): **Gosling test**



20 minutes

dark room

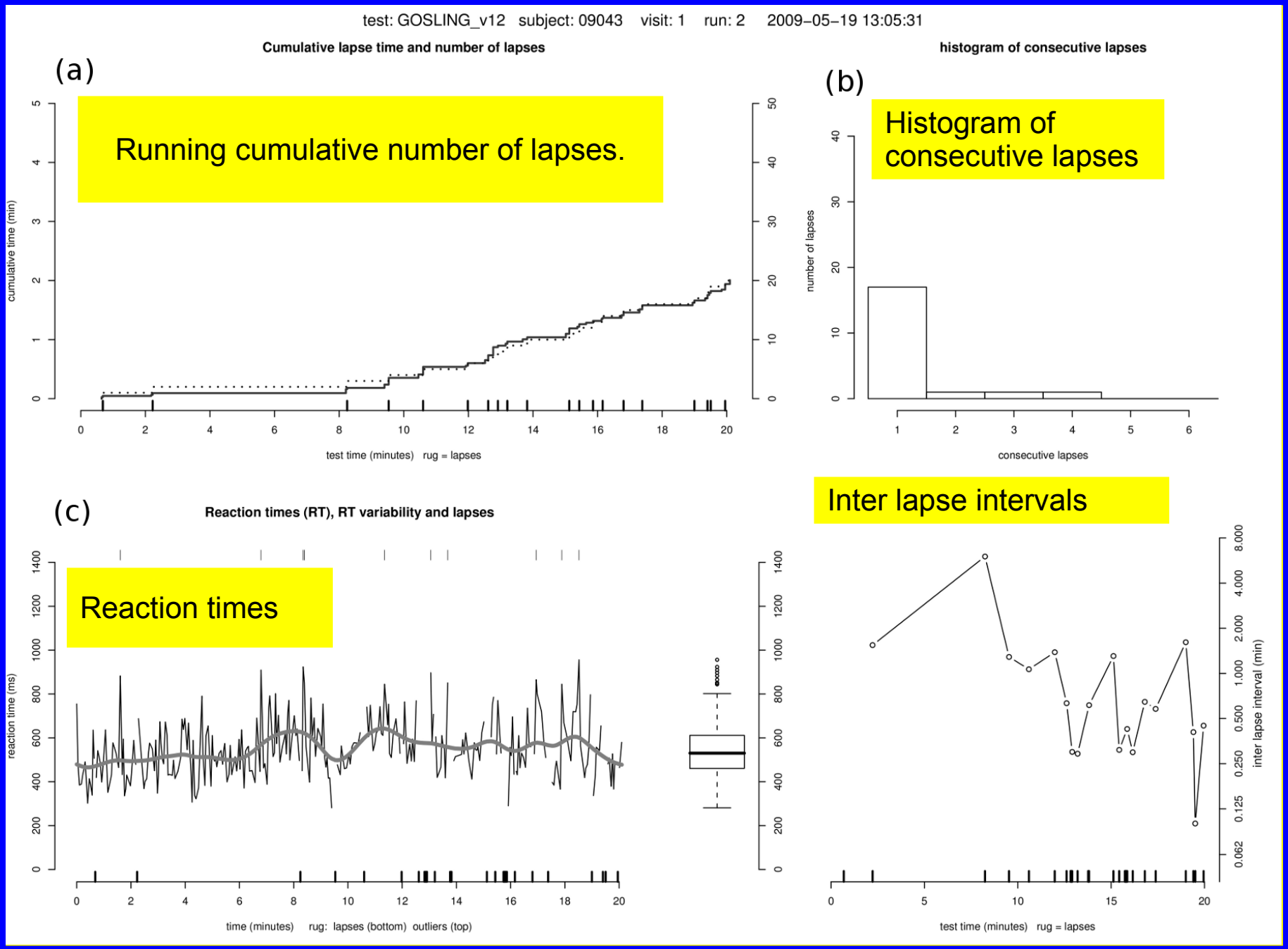
intervals 3-10 s.

<u>Outcomes</u>:

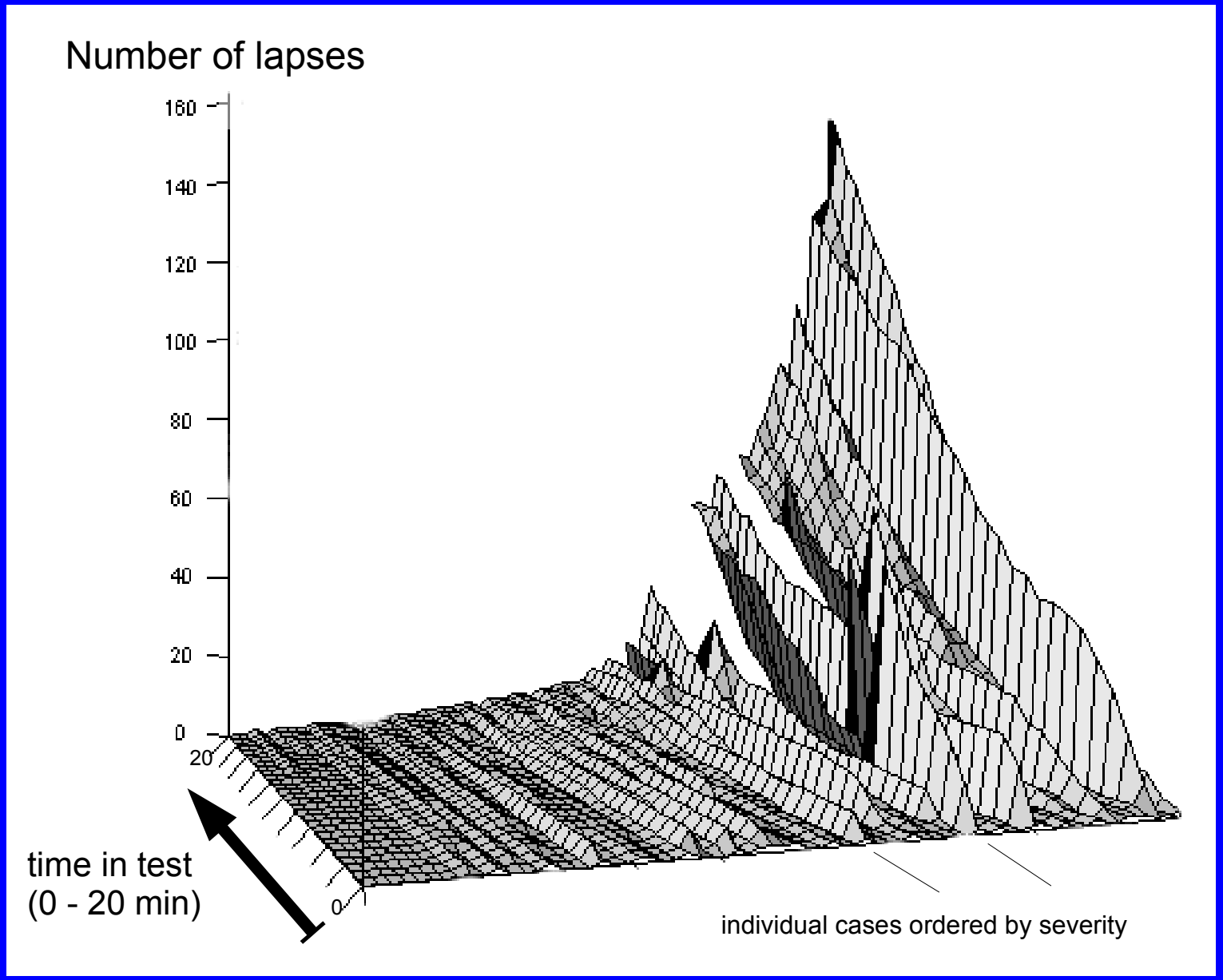
Reaction times (RT)

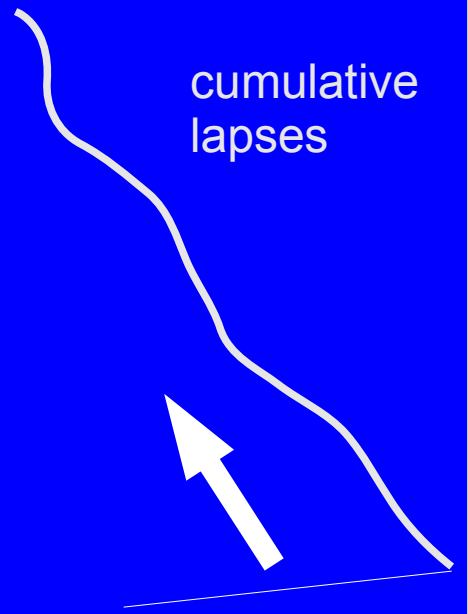
Lapses (RT > 2 seconds)

Gosling test results



Gosling patient group summary (n=39): Cumulative lapses over test time in sleep disorders





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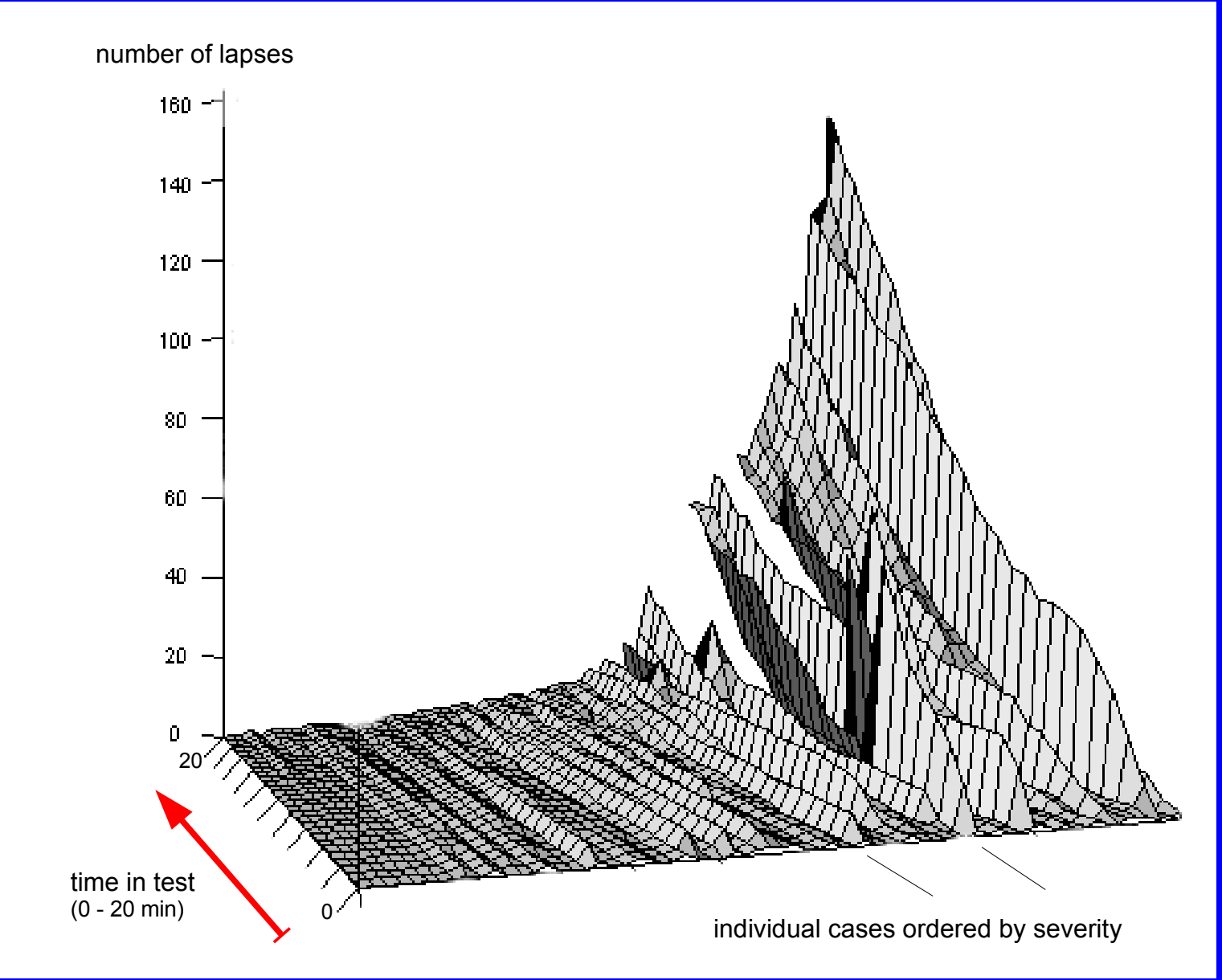
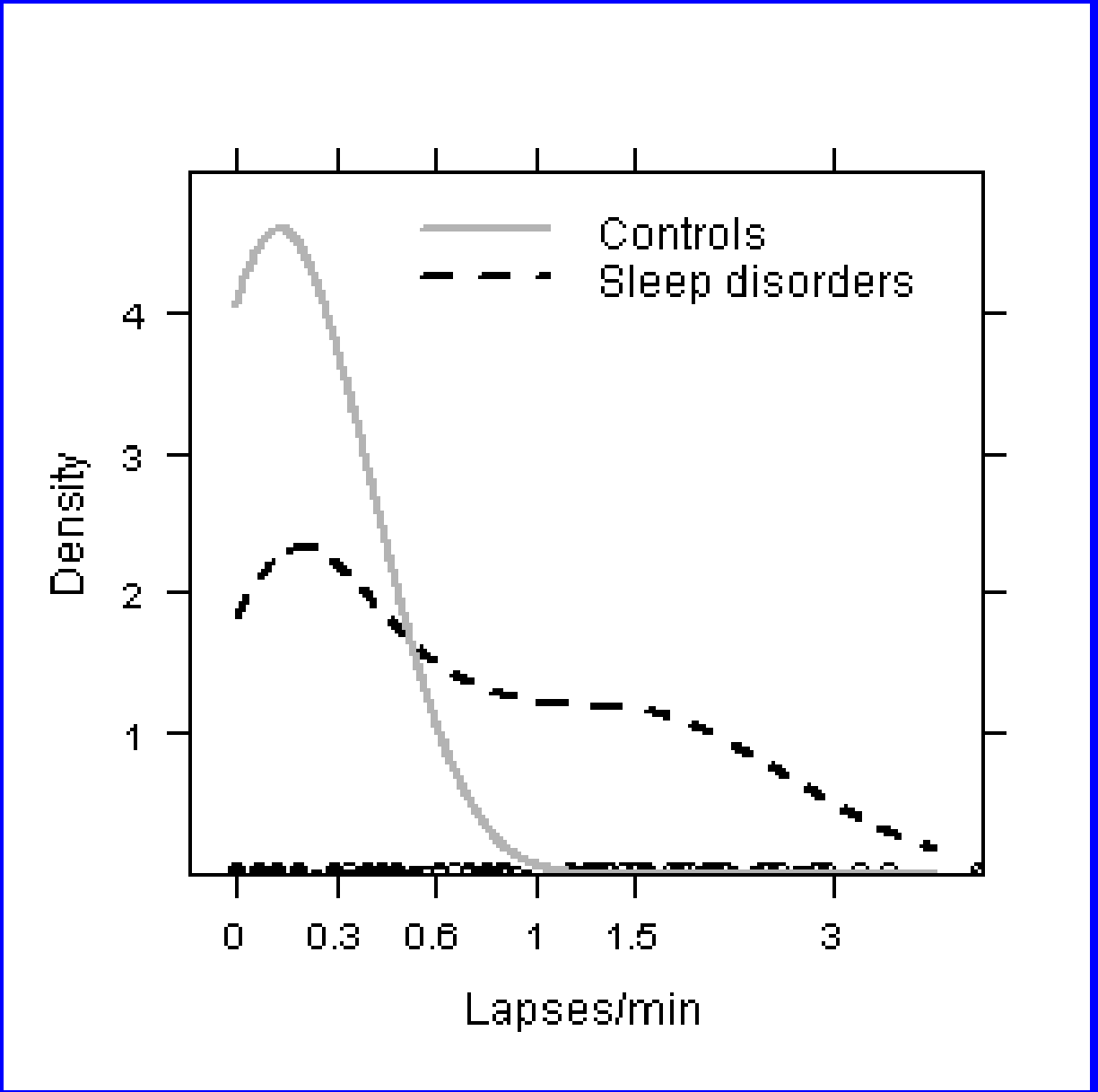
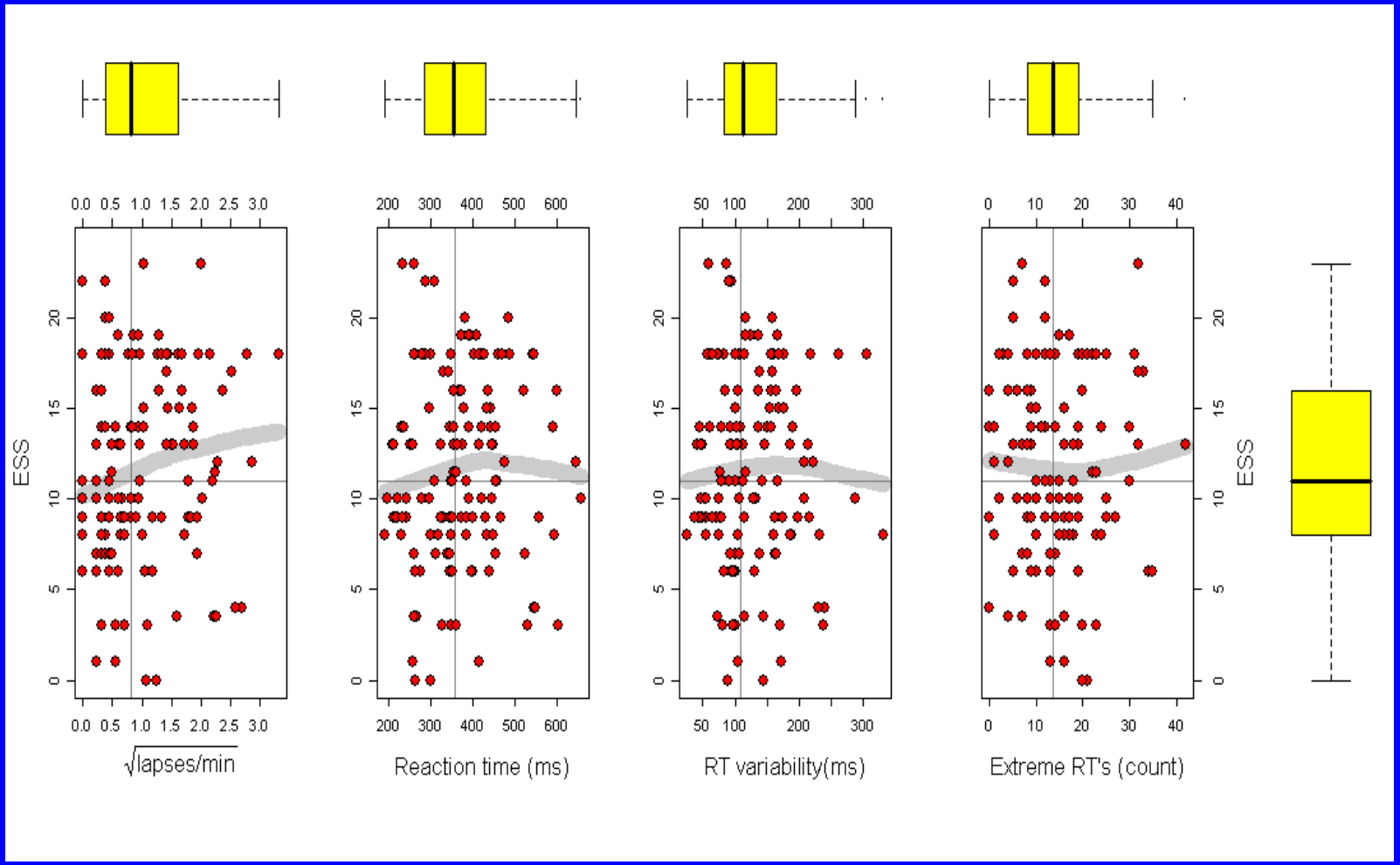


Probability density plots of lapse incidence in sleep disorders and healthy controls



No apparent relationship between subjective sleepiness and objective attention and alertness

Subjective sleepiness (ESS)



Objective attention (reaction times and lapses)

Summary

Short test of vigilance (Gosling) sensitive detection of attentional lapses

Some sleep disordered patients exhibit marked vigilance deficits

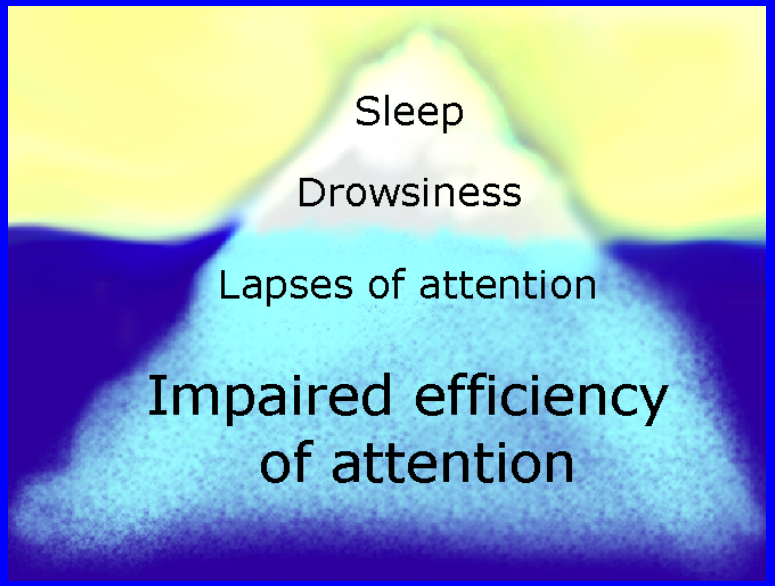
Retrospective self-reports of “daytime sleepiness” do not predict attention performance

Conclusion

Accident risks associated with sleep disorders span 2 domains:

Drowsiness

Impaired attention



Future perspectives

Generalize laboratory performance to real world operational environments

Develop better understanding of pathology of attention

Optimize

- detection and risk assessment
- treatment
- inform countermeasures

The wise protect attention as the greatest treasure

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Influences of Age and Gender on accident morbidity

Table 9. Exposure, risk and consequence for car drivers by age and gender.

Car driver – Male	Age						
1997-1999	18-24	25-34	35-44	45-54	55-64	65-74	75-
Million person kilometres per year	2307	7940	8820	8855	5633	2921	890
All injured/Million person kilometres	0.584	0.192	0.126	0.112	0.110	0.159	0.449
Fatalities/All injured	0.024	0.025	0.026	0.030	0.044	0.062	0.093
Car driver – Female	Age						
1997-1999	18-24	25-34	35-44	45-54	55-64	65-74	75-
Million person kilometres per year	1354	3461	4237	3755	2053	713	131
All injured/Million person kilometres	0.417	0.264	0.179	0.179	0.181	0.264	0.582
Fatalities/All injured	0.013	0.007	0.005	0.010	0.013	0.032	0.044

- "U shaped" age risk
- young women < young men
- old women > old men

Göran Nilsson (2004)

Prevalences – population survey

Sleep related complaints (%) in the Swedish population