National Transportation Safety Board

The Vital Role of Sleep for Safety, Health, and Performance

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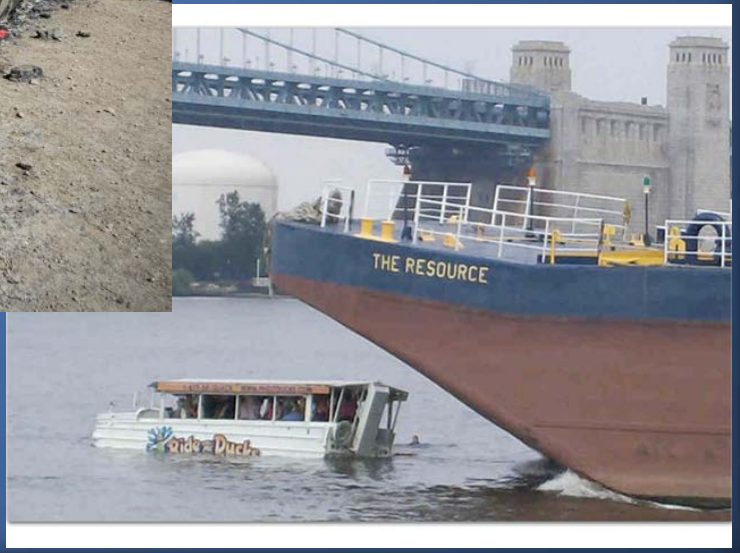
Board Member

6th Annual Meeting
Integrated Sleep Medicine Society Japan
August 2, 2014

1) determining the probable cause of transportation accidents

2) making recommendations to prevent their recurrence

All Modes



NTSB

Independent Federal Agency: Created in 1967

- >140,500 accident investigations
- 14,000+ safety recommendations
- ~ 2,300 organizations/recipients
- 82% acceptance rate

Challenges of a 24/7 Society

Four Fatigue Factors +

- Sleep loss
- Extended wakefulness
- Circadian/time of day
- Sleep disorders
- Other considerations

Uncontrolled In-Flight Collision with Terrain
AIA Flight 808, Douglas DC-8-61, N814CK
U.S. NAS, Guantanamo Bay, Cuba, August 18, 1993

First NTSB aviation accident investigation
to cite fatigue as probable cause

- acute sleep loss, sleep debt, circadian disruption

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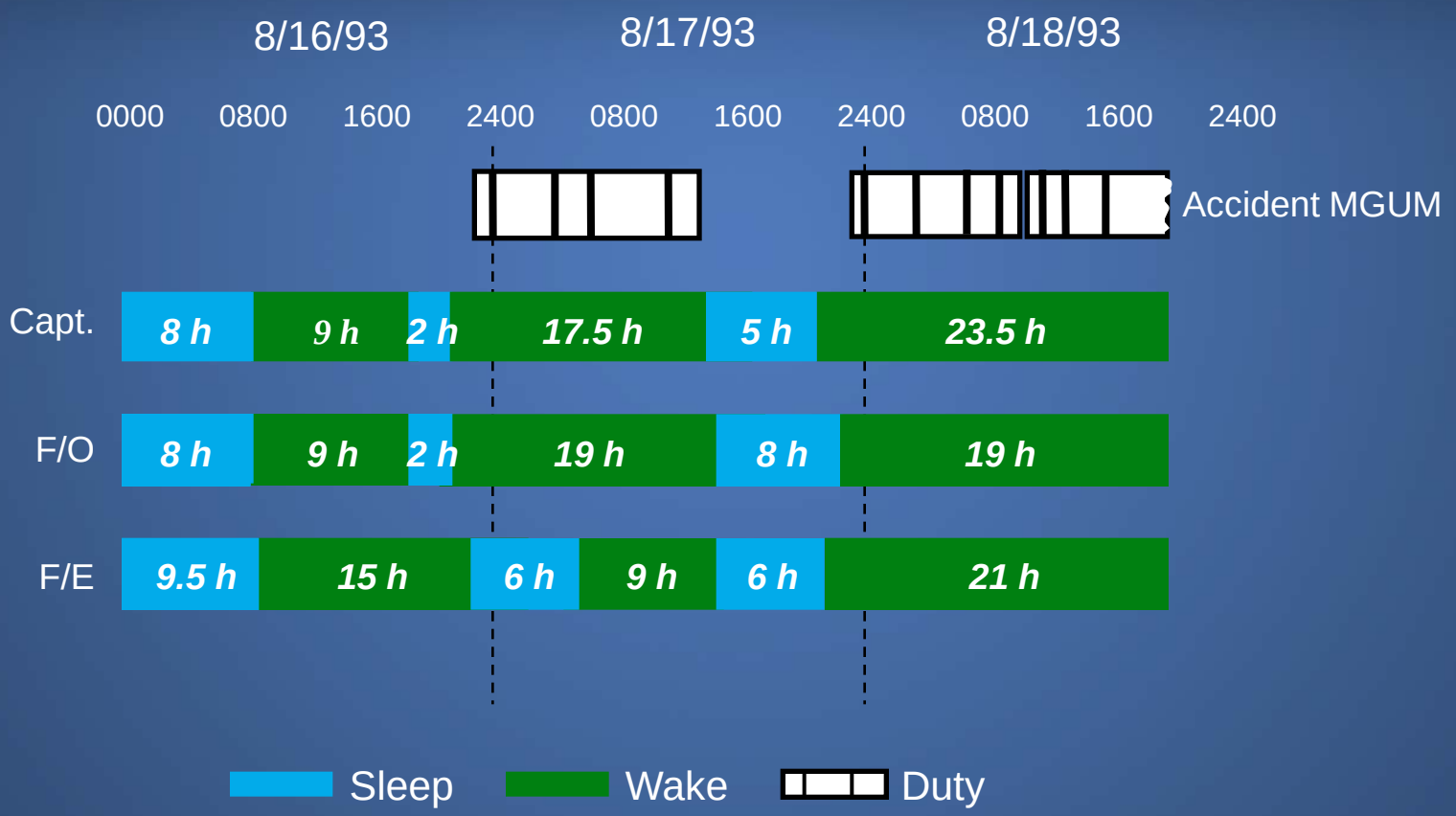
Crew Sleep History



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Observed Performance Effects

- Degraded decision-making
- Visual/cognitive fixation
- Poor communication/coordination
- Slowed reaction time

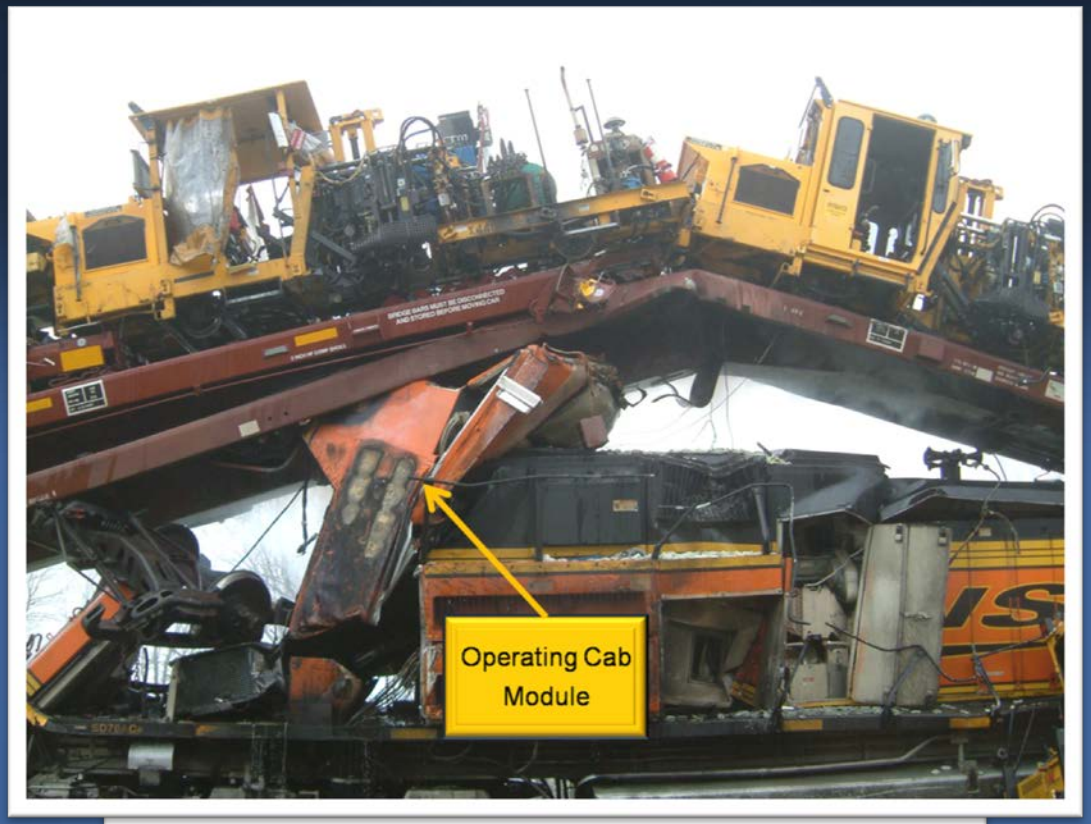
Uncontrolled In-Flight Collision with Terrain
AIA Flight 808, Douglas DC-8-61, N814CK
U.S. NAS, Guantanamo Bay, Cuba, August 18, 1993

"The National Transportation Safety Board determines that the probable causes of this accident were the impaired judgment, decision making, and flying abilities of the captain and flight crew due to the effects of fatigue…"

National Transportation Safety Board

Track Path Animation

Collision Between Two BNSF Railway Freight Trains
Red Oak, Iowa
April 17, 2011
DCA11FR002



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Probable Cause (fatigue)

". . . failure of the crew of the striking train to comply with the signal indication requiring them to operate in accordance with restricted speed requirements and stop short of the standing train because they had fallen asleep due to fatigue resulting from their irregular work schedules and their medical conditions."

Miami, Oklahoma (June 26, 2009)
Fatigue Factors

- Off work for 3 weeks: day active/night sleep schedule
- 3am to 3pm shift work/drive schedule (since 1997)
- Early bedtime (2 hr phase advance in sleep time)
- Obtained min 3 hrs/max 5 hrs sleep prior to accident
- Subsequently diagnosed with mild sleep apnea

10 fatalities
3 serious injuries
2 minor injuries
5 no injuries

Source: Oklahoma State Police

Probable Cause (fatigue)

"... driver's fatigue, caused by the combined effects of acute sleep loss, circadian disruption associated with his shift work schedule, and mild sleep apnea, which resulted in the driver's failure to react to slowing and stopped traffic ahead by applying the brakes or performing any evasive maneuver to avoid colliding with the traffic queue. . . ."

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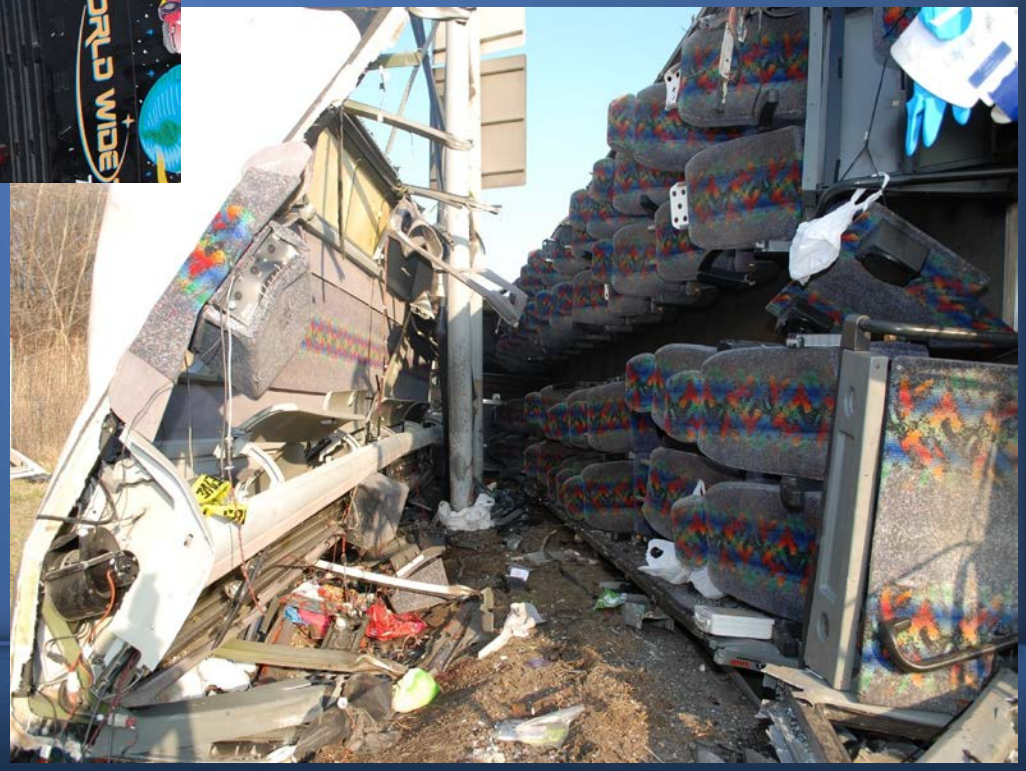
Animation of Accident Reconstruction

Motorcoach Run Off Road-Collision with Bridge Signpost

Interstate Highway 95 Southbound
New York, New York
March 12, 2011

HWY11MH005

‘Bronx Bus’, New York, NY (March 12, 2011)



15 fatalities

17 injuries

Probable Cause

"The National Transportation Safety Board determines that the probable cause of the accident was the motorcoach driver's failure to control the motorcoach due to fatigue resulting from failure to obtain adequate sleep, poor sleep quality, and the time of day at which the accident occurred."

Asiana 214 (July 6, 2013)
San Francisco, CA (SFO)

3 fatalities

49 seriously injured

NTSB

Probable Cause

Contributing to the accident were . . .

(5) flight crew fatigue, which likely degraded their performance.

Fatal Aviation Accidents
(examples: fatigue cited)

- 8/97 Guam: 228 fatalities
- 6/99 Little Rock AK: 11 fatal
- 10/04 Kirksville MO: 11 fatalities
- 8/06 Lexington KY: 49 fatalities
- 7/08 Owatonna MN: 8 fatalities
- 2/09 Buffalo NY: 49 fatalities
- 6/09 Santa Fe NM: 2 fatalities
- 7/13 San Francisco, CA: 3 fatalities

Honorable John K. Lauber:

No Accident ≠
Safe Operation

Go! Flight 1002

- early starts, multiple segment days, sleep apnea

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SHARE

MOST WANTED LIST

A program to increase the public's awareness of, and support for, action to adopt safety steps that can help prevent accidents and save lives.
The following are ten of the current issues.

Addressing Human Fatigue

General Aviation Safety

Safety Management Systems

Runway Safety

Bus Occupant Safety

Pilot & Air Traffic Controller Professionalism

Recorders

Teen Driver Safety

Addressing Alcohol-Impaired Driving

Motorcycle Safety

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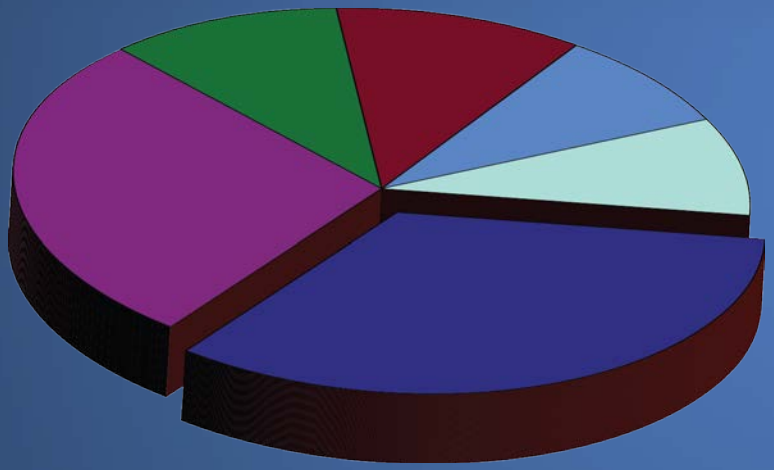
NTSB Safety Recommendations: Fatigue

- MOST WANTED 1990 - 2011
- ~200 fatigue recommendations

Complex Issue:



Requires Multiple Solutions

- Scheduling Policies and Practices
- Education/Awareness
- Organizational Strategies
- Healthy Sleep
- Vehicle and Environmental Strategies
- Research and Evaluation

NTSB Safety Recommendations: Fatigue Status (May, 2012)

- Total: 194
- Open: 48
- Closed: 146
- CUN*: 26

CUN = closed unacceptable

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Health: Sleep Disorders

sleep apnea

restless legs

parasomnias

jet lag

shift work

narcolepsy

hypersomnia

sleep phase

REM behavior

insomnia

Health: Medical Conditions

obesity

hypertension

inflammation

metabolic dysfunction

cancer

gene regulation

stroke

Mood disorders

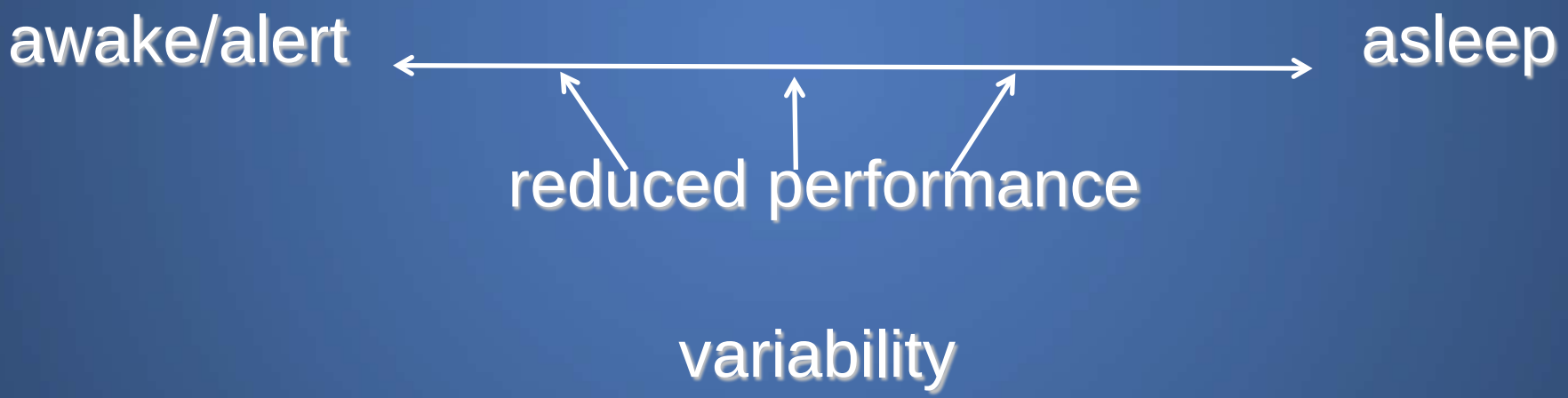
diabetes

immune dysfunction

Fatigue Risks

Fatigue can degrade every aspect of human capability.

Fatigue Risks



Fatigue Risks

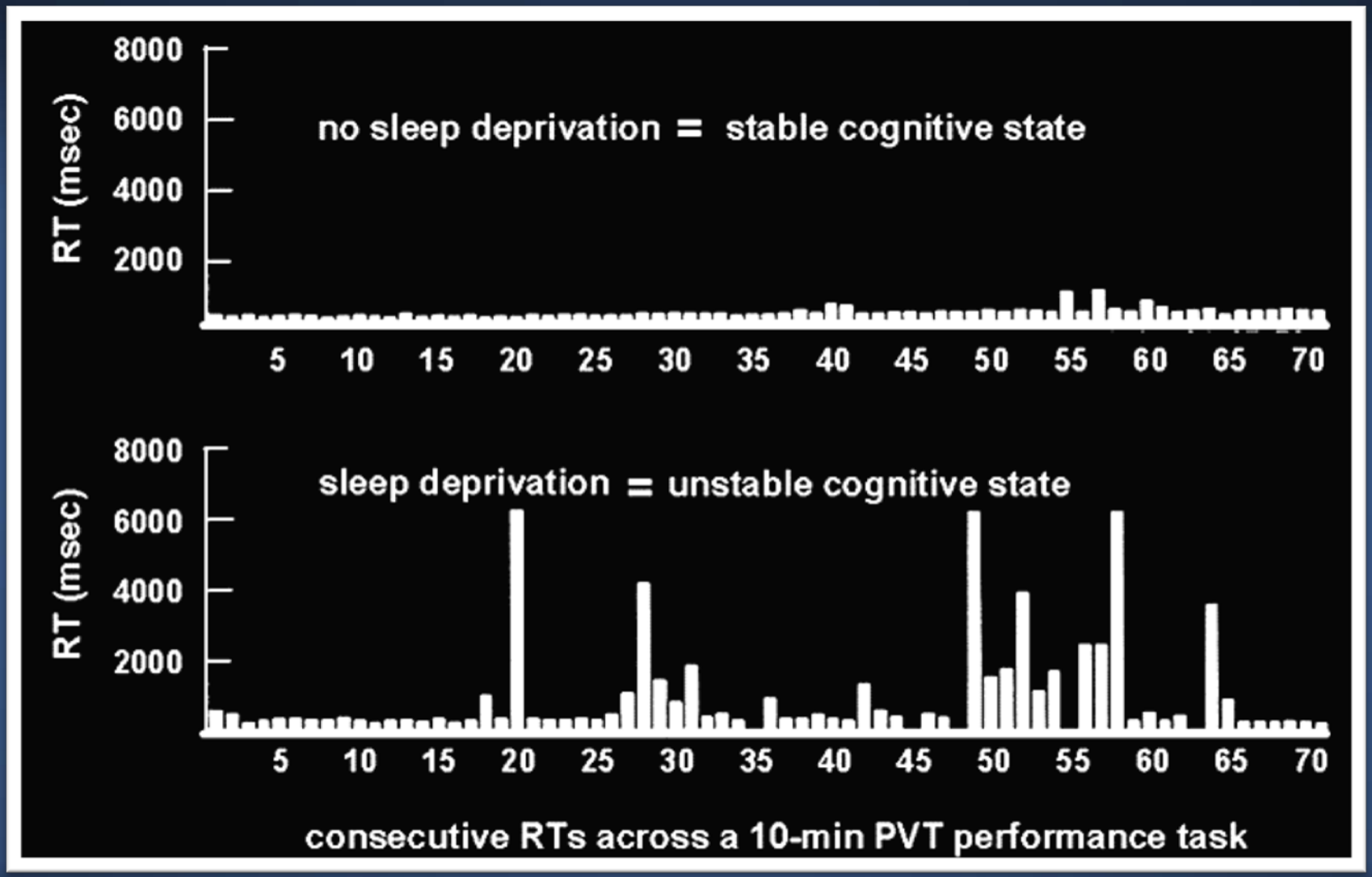
- degraded 20 – 50%+:

  - reaction time
  - memory
  - communication
  - situational awareness
  - judgment
  - attention
  - mood

- increased:

  - irritability
  - apathy
  - attentional lapses
  - microsleeps

Fatigue and Reaction Times



Doran SM, Van Dongen HP, Dinges DF. Sustained attention performance during sleep deprivation: evidence of state instability. *Archives of Italian Biology: Neuroscience* 2001;139:253-267.

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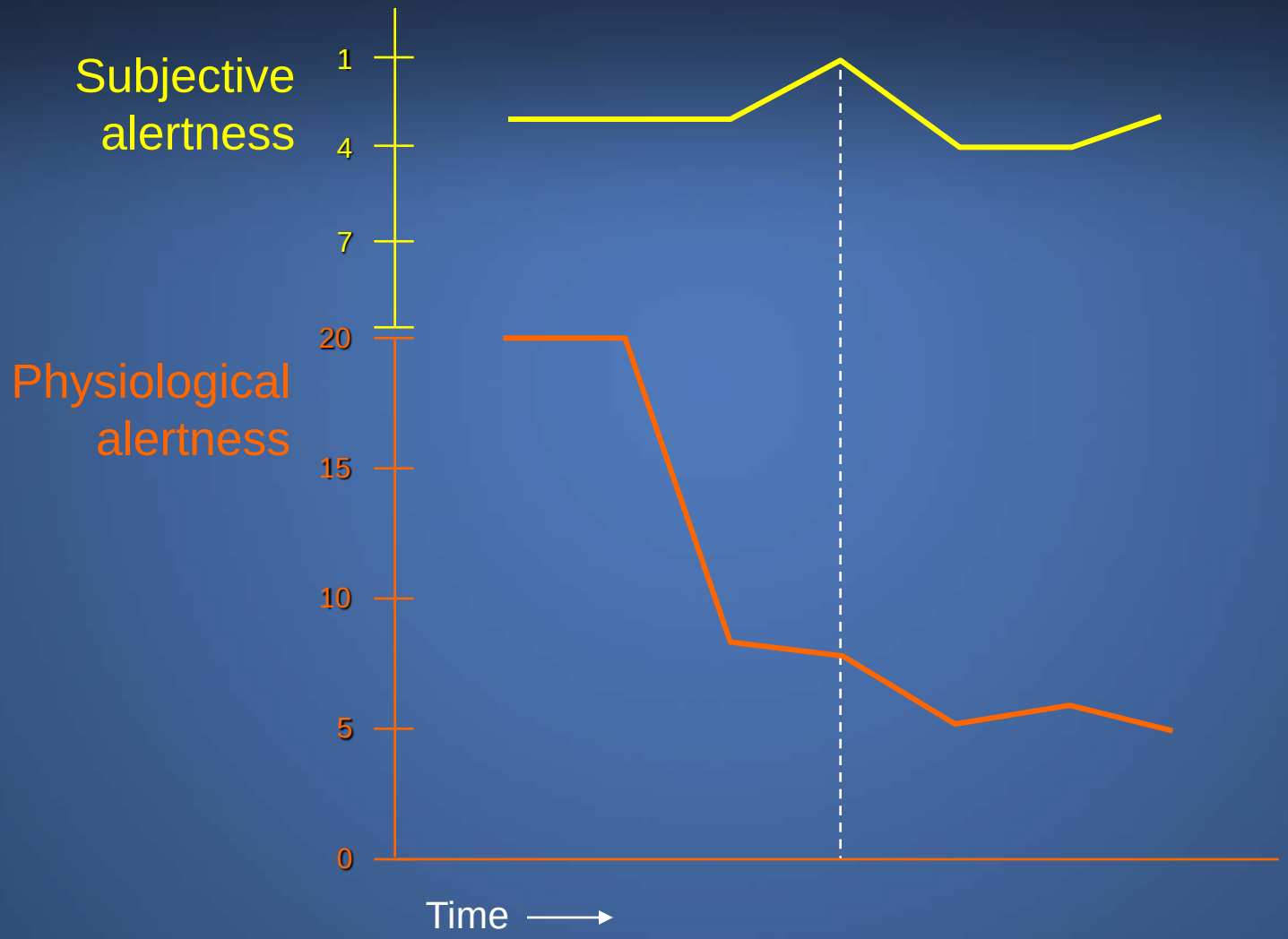
Alertness Reports Often Inaccurate



Adapted from Sasaki et al., 1986

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Success requires . . .

A culture change that supports

different attitudes and behaviors

Your Personal Role/Responsibility

Be an educator

Challenge attitudes

Enact change

Personal life

Family

Workplace

Organization

Model good sleep behavior

#40 Ceremonial Swearing In

Good sleep is vital for . . .

- safety
  - health
    - performance

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