



**National  
Transportation  
Safety Board**

# Stanford Sleep and Dreams: Enhancing Transportation Safety

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Board Member  
(S&D '75/Stanford '77)

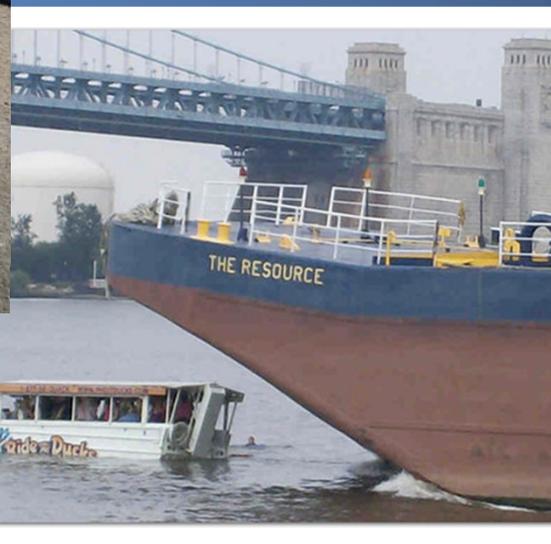
Sleep and Dreams  
Stanford University  
March 8, 2013



- 1) determining the probable cause of transportation accidents**
- 2) making recommendations to prevent their recurrence**



# All Modes



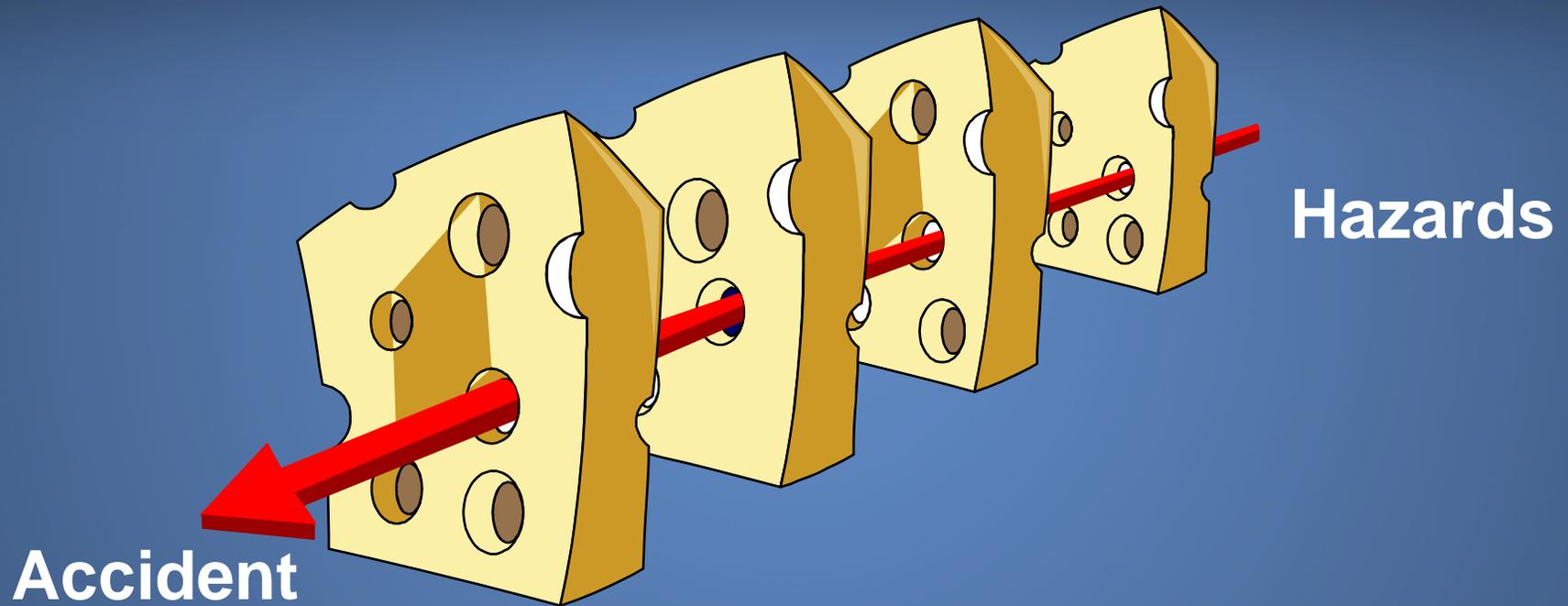
## Independent Federal Agency: Created in 1967

- ~ 132,000 accident investigations
- 13,500+ safety recommendations
- ~ 2,500 organizations/recipients
- 82% acceptance rate



NTSB

# “Swiss Cheese” Model (Reason)



Successive layers of defenses, barriers, and safeguards

# NTSB Characterized as:

‘moral compass and industry conscience’

NTSB Chairman Deborah A.P. Hersman

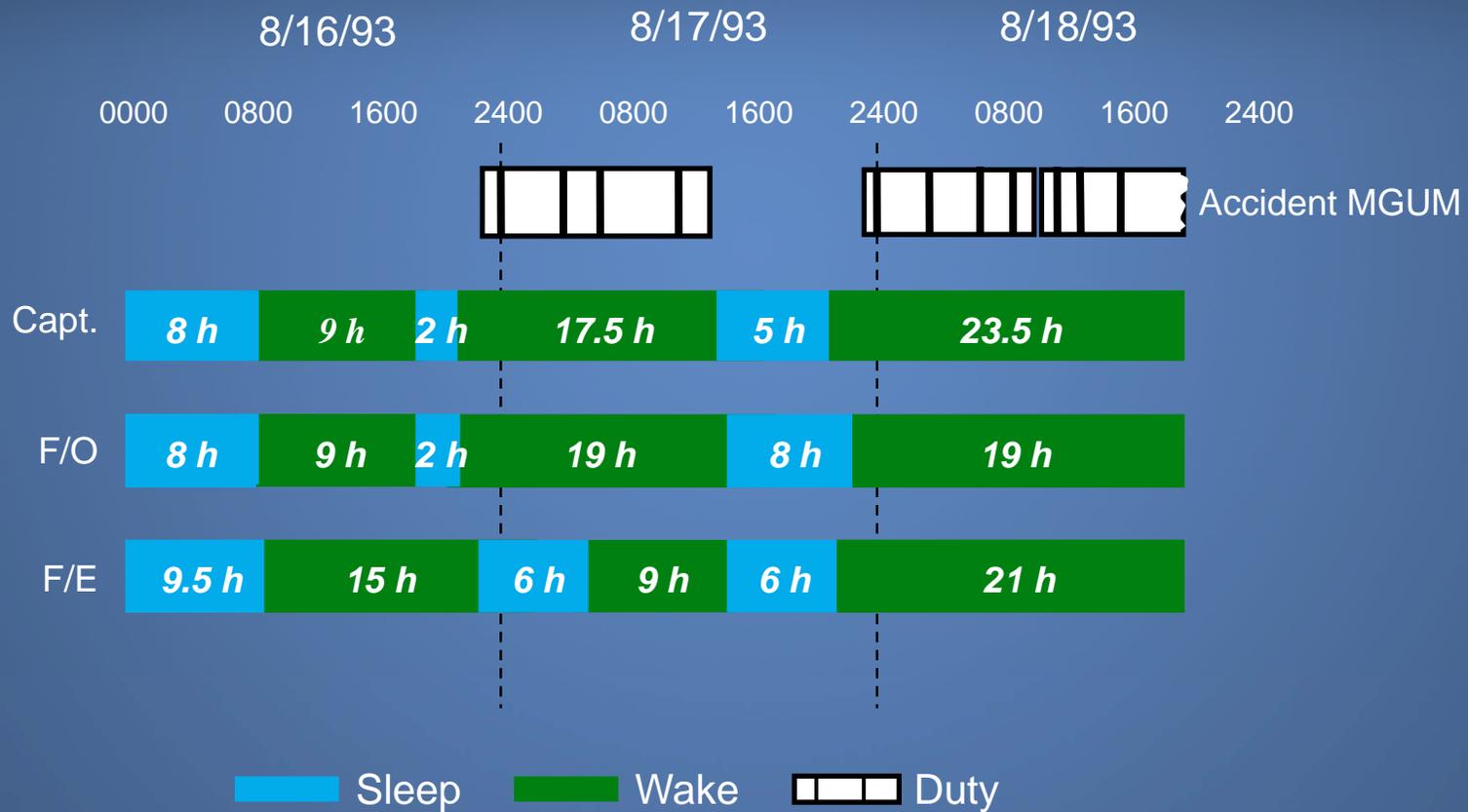
# Guantanamo Bay Cuba

First NTSB aviation accident to cite fatigue as probable cause



- acute sleep loss, sleep debt, circadian disruption

# Crew Sleep History



# 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...”



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# 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

Ford  
Windstar



Hyundai  
Sonata

Kia  
Spectra

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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## **Track Path Animation**

Collision Between Two BNSF Railway Freight Trains

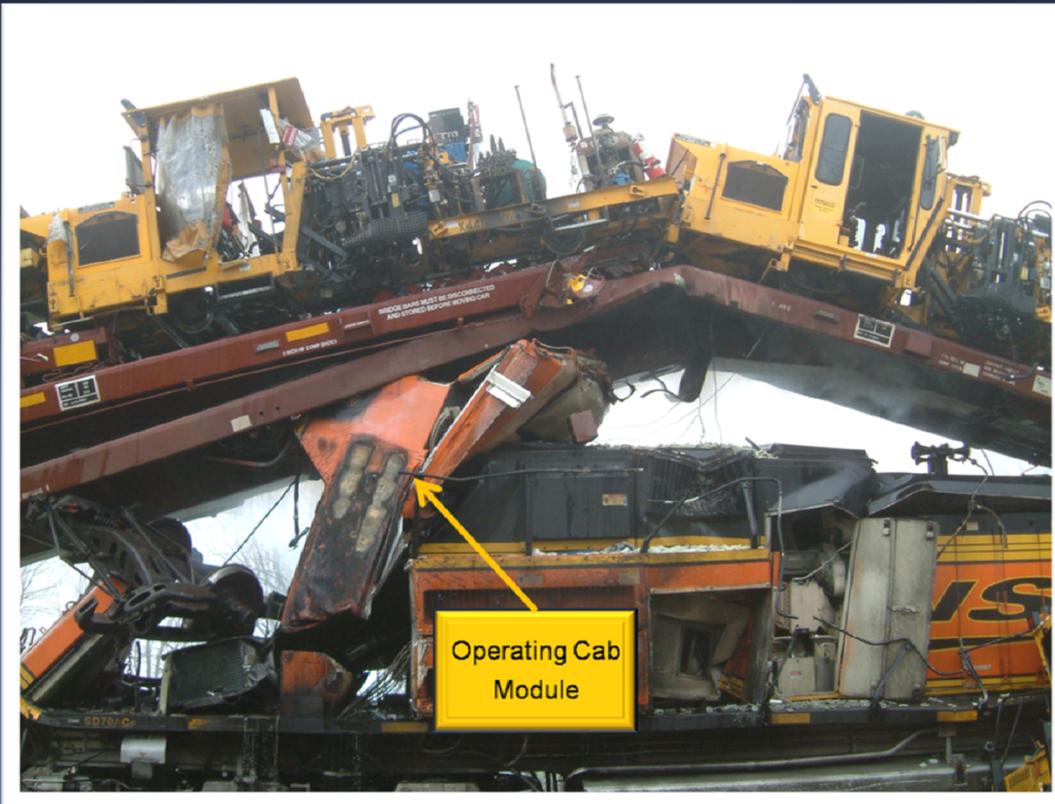
Red Oak, Iowa

April 17, 2011

DCA11FR002



**NTSB**



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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.”





Home > Transportation Safety > Most Wanted List

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



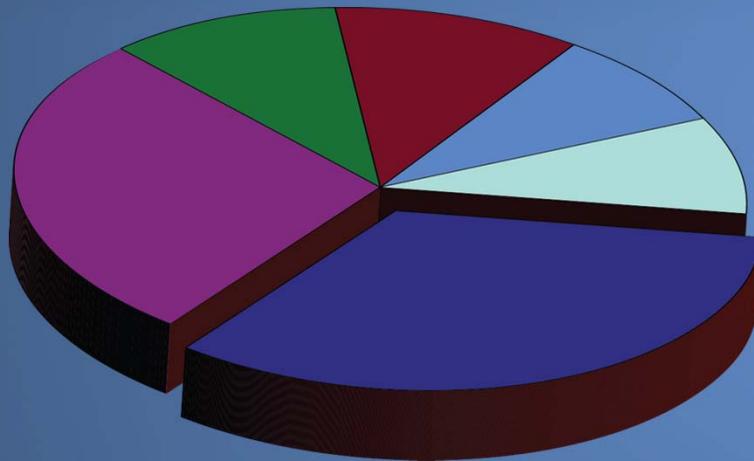
# NTSB Recommendations

- MOST WANTED 1990 -2012
- ~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



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# Challenges of a 24/7 Society



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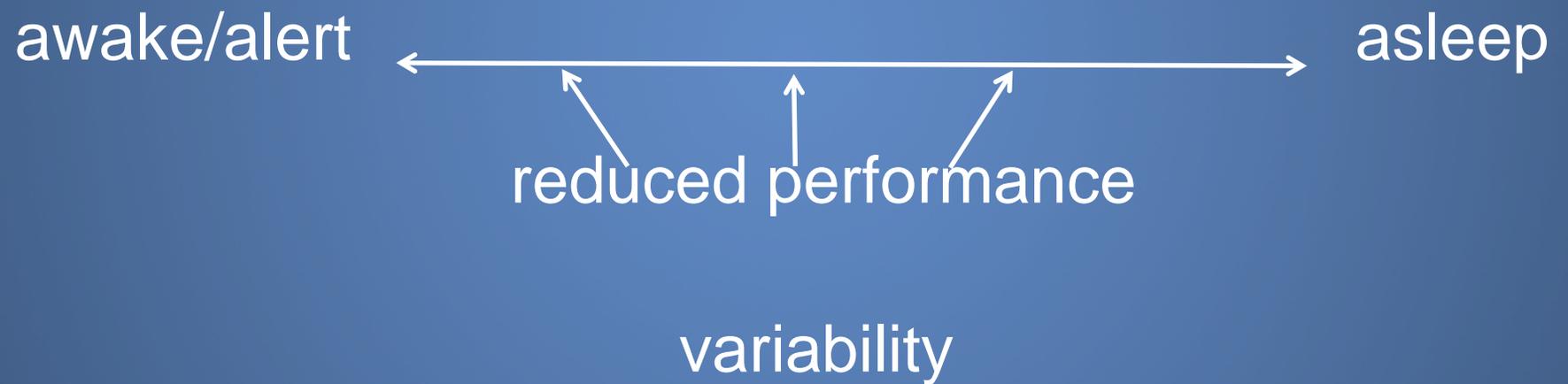
# Fatigue Risks

Fatigue can degrade  
every aspect of  
human capability.



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# Fatigue Risks



# Fatigue Risks

- degraded 20 – 50%+:

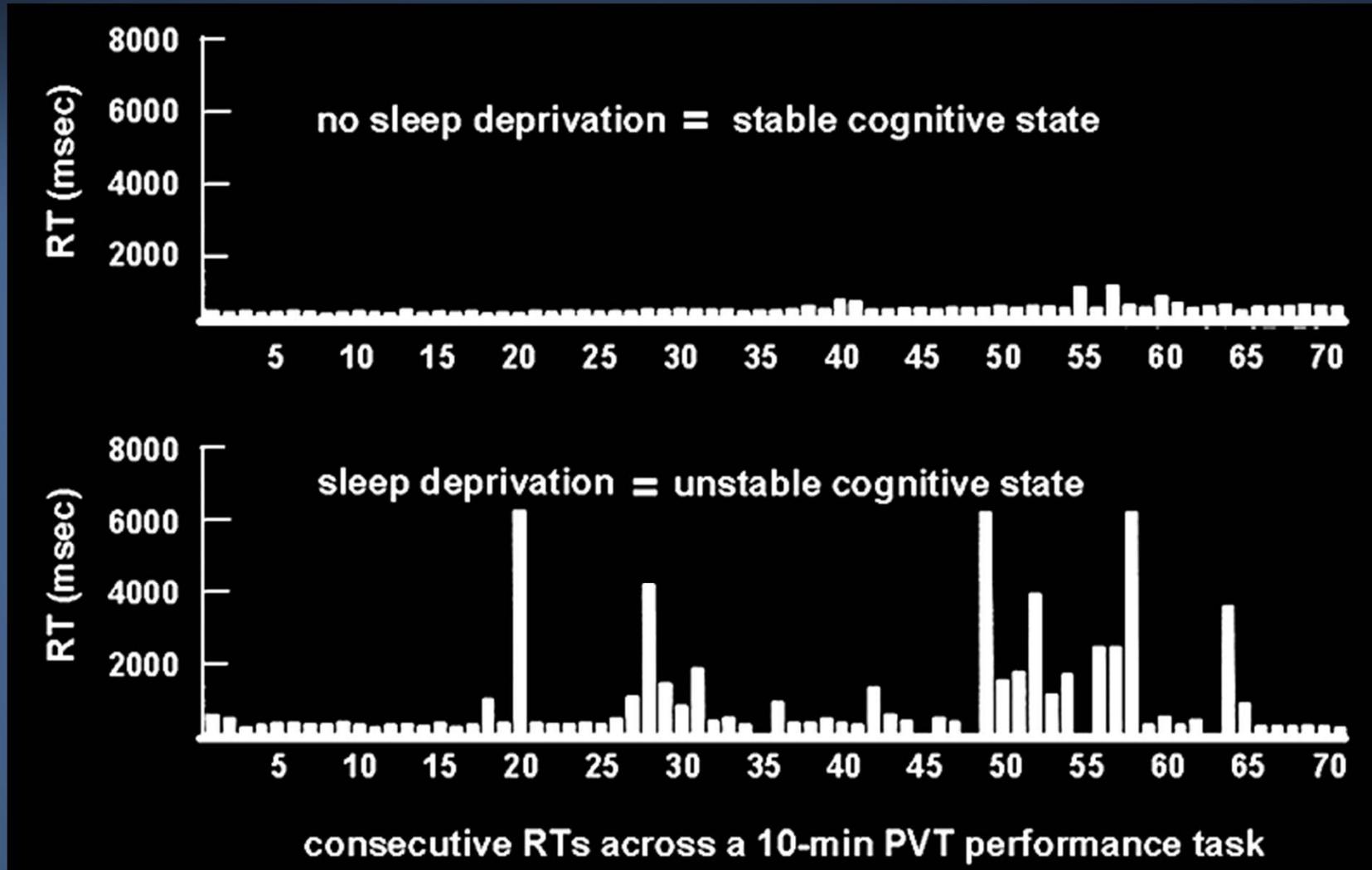
- reaction time
- memory
- communication
- situational awareness
- judgment
- attention
- mood

- increased:

- irritability
- apathy
- attentional lapses
- microsleeps



# Fatigue and Reaction Times

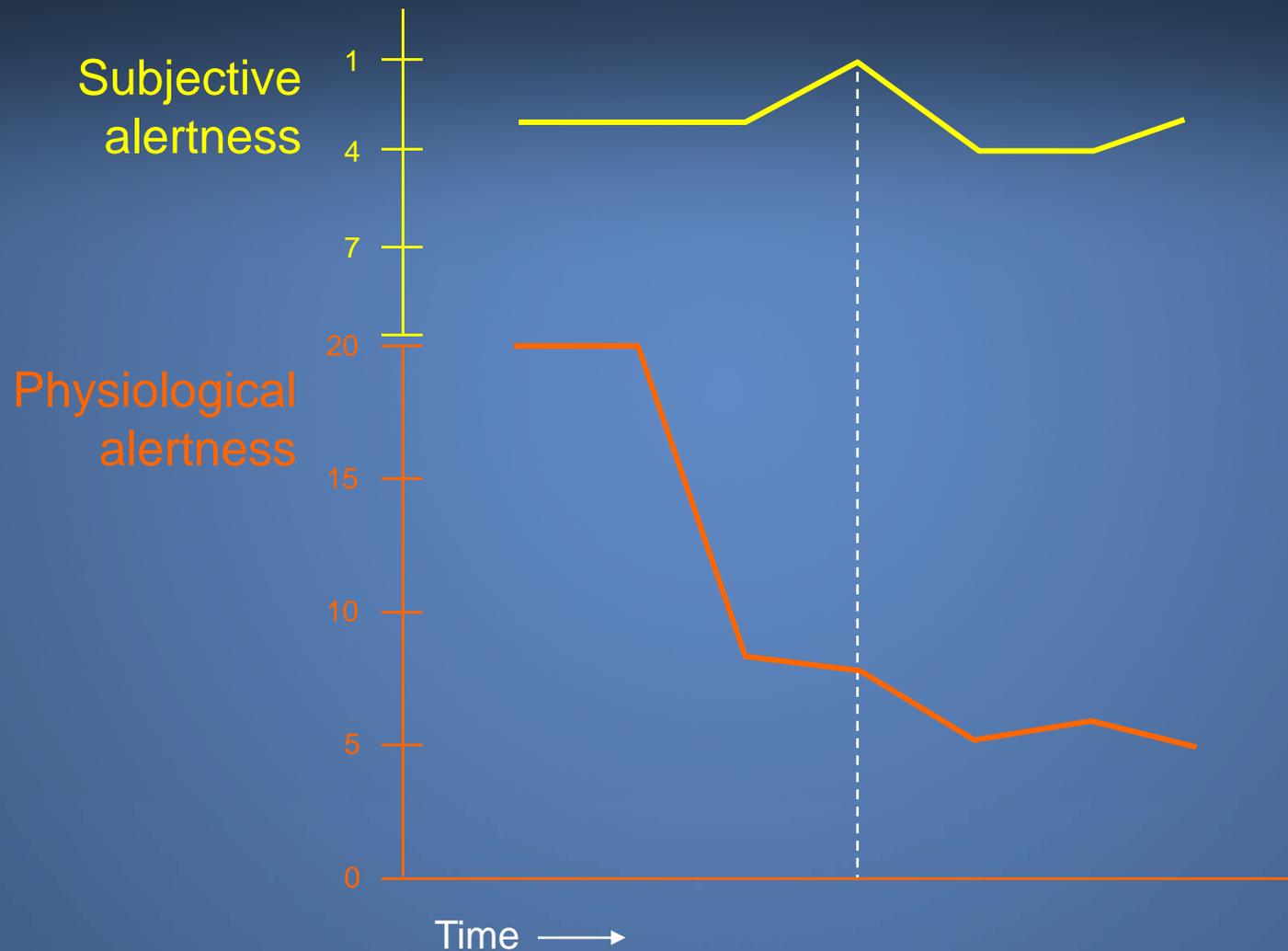


Doran SM, Van Dongen HP, Dinges DF. Sustained attention performance during sleep deprivation: evidence of state instability. *Archives of Italian Biology: Neuroscience* 2001;139:253-267.



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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



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Stanford Sleep and Dreams: 40+ Years

Drowsiness is Red Alert!



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# #40 Ceremonial Swearing In



Good sleep, safe travels.



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