



**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  
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UNITED STATES CODE, TITLE 49

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### SUBCHAPTER I—GENERAL

§101. Definitions

Section 40102(a) of this title applies to this chapter.

### SUBCHAPTER II—ORGANIZATION AND ADMINISTRATIVE

§103. General organization

(a) ORGANIZATION.—The National Transportation Safety Board is an independent establishment of the Executive Branch of the Government.

(b) APPOINTMENT OF MEMBERS.—The Board is composed of 5 members appointed by the President, by and with the advice and consent of the Senate. Not more than 3 members may be appointed from the same political party. The members shall be appointed on the basis of technical qualification, professional standing, and demonstrated knowledge of accident reconstruction, safety engineering, human factors, transportation safety, or transportation regulation.

(c) TERMS OF OFFICE AND REMOVAL.—The term of office of each member is 5 years. An individual may be appointed to fill a vacancy occurring before the expiration of the term for which the predecessor of that individual was appointed for the remainder of that term. When the term of office of a member ends, the member may be reappointed if a successor is appointed and qualified. The President may remove a member for inefficiency, neglect of duty, or other cause in office.

(d) CHAIRMAN AND VICE CHAIRMAN.—The President shall designate, by and with the advice and consent of the Senate, a Chairman of the Board. The President also shall designate a Vice Chairman of the Board. The terms of both the Chairman and Vice Chairman are 2 years. When the Chairman is absent or unable to perform the duties of the office, the Vice Chairman shall perform those duties.

# Mission

The NTSB is charged with:

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



## The NTSB is Responsible for Investigating:

- Aviation, highway, rail, marine, pipeline, and hazardous material accidents



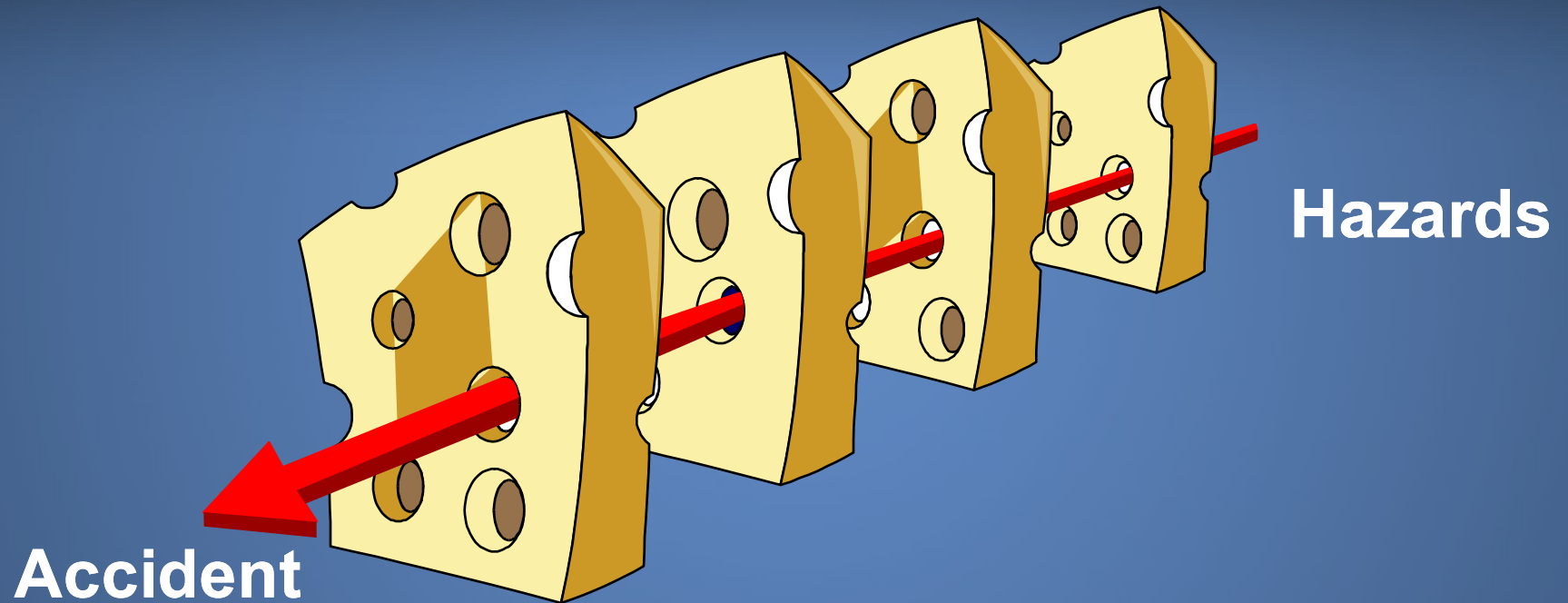
# PG&E/San Bruno Gas Pipeline Explosion





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

# “Swiss Cheese” Model (Reason)



Successive layers of defenses, barriers, and safeguards

# Guantanamo Bay Cuba

First NTSB aviation accident to cite fatigue as probable cause

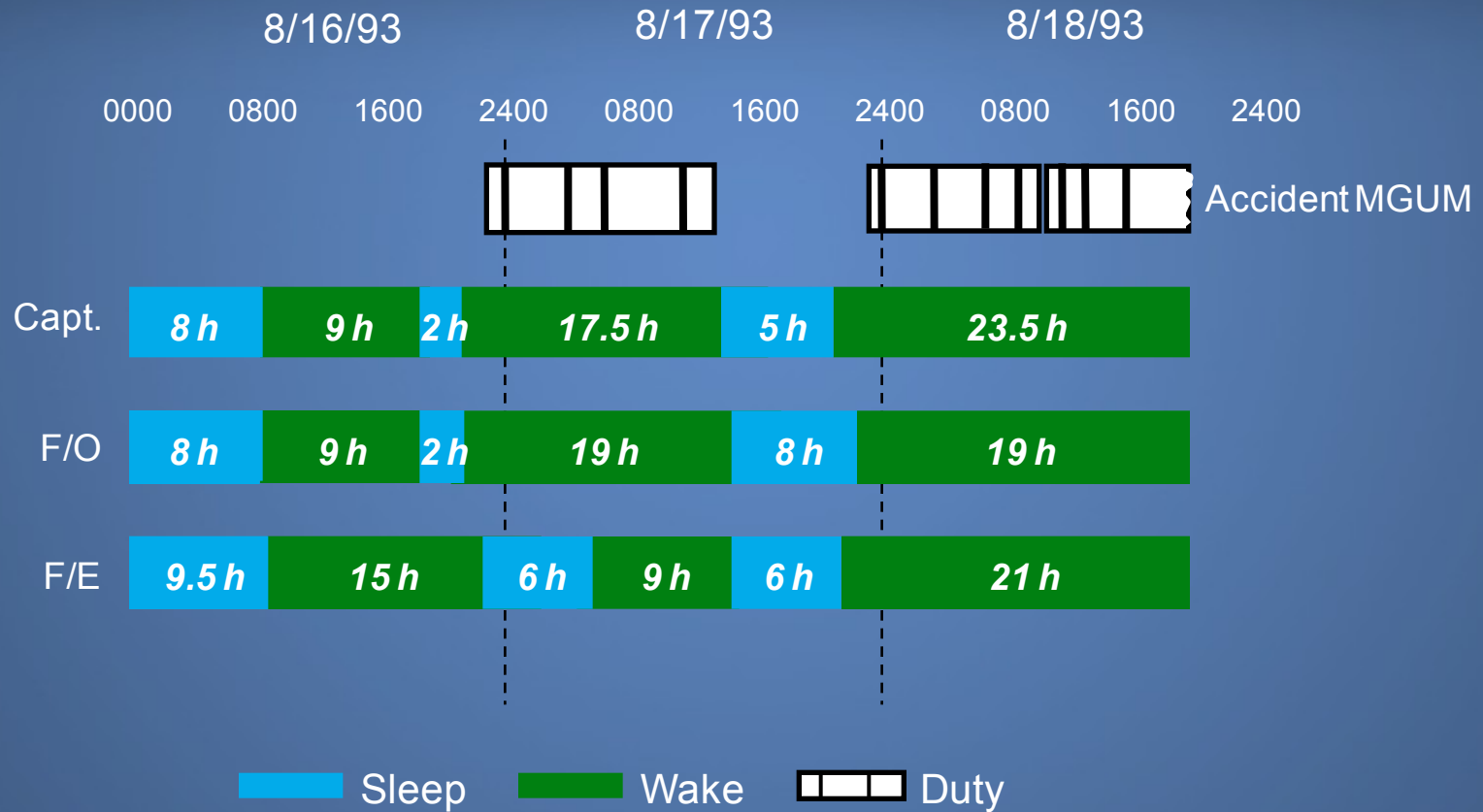


- acute sleep loss, sleep debt, circadian disruption



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# 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...”



# Miami, Oklahoma (June 26, 2009)

- Initial minor accident (~1:13 pm)
  - blocked eastbound I-44
- 2008 Volvo truck-tractor (~1:19 pm)
  - refrigerated semitrailer
  - traveling eastbound on I-44
  - 69 mph with cruise control engaged
  - without slowing or braking collided into queue of slowing & stopped vehicles



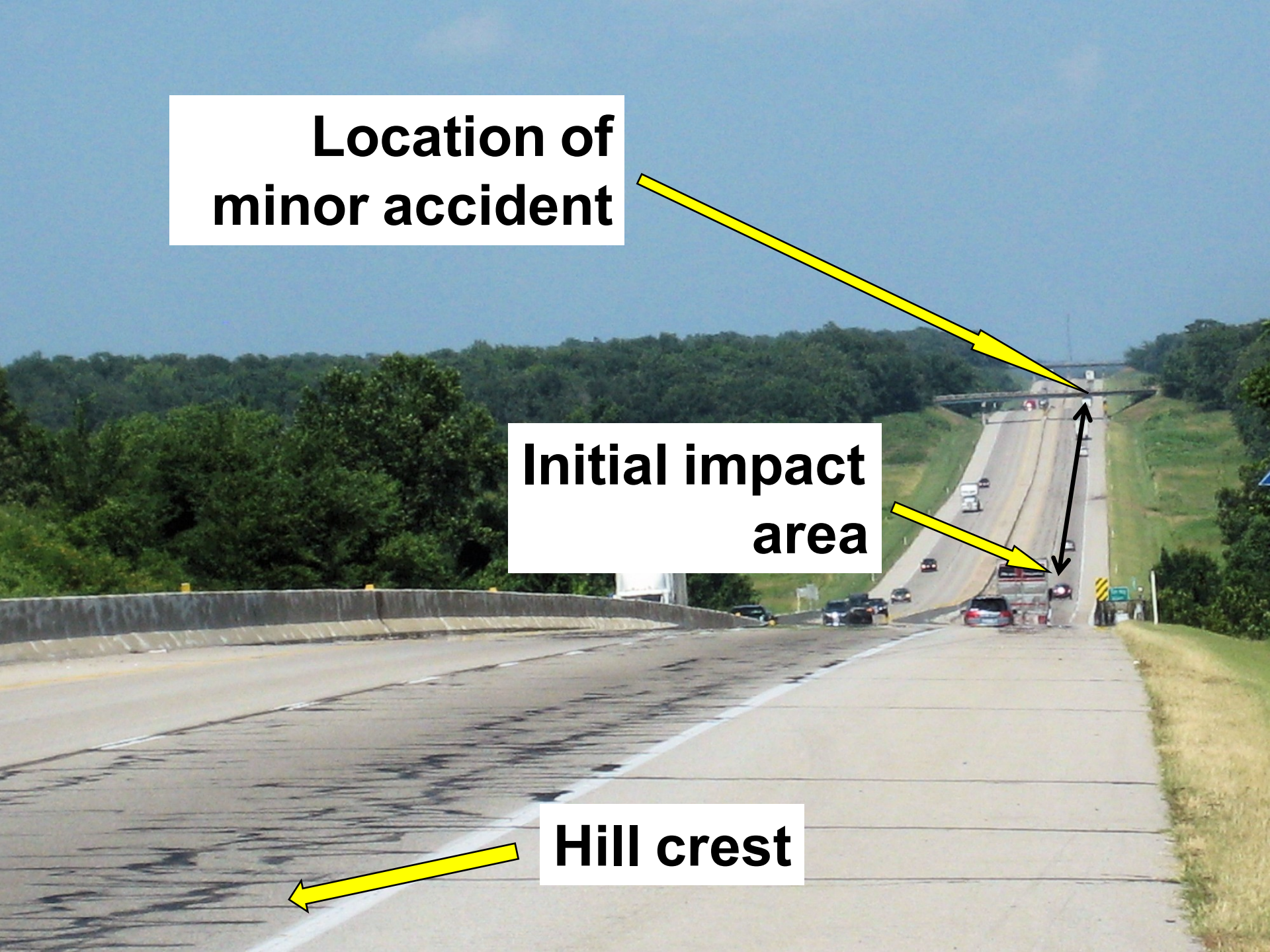
# Fatigue Factors

- 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

**Location of  
minor accident**

**Initial impact  
area**

**Hill crest**



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. . . . ”





**National  
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## **Track Path Animation**

Collision Between Two BNSF Railway Freight Trains

Red Oak, Iowa

April 17, 2011

DCA11FR002



**NTSB**



# 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

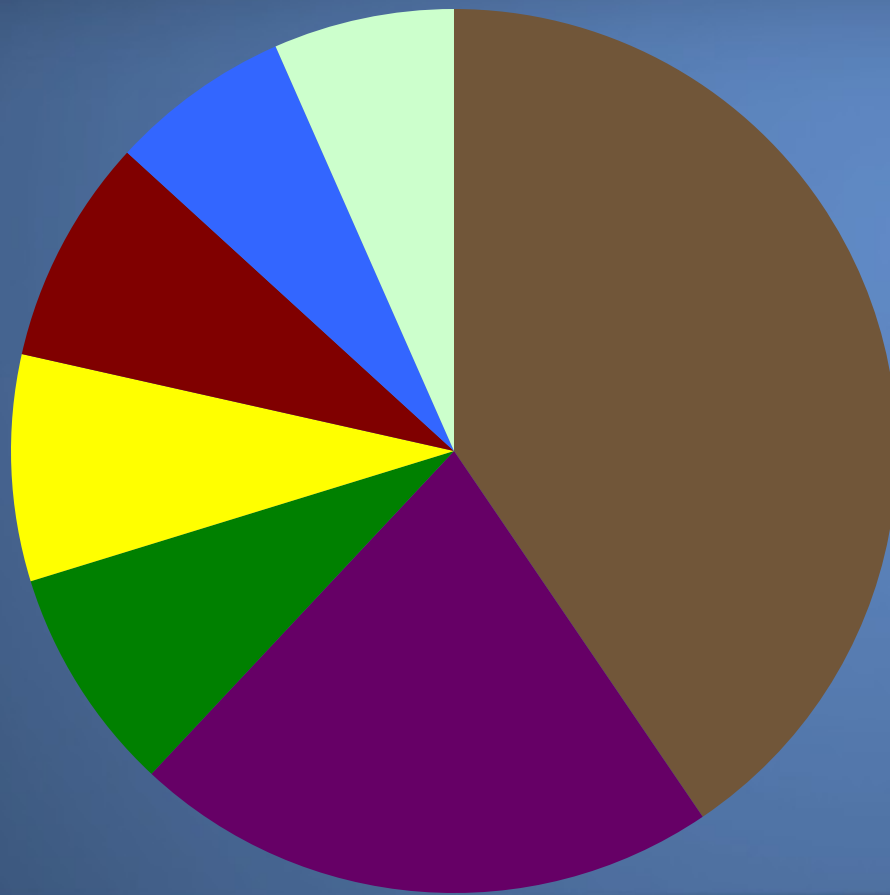


# NTSB Recommendations

- MOST WANTED since 1990
- ~200 fatigue recommendations



# Complex Issue: Requires Multiple Solutions



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



# Challenges of a 24/7 Society



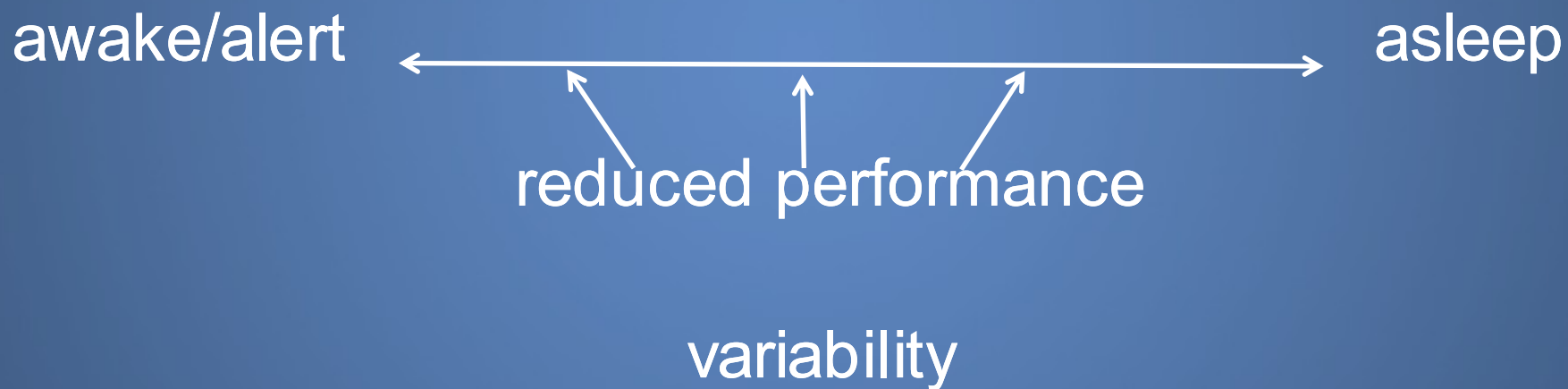
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# Fatigue Risks

Fatigue can degrade  
every aspect of  
human capability.



# Fatigue Risks



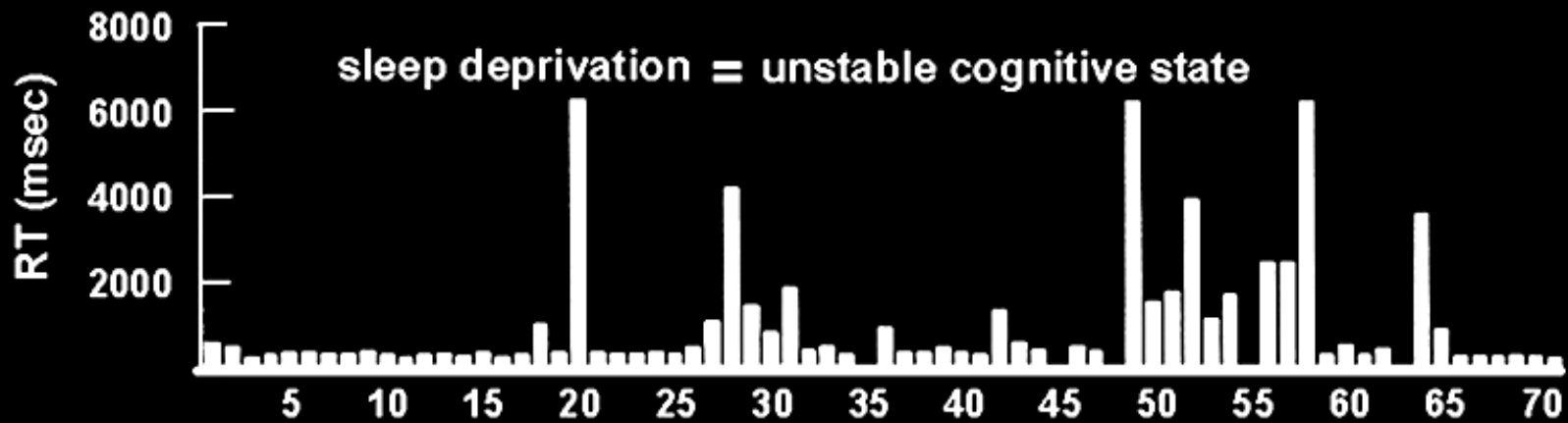
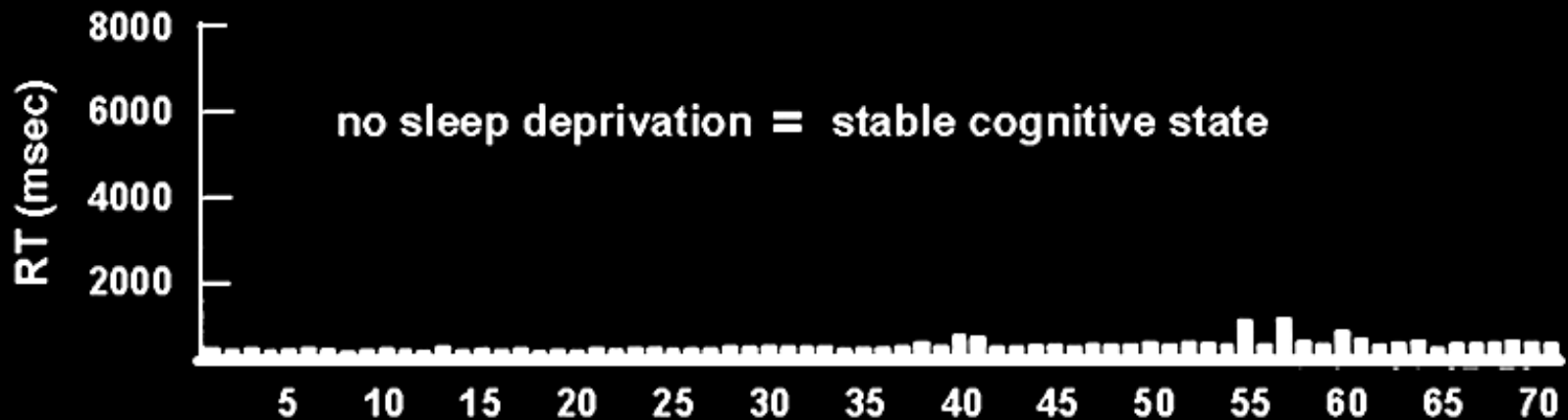
# Fatigue Risks

- degraded 20 – 50%+:
  - reaction time
  - memory
  - communication
  - situational awareness
  - judgment
  - attention
  - mood
- increased:
  - irritability
  - apathy
  - attentional lapses
  - microsleeps



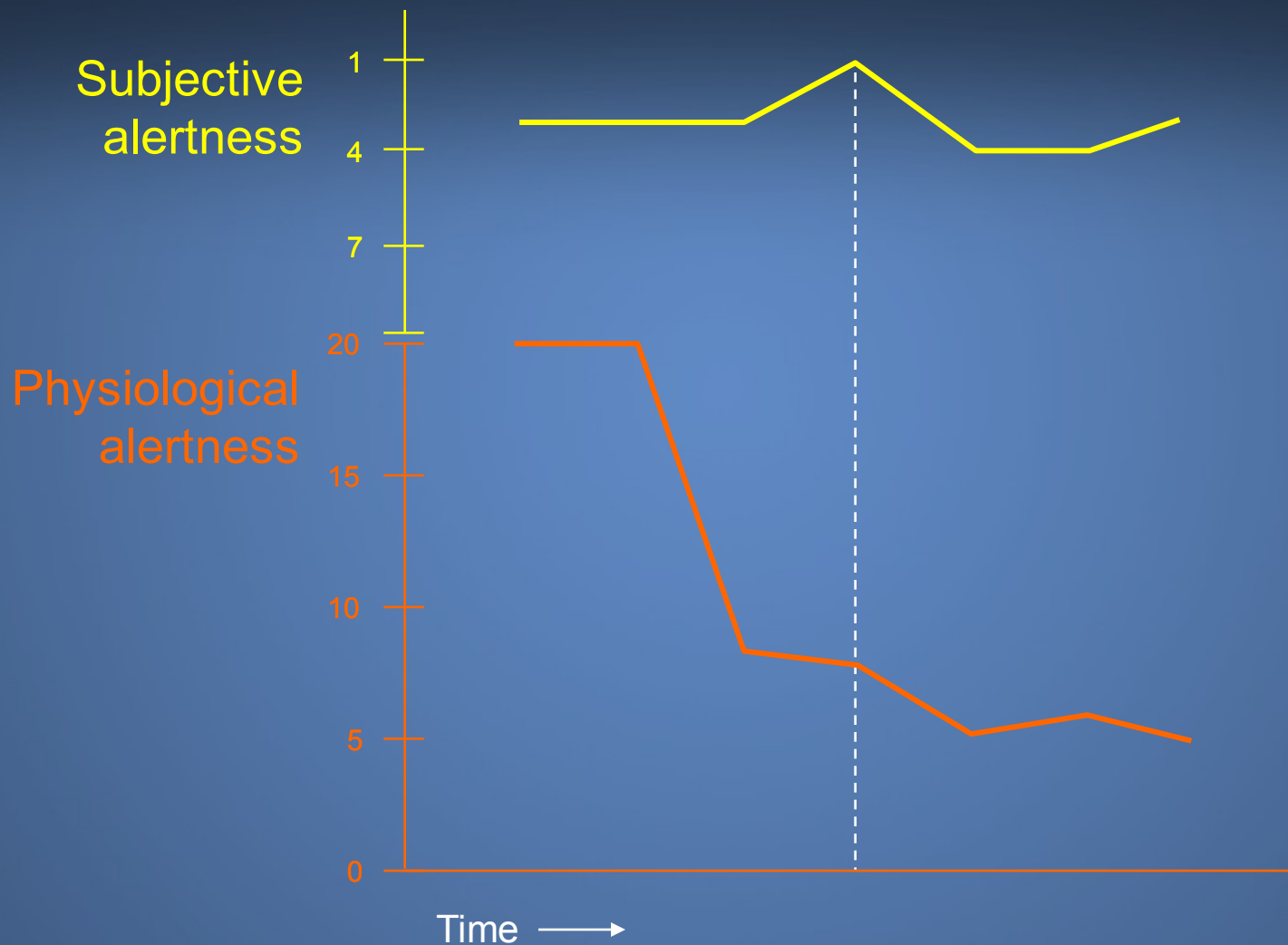


# Fatigue and Reaction Times



consecutive RTs across a 10-min PVT performance task

# Alertness Reports Often Inaccurate

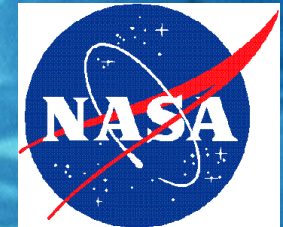


Adapted from Sasaki et al., 1986



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# Example: NASA Planned Rest Study



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# Success requires . . .

A culture change that supports  
different attitudes and behaviors



Stanford Sleep and Dreams: 40+ Years

Drowsiness is Red Alert!



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# #40 Ceremonial Swearing In





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