



**NTSB** National Transportation Safety Board

---

# **Managing Fatigue During an Accident Investigation Launch**

Honorable Mark R. Rosekind, Ph.D.  
Board Member

IIC Course  
November 29, 2011

# Go! Flight 1002



- early starts, multiple segment days, sleep apnea

NTSB





# Honorable John K. Lauber:

No Accident  $\neq$   
Safe Operation

# Guantanamo Bay Cuba

First NTSB aviation accident to cite fatigue as probable cause



- acute sleep loss, sleep debt, circadian disruption

NTSB





# 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...”



# Challenges of a 24/7 Society



NTSB

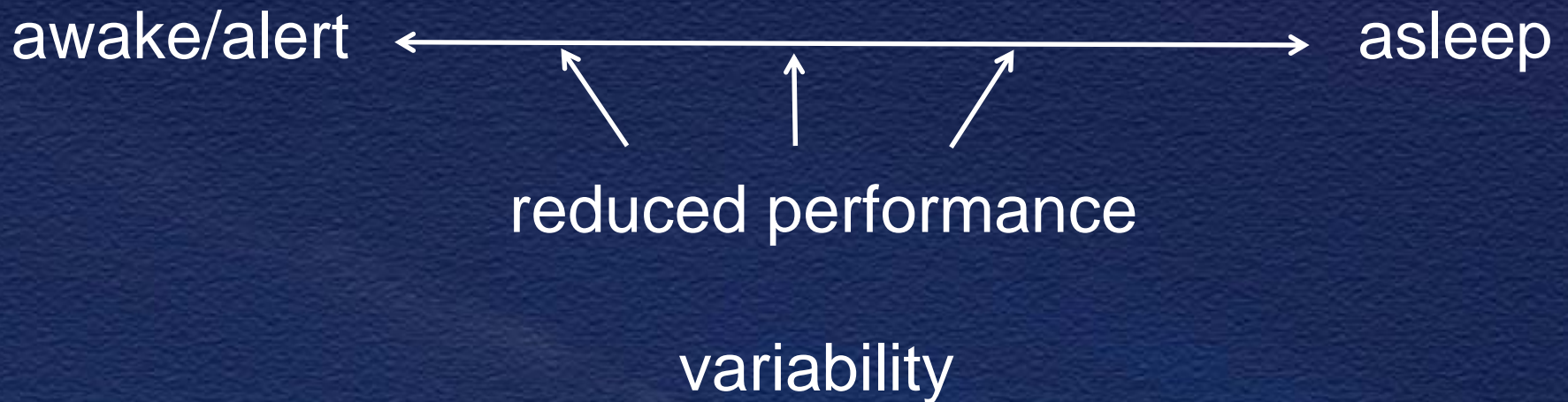


# Fatigue Risks

Fatigue can degrade  
every aspect of  
human capability.



# Fatigue Risks

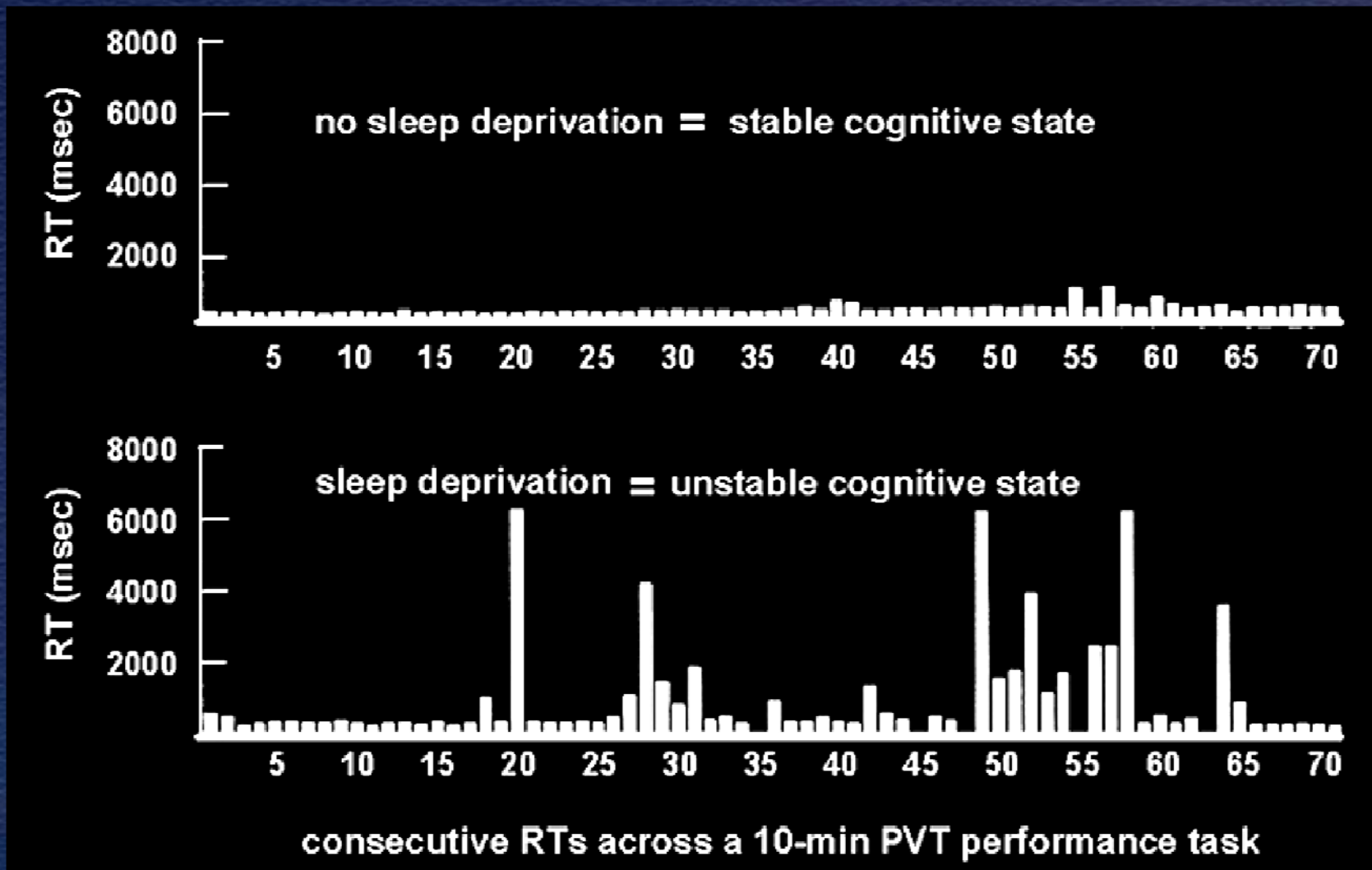


# Fatigue Risks

- reduced (20 – 50%+):
  - reaction time
  - memory
  - communication
  - situational awareness
  - judgment
  - attention
  - mood
  - more . . .
- 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.



# Fatigue Factors

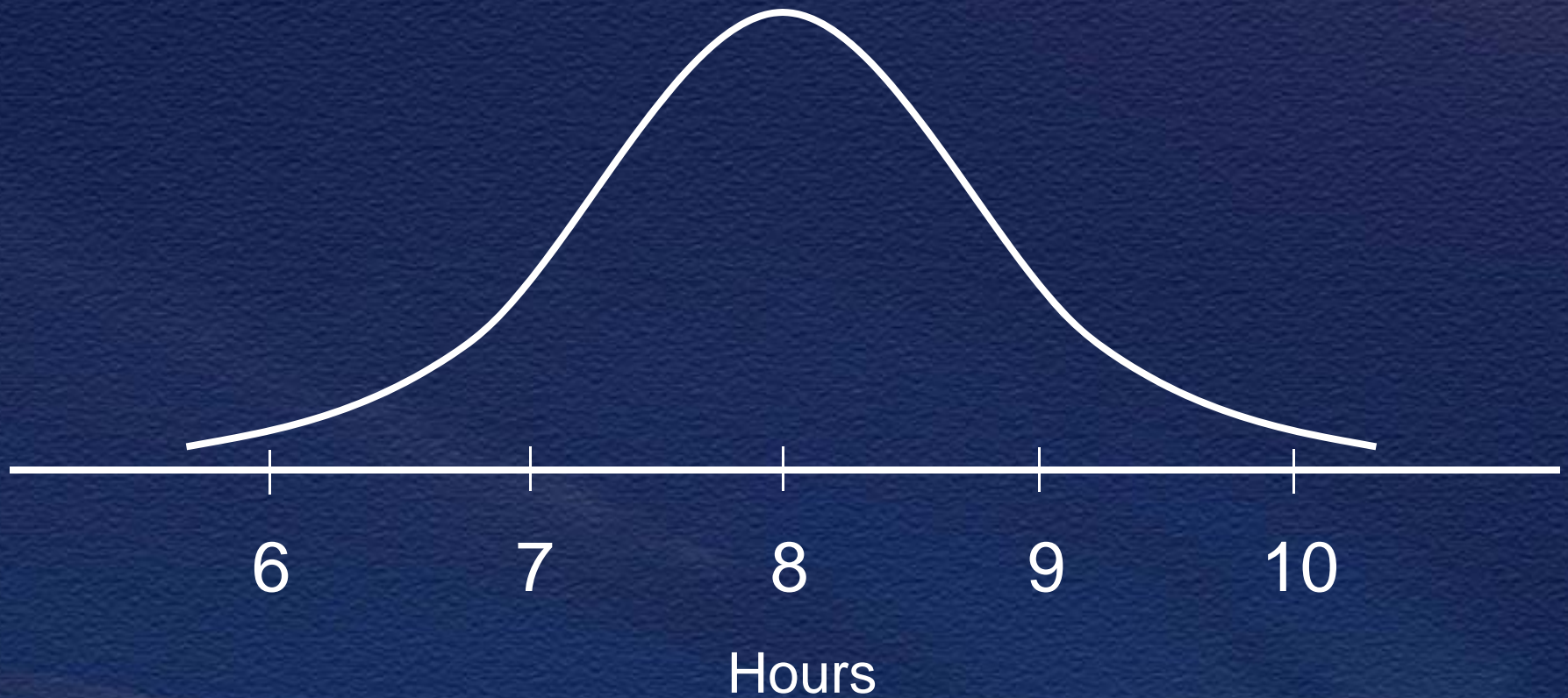
- sleep
- circadian clock
- hours awake
- sleep disorders



# Fatigue Factors

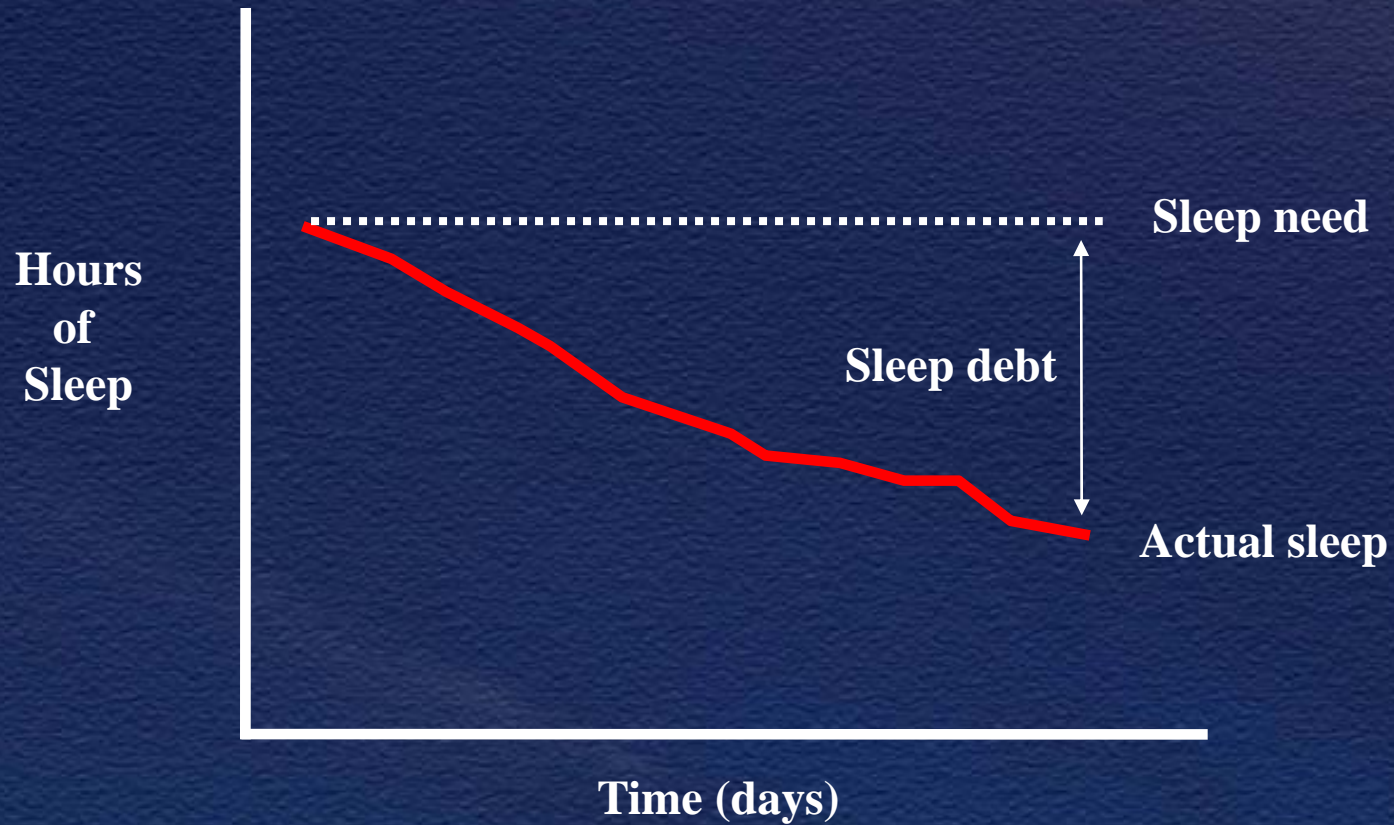
- sleep
  - acute sleep loss
  - cumulative sleep debt
- circadian clock
- hours awake
- sleep disorders

# Sleep Requirement





# Cumulative Sleep Debt



Sleep Need – Actual Sleep = Sleep Debt

Sleep debt grows cumulatively over time

# Sleep Loss and Alcohol: Performance Equivalents

<u>Sleep loss (hrs)</u>	<u>12oz Beers</u>	<u>BrEC%</u>
2	2 - 3	.045%
4	5 - 6	.095%
6	7 - 8	.102%
8	10 - 11	.190%





# Fatigue Factors

- sleep
- circadian clock
  - 'sleepy' windows
  - 'alert' windows
  - irregular schedule
  - time zones
- hours awake
- sleep disorders

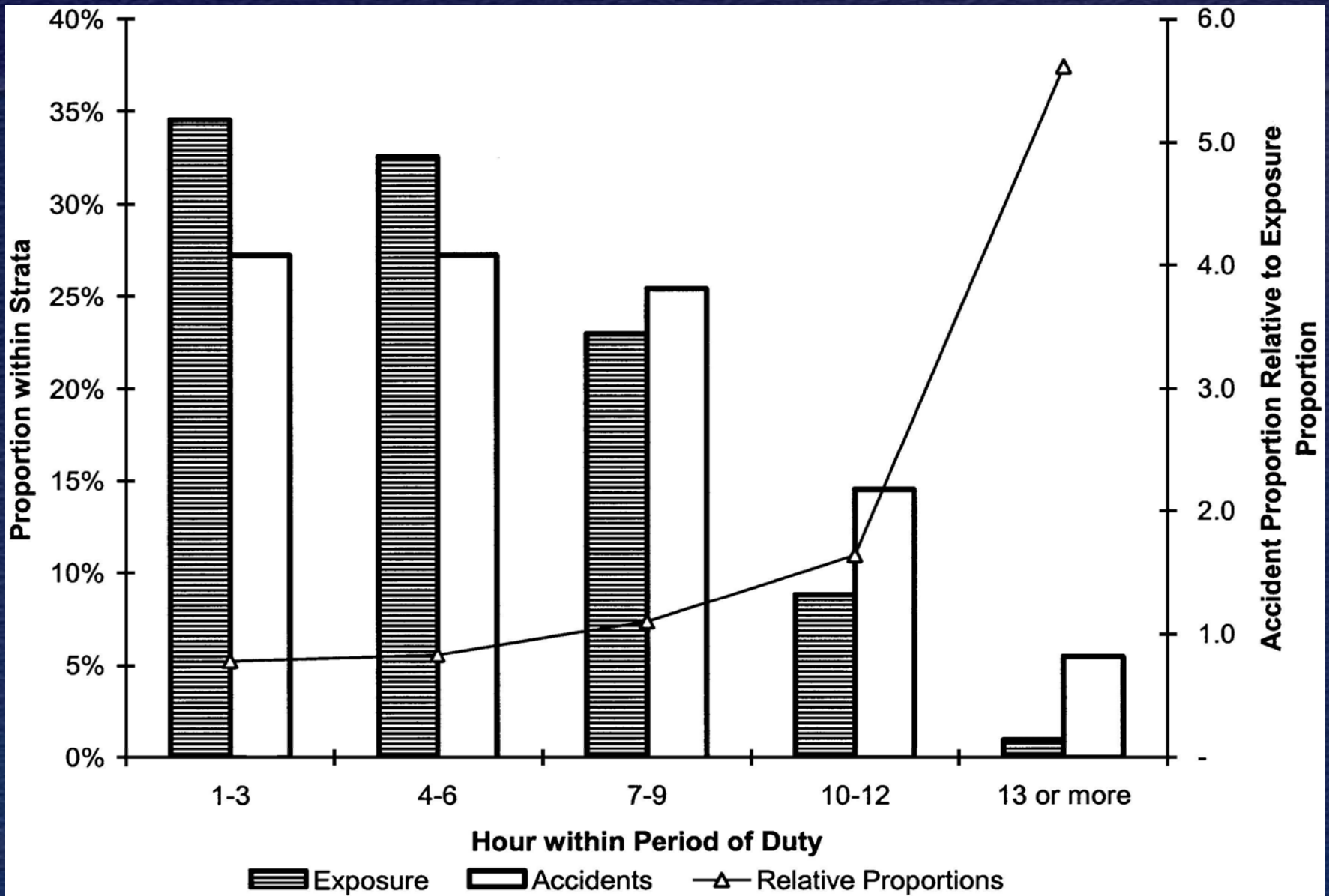
# “Adapting” to Shift Work

- In most instances, complete circadian adaptation to night shift work never occurs
  - early morning light prevents adaptation
  - reversion to day-active schedule on days off



# Fatigue Factors

- sleep
- circadian clock
- hours awake
  - > 12 hrs
  - > 16 hrs
  - 24 hrs
- sleep disorders





# Fatigue Factors

- sleep
- circadian clock
- hours awake
- sleep disorders
  - ~ 90 sleep disorders
  - sleep apnea

# Sleep Apnea is a Safety Risk

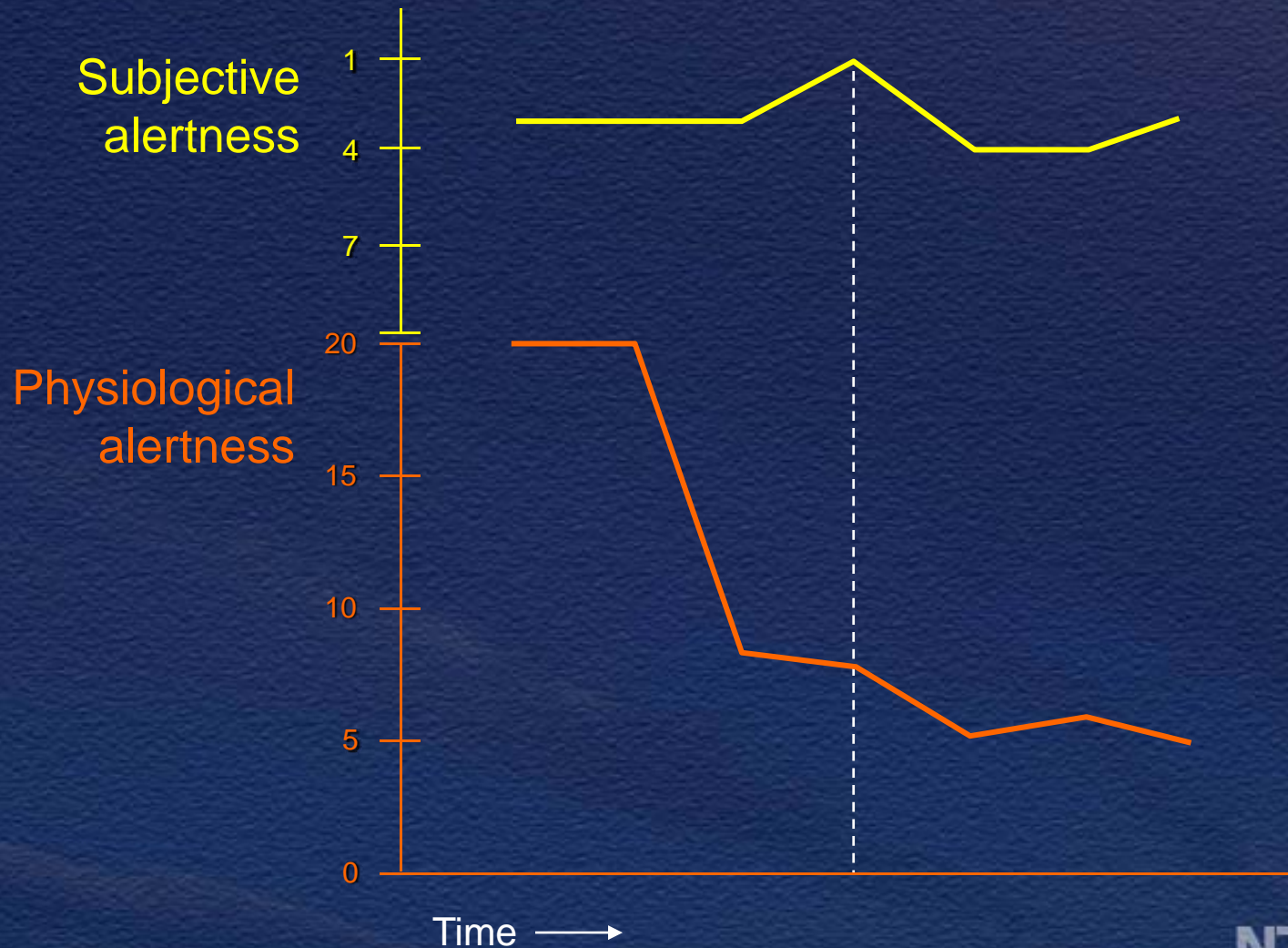
- > 6 times increased risk for crash
- > 7 times increased risk for multiple crashes
- SA performance = .06 - .08 BAC



# Fatigue Factors

- sleep
- circadian clock
- hours awake
- sleep disorders

# Alertness Reports Often Inaccurate



Adapted from Sasaki et al., 1986

NTSB





# Manage Fatigue = Enhance Safety

- Culture change
- Get educated
- Acknowledge
- Act!



**NTSB**