National Transportation Safety Board

Managing Fatigue in 24/7 Ops: Risks, Fatigue Factors, and Strategies

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Board Member

USCG Senior Executives
May 10, 2012

Guantanamo Bay, Cuba

First NTSB aviation accident to cite fatigue as probable cause

- acute sleep loss, sleep debt, circadian disruption

NTSB

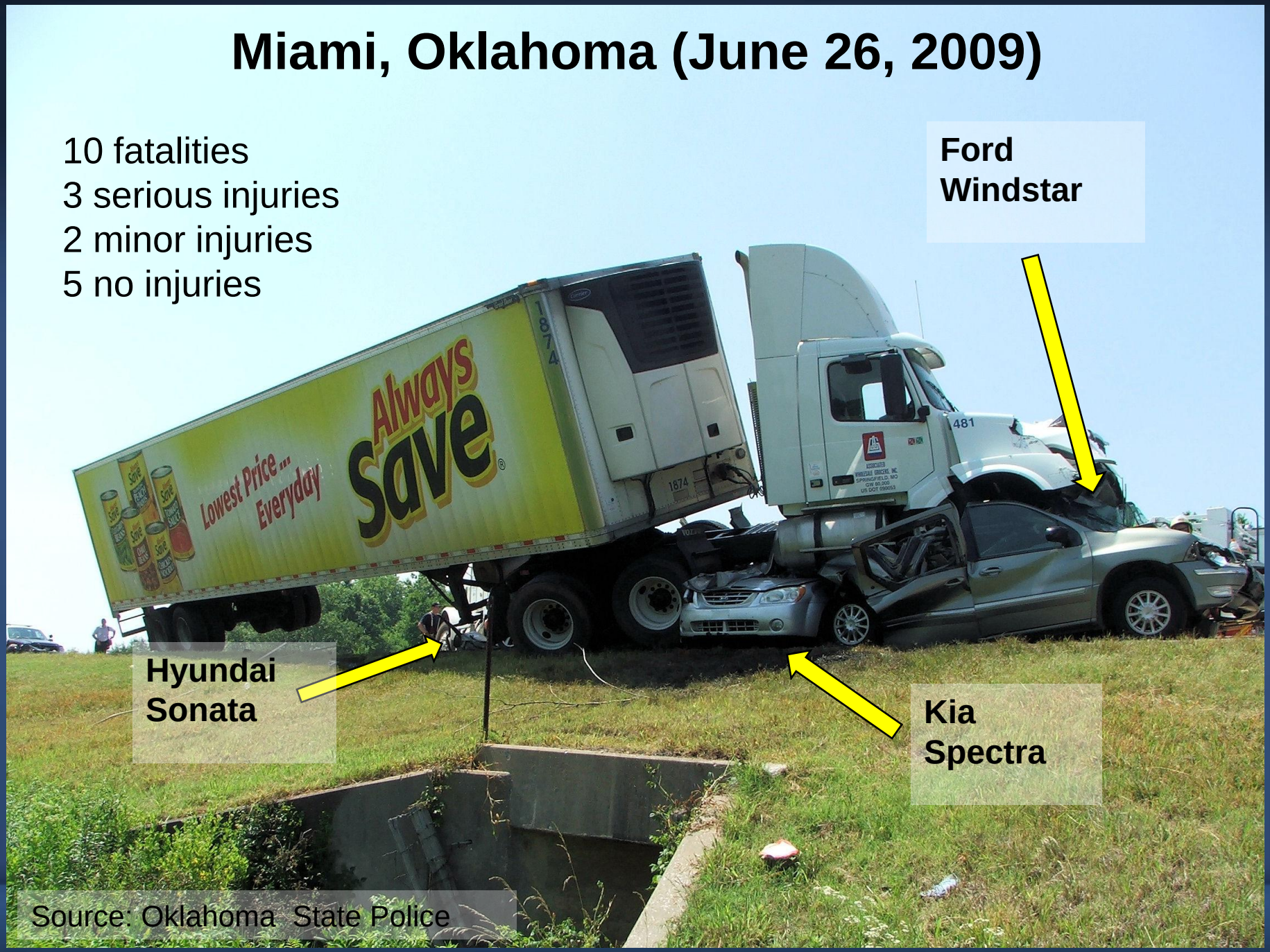
Owatonna, MN (July 31, 2008)

8 fatalities

NTSB

Miami, Oklahoma (June 26, 2009)

10 fatalities
3 serious injuries
2 minor injuries
5 no injuries



Source: Oklahoma State Police

Red Oak, Iowa (April 7, 2011)

2 fatalities

NTSB

Collision of Tankship *Eagle Otome* with Cargo Vessel *Gull Arrow*
and Subsequent Collision with the *Dixie Vengeance* Tow
Sabine-Neches Canal, Port Arthur, Texas
January 23, 2010

Accident Report

NTSB/MAR-11/04
PB2011-916404

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Eagle Otome, Port Arthur, TX

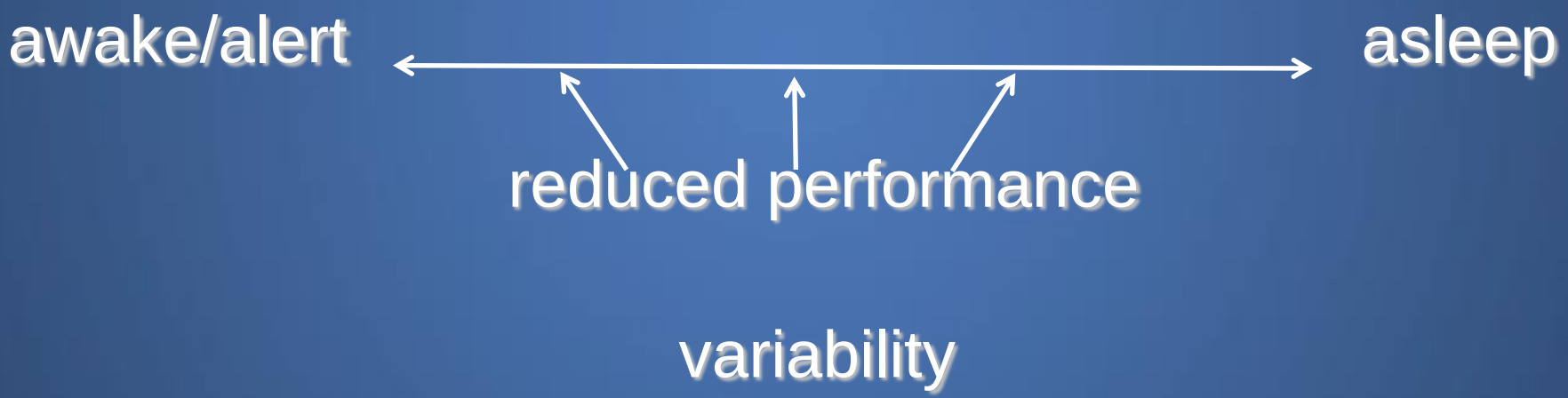
January 23, 2010

NTSB

Probable Cause/Contributing Factors

"Contributing to the accident was the first pilot's fatigue, caused by his untreated obstructive sleep apnea and his work schedule, which did not permit adequate sleep;"

Fatigue Risks



Fatigue Risks

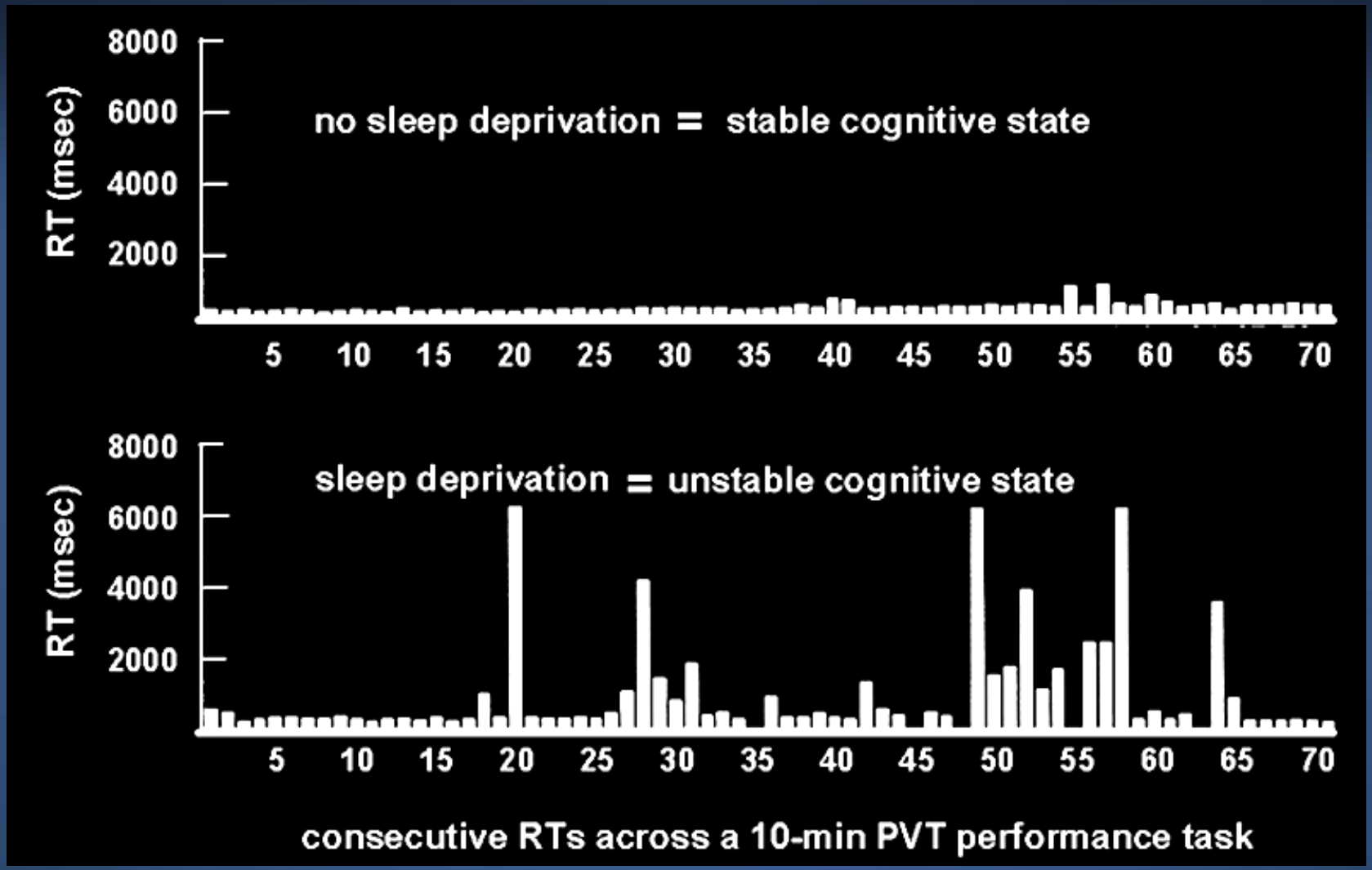
- degraded 20 – 50%+:

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

- increased:

  - irritability
  - apathy
  - attentional lapses
  - microsleeps

Fatigue and Reaction Times



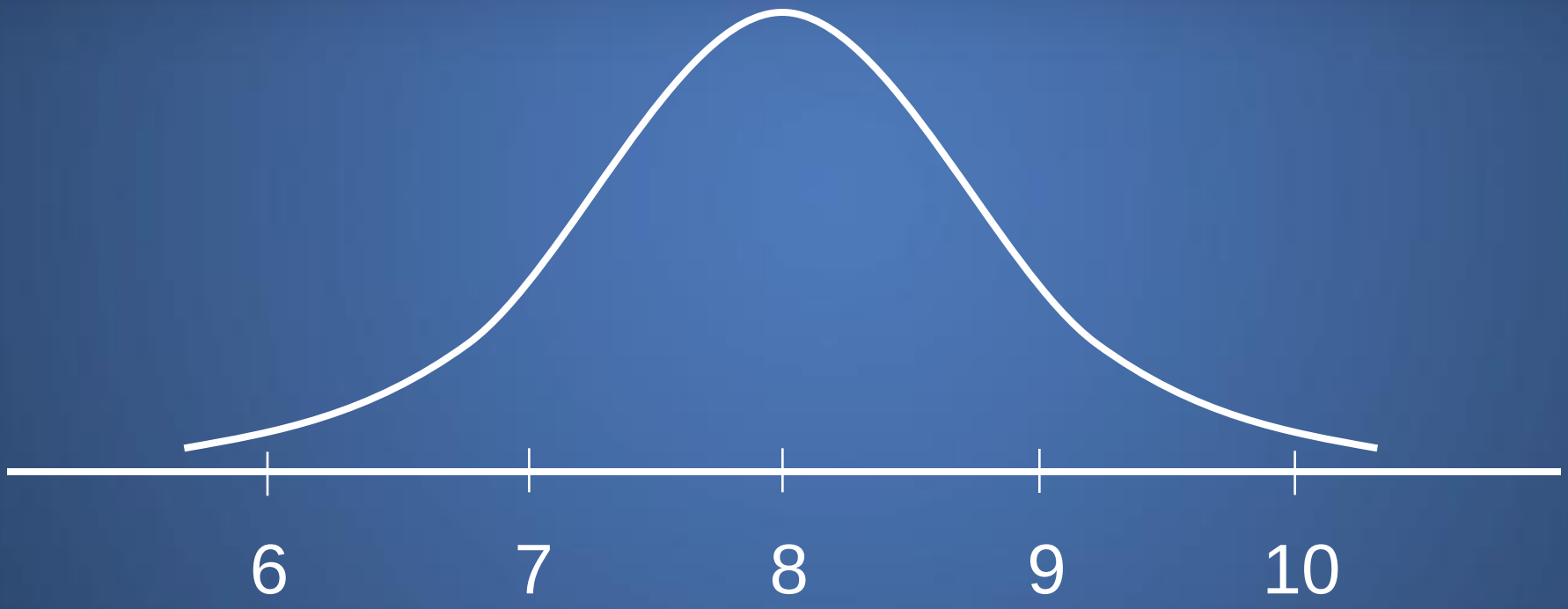
Doran SM, Van Dongen HP, Dinges DF. Sustained attention performance during sleep deprivation: evidence of state instability. *Archives of Italian Biology: Neuroscience* 2001;139:253-267.

NTSB

Fatigue Factors

- sleep
- 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

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

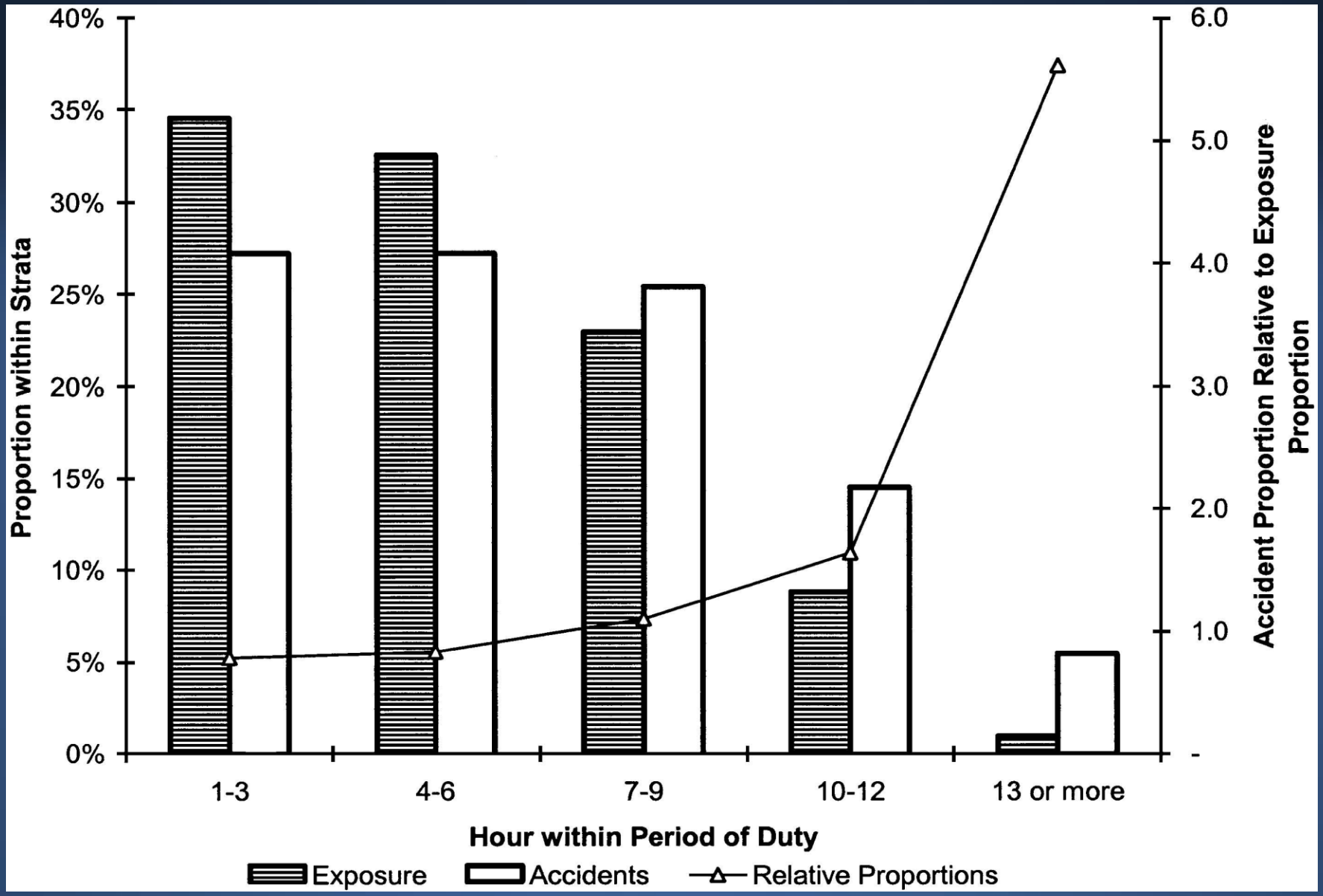
Roehrs et al. Sleep, Vol. 26, No. 8, 2003

“Adapting” to Shift Work

- In most instances, complete circadian adaptation to night shift work never occurs

  - early morning light prevents adaptation

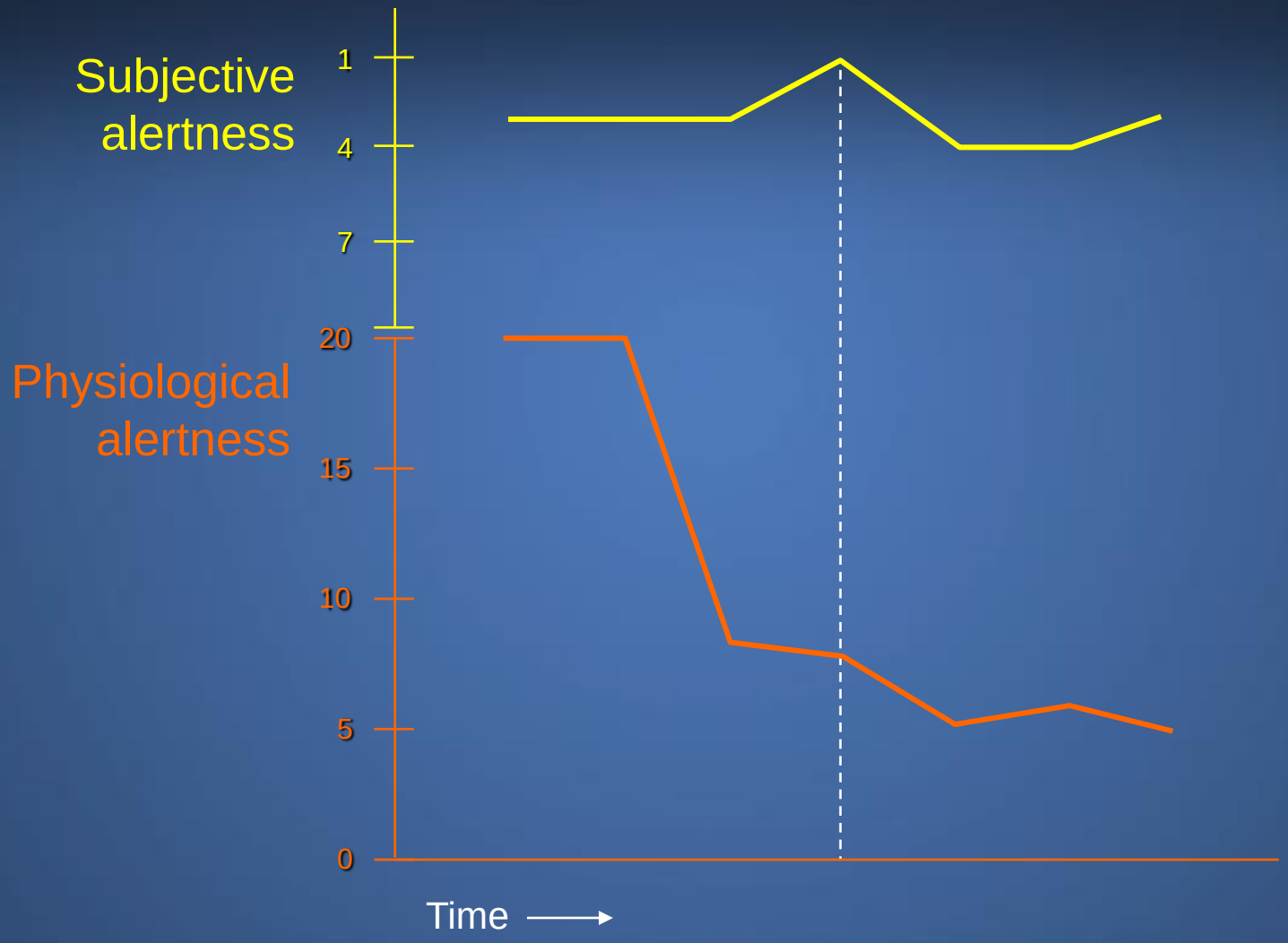
  - reversion to day-active schedule on days off


40%
35%
30%
25%
20%
15%
10%
5%
0%
Proportion within Strata
6.0
5.0
4.0
3.0
2.0
1.0
-
Accident Proportion Relative to Exposure
Proportion
1-3
4-6
7-9
10-12
13 or more
Hour within Period of Duty
Exposure
Accidents
Relative Proportions

Sleep Apnea is a Safety Risk

- > 6 times increased risk for car crash
- SA performance = .06 - .08 BA

Alertness Reports Often Inaccurate



Adapted from Sasaki et al., 1986

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The Challenges . . .

Diverse operational requirements

Individual differences

Complex physiology

History (“that’s how its always been”)

Economics

The Challenges Preclude . . .

A simple solution

A single solution

One-size-fits-all

“Magic Bullet”

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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

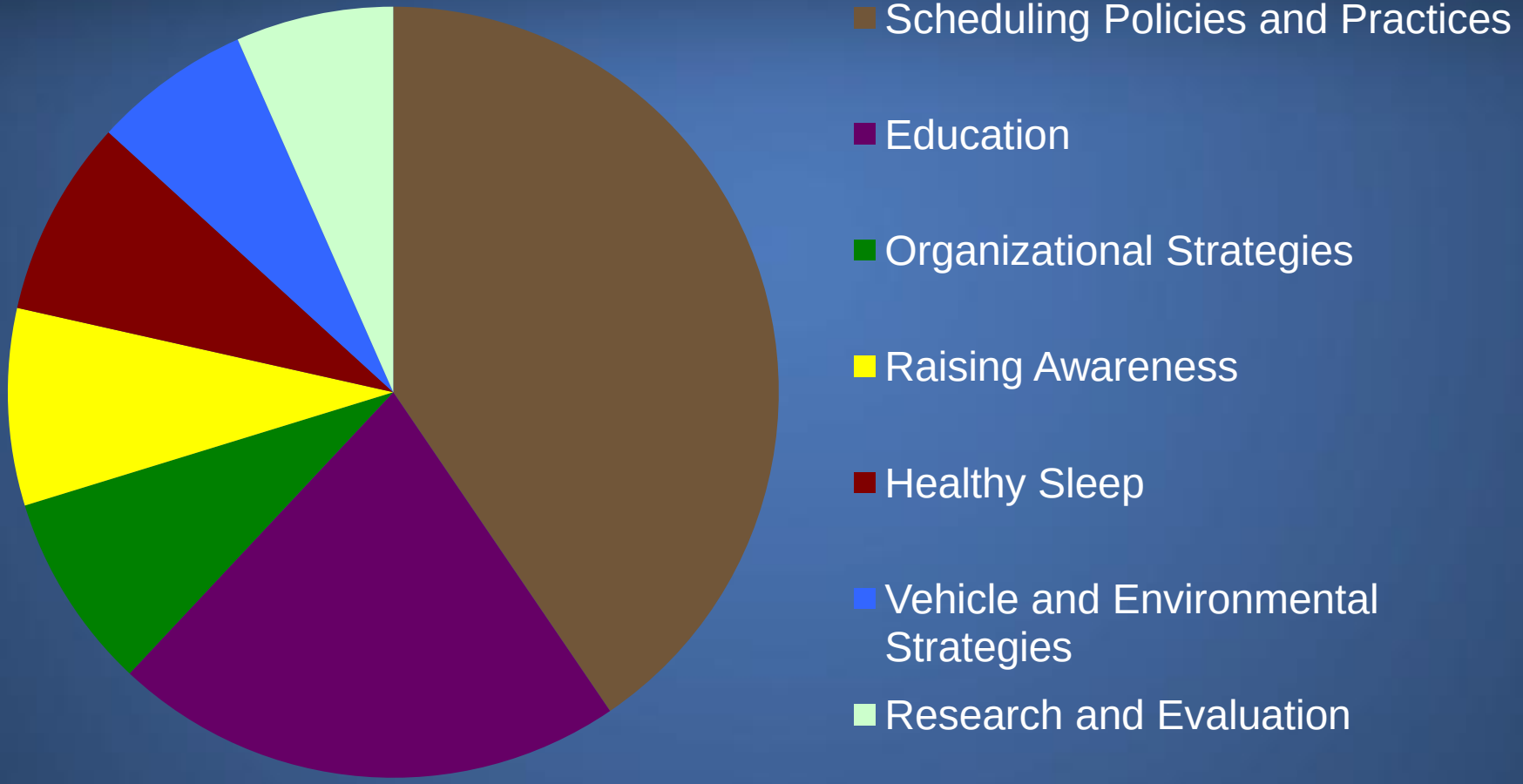
Motorcycle Safety

NTSB

NTSB Recommendations

- MOST WANTED since 1990
- ~200 fatigue recommendations

Complex Issue:
Requires Multiple Solutions



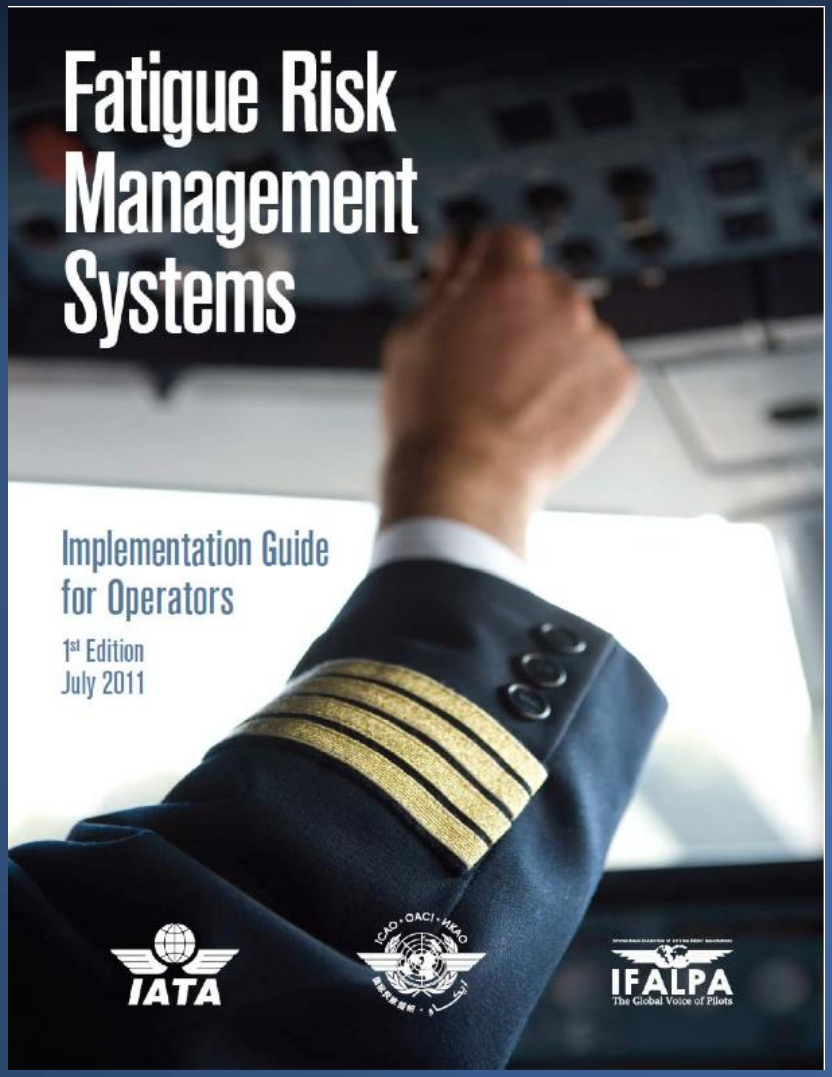
NTSB Recommendations: Hours of Service / Scheduling

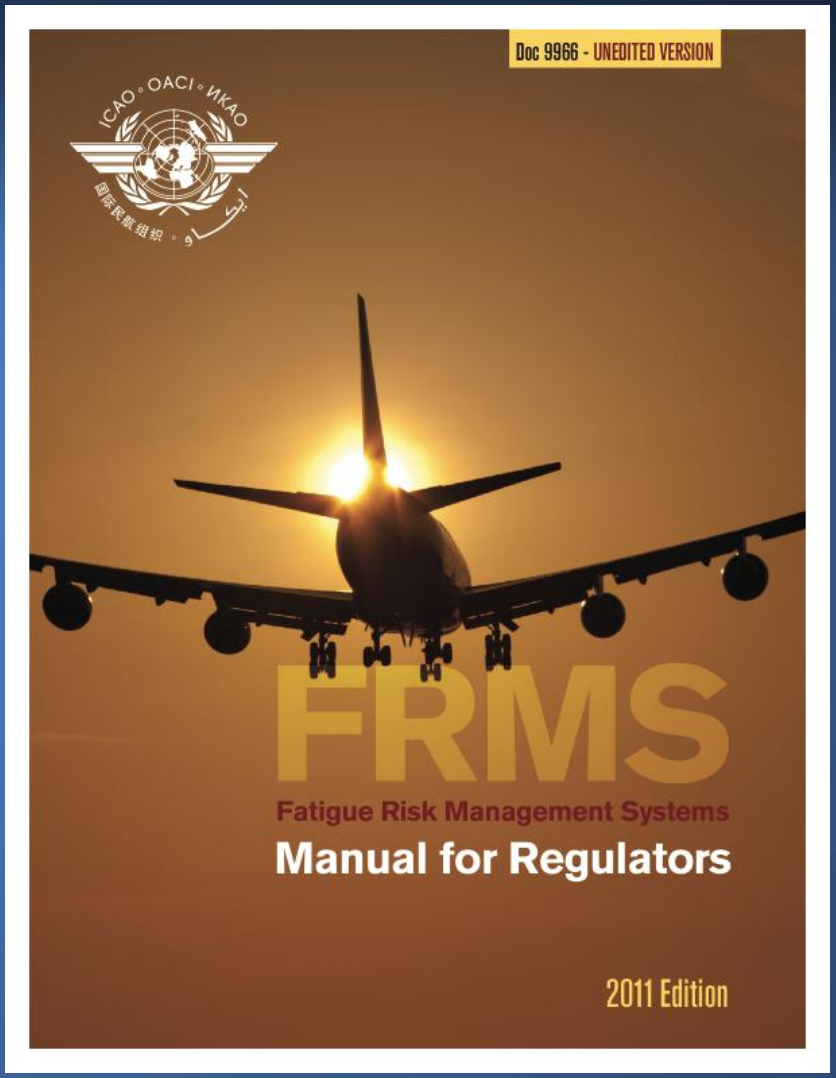
- Science-based hours of service
- Allow for at least 8 hours of uninterrupted sleep
- Reduce schedule irregularity and unpredictability

NTSB Recommendations: Fatigue Management Systems

- Develop guidance based on empirical and scientific evidence for operators to establish fatigue management systems
- Develop and use a methodology that will continually assess the effectiveness of fatigue management systems

Examples





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NTSB Recommendations: Education/Strategies

- Develop a fatigue education and countermeasures training program
- Educate operators and schedulers
- Include information on use of strategies: naps, caffeine, etc.
- Review and update materials

NTSB Recommendations: Education/Strategies

- Include information on use of strategies: naps, caffeine, etc.
- No recommendations on specific personal strategies

Example: NASA Planned Rest Study

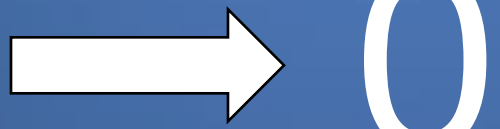
Success requires . . .

A culture change that supports

different attitudes and behaviors

Changing Safety Culture

Safety goal . . .



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