How Fatigue Increases Accident Risk: Evidence and Theories

Kimberly A. Honn, Ph.D.
Assistant Research Professor
Sleep and Performance Research Center
Elson S. Floyd College of Medicine
Washington State University
Spokane, WA, USA
Fatigue is complex

• Not a dichotomous state ("fatigue" vs "no fatigue")
• Unless asleep, fatigue is on a continuum with a range of severity
• Fatigue is a function of a variety of factors
Fatigue is a function of:

- Time of day (circadian rhythm)
- Time since awakening (homeostatic sleep pressure)
- Duration of prior sleep (sleep history)
- Sleep quality (disordered sleep)
- Type of task/Workload
- Task duration (time on task)
- Caffeine (stimulant use)
- Medical health status
- Drug use
- Other variables...
Changing levels of fatigue

- Fatigue is widely accepted as a danger when driving
- Fatigue does not stay at a stable level
- Fatigue fluctuates
  - Day-to-day
  - By hour of the day
  - By task
  - By minute, second, or millisecond
Fatigue-related accidents

• Fatigue is widely accepted as a danger when driving
• Not always “asleep at the wheel”
• After an accident, difficult to work backwards and determine the cause
  • Biomathematical modeling
  • Fatigue prediction
  • Evidence of time awake, distraction
  • Likelihood of risk
Fatigue and attentional lapses

- Psychomotor vigilance test (PVT)
  - Serial reaction time (RT) task
  - Used in laboratory and field sleep research
  - Gold-standard measure of fatigue
  - Measures mean RT and number of lapses (RTs > 500ms)

Doran, Van Dongen, & Dinges (2001)
A lapse does not *always* produce an accident

- Lapsing increases *risk* of accident
- Dependent on situational factors
  - Other traffic / pedestrians
  - Potential consequences
  - Double-checks and supervision
A lapse does not *always* produce an accident

- Lapsing increases *risk* of accident
- Dependent on situational factors
  - Other traffic / pedestrians
  - Potential consequences
  - Double-checks and supervision

- “Swiss Cheese Model of Accident Causation” – J. Reason

The Swiss Cheese Model of Accident Causation

- Some holes due to active failures
- Other holes due to latent conditions
- Successive layers of defenses, barriers, & safeguards
Fatigue-related non-vigilance accidents

• Guantanamo Bay 1993 aviation accident
  • Flight crew had been on duty 18 hours, flying for 9 hours
  • Visual approach over the sea from the south to land on an easterly runway
  • Captain was looking for a lighthouse strobe light, which was not functioning
  • Failure to prevent the loss of airspeed and avoid a stall while in the steep bank turn
  • Failure to recover from the stall
  • Captain asked about strobe 7 times, even during warnings from crew members
  • No single, attentional lapse could account for these failures
Sleep loss causes feedback blunting

- Fatigue impairs cognitive flexibility
- Failure to adapt to sudden, unexpected changes in circumstances or information

Whitney, Hinson, Jackson, & Van Dongen (2015)
Proposed conceptual framework

Modified from Honn, Salo, & Van Dongen (in press)
Perspectives on managing fatigue

- Safety culture
- Regulatory
- Technology
- Shift worker
- Scheduling

Managing Fatigue
Contact information

Kimberly A. Honn, Ph.D.
Sleep and Performance Research Center
Washington State University Spokane

Phone: +1-509-358-7850
Fax: +1-509-358-7810
E-mail: kimberly.honn@wsu.edu