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 since awakening
(homeostatic sleep pressure)

Duration of prior sleep
(sleep history)

Other variables…

Sleep quality
(Disordered sleep)

Medical health status

Type of task/Workload

Time of day
(circadian rhythm)

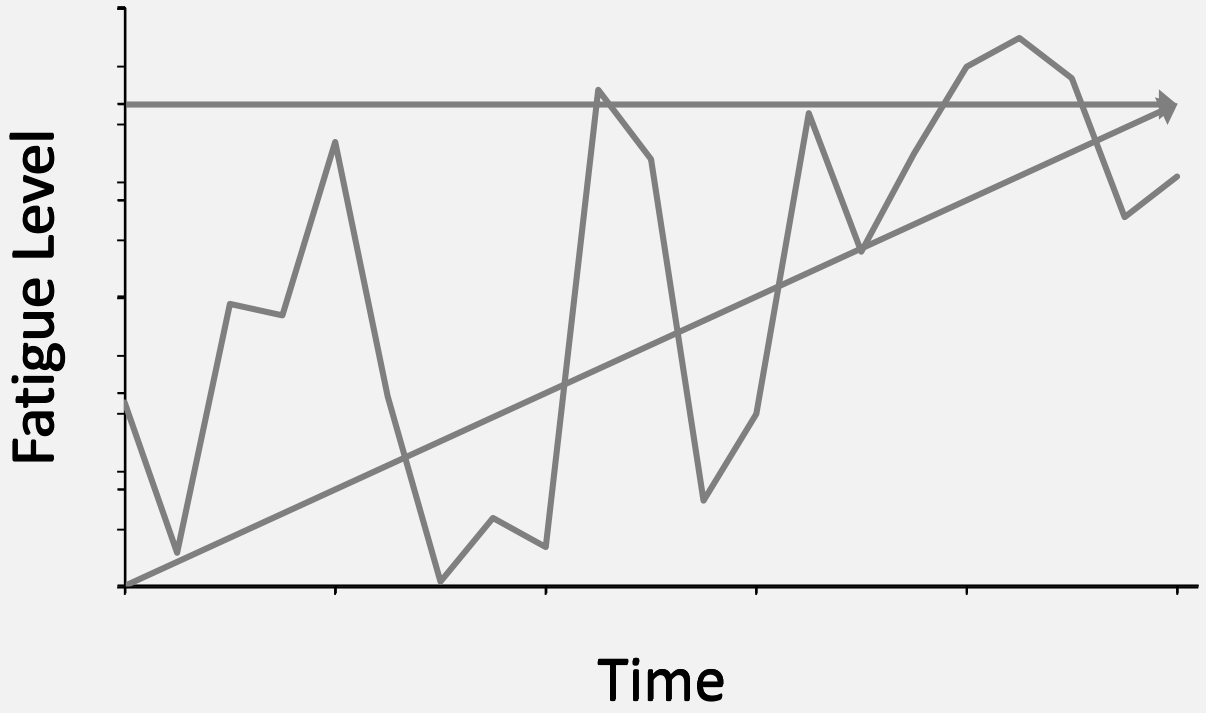
Drug use

Task duration
(Time on task)

Caffeine
(Stimulant use)

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

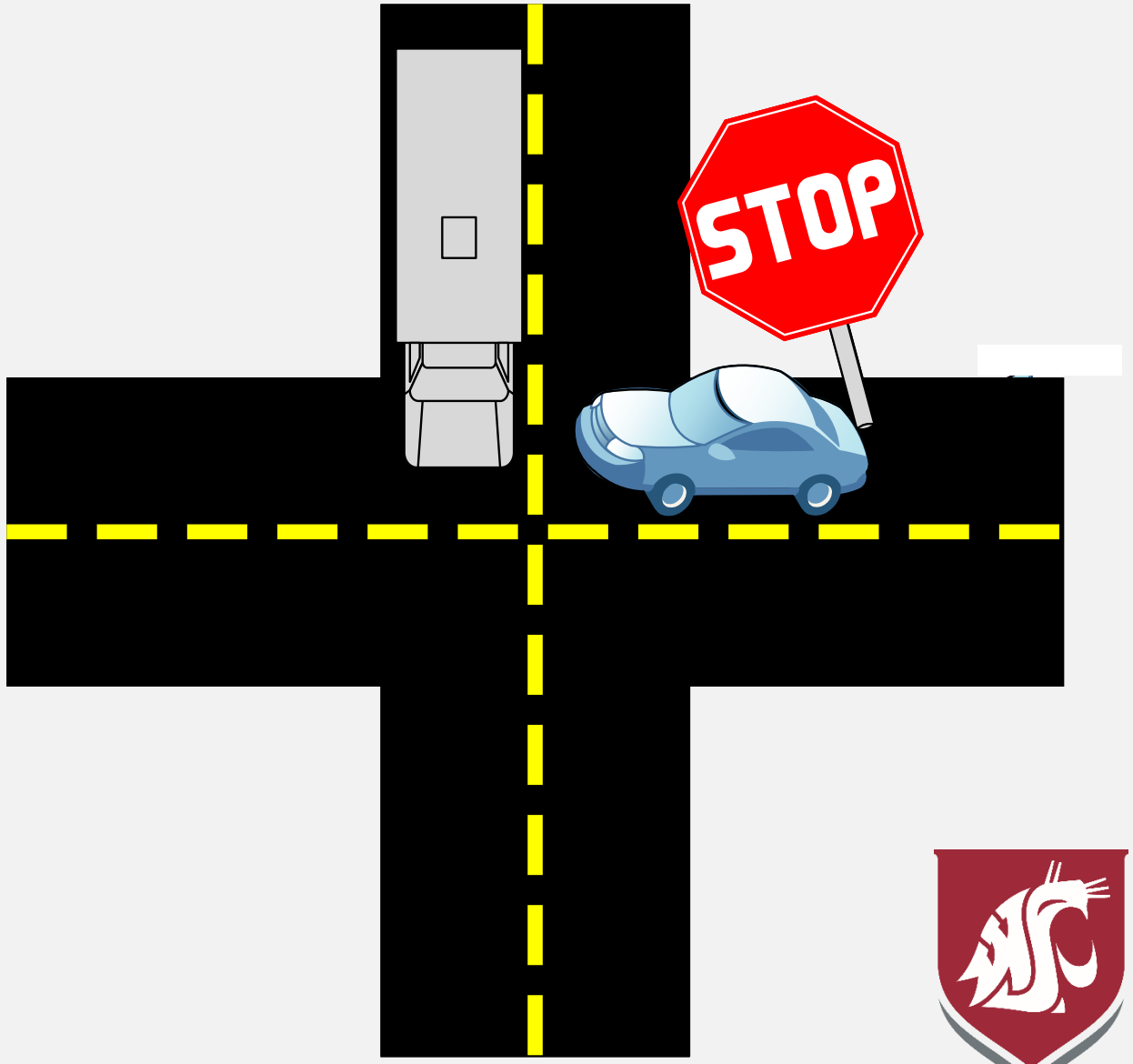
- Fatigue is widely accepted as a danger when driving
- Not always “asleep at the wheel”
- After an accident, difficult to work backwards and determine the cause
  - Biomathematical modeling
  - Fatigue prediction
  - Evidence of time awake, distraction
  - Likelihood of risk

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)

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



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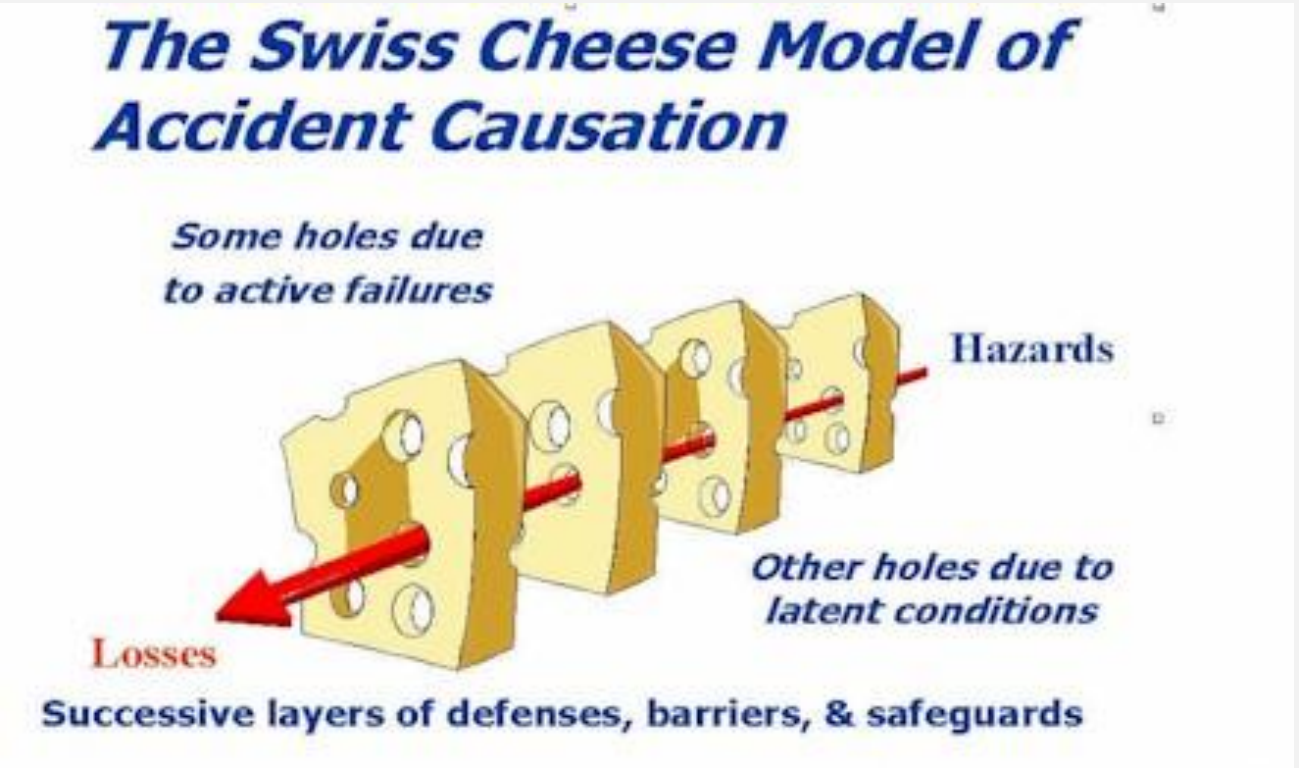
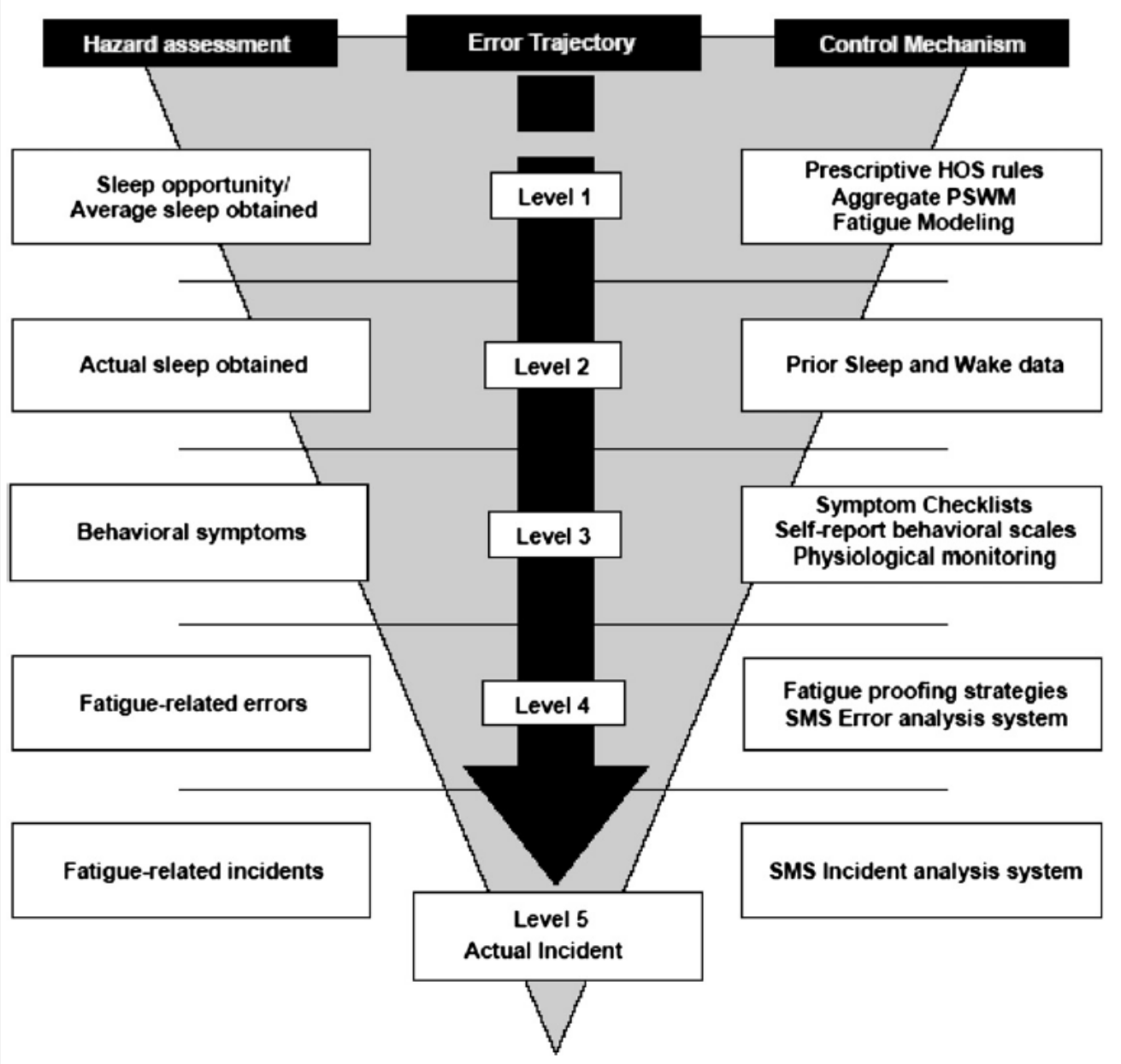
- "Swiss Cheese Model of Accident Causation" – J. Reason





Dawson, Chapman, & Thomas (2012)

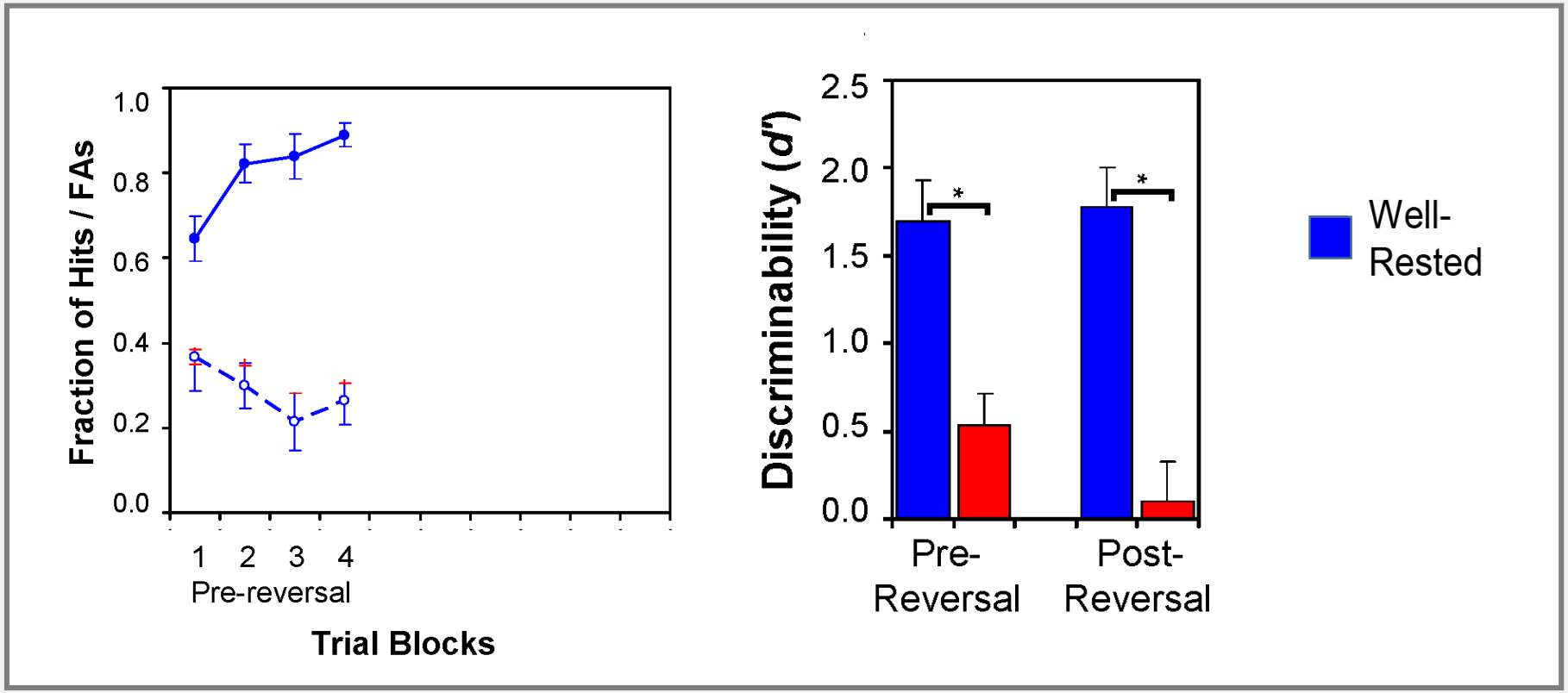
Fatigue-related non-vigilance accidents

- 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

Accident information from flightglobal.com and flight-safety.net

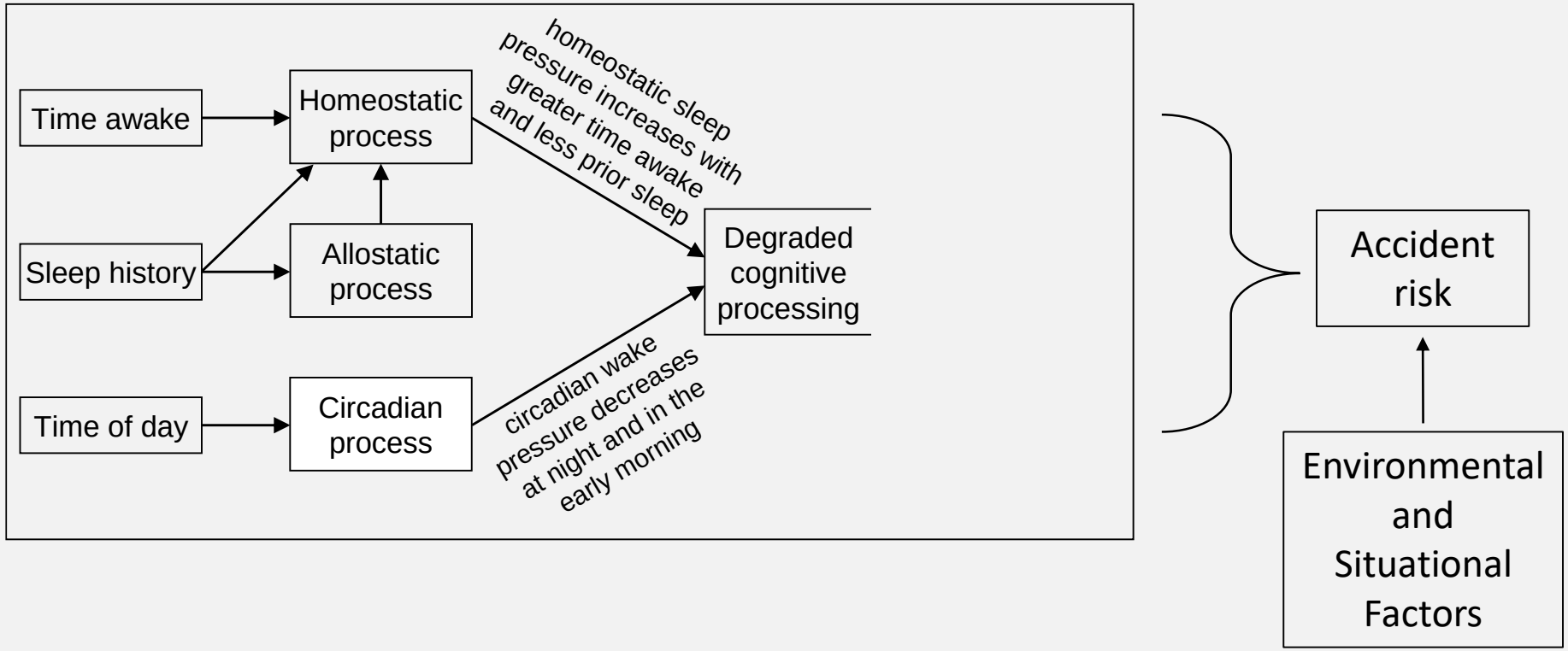
Sleep loss causes feedback blunting

- 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

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