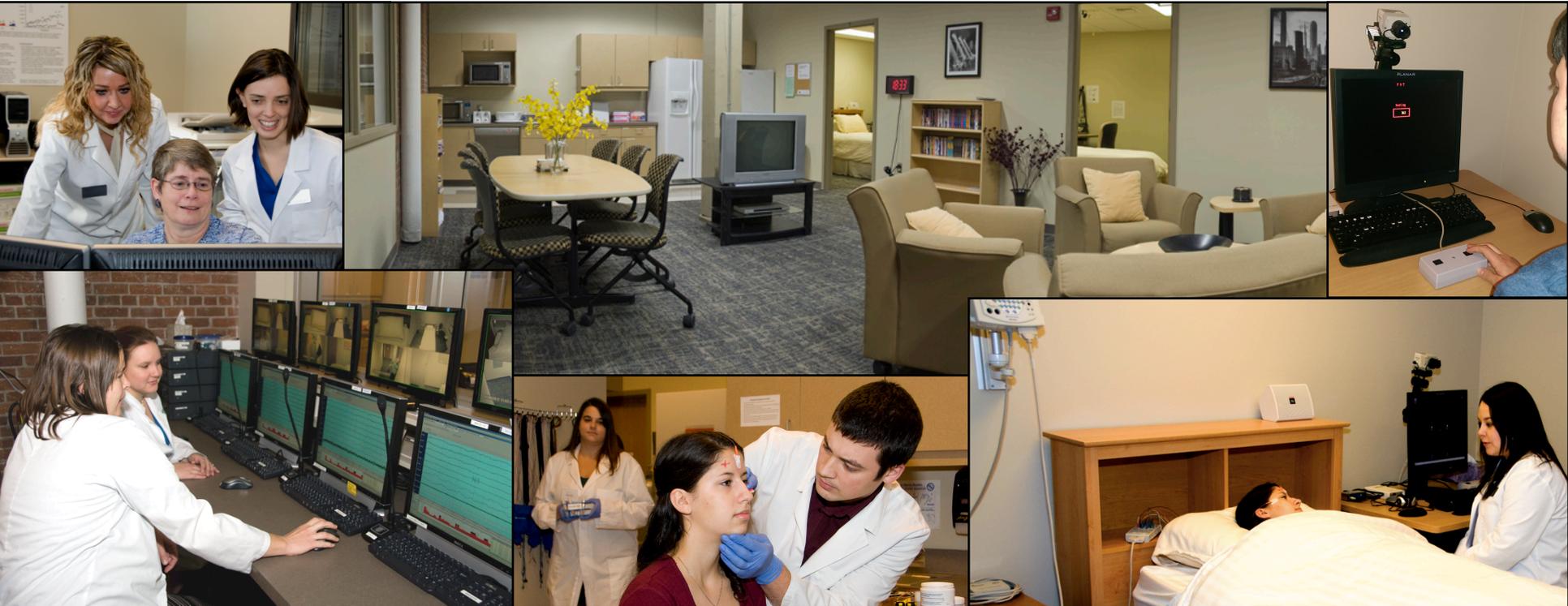




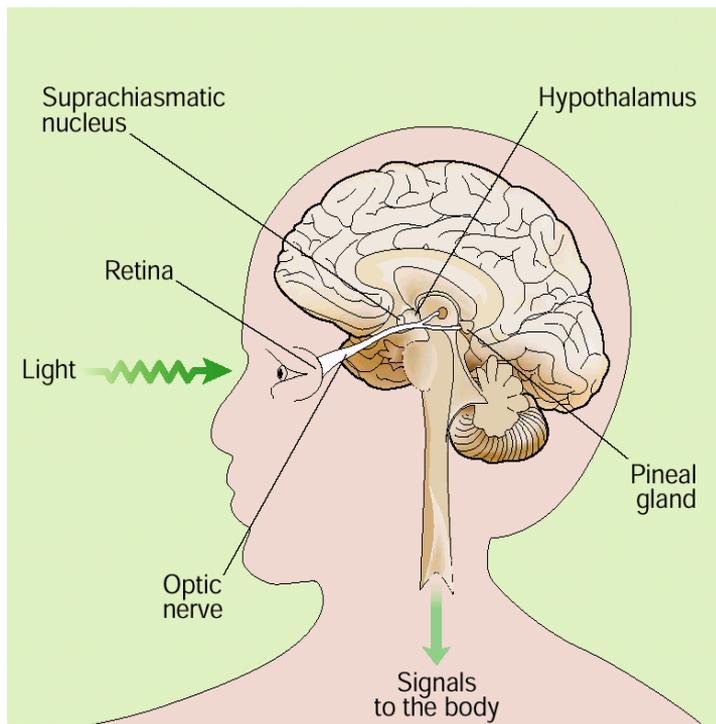
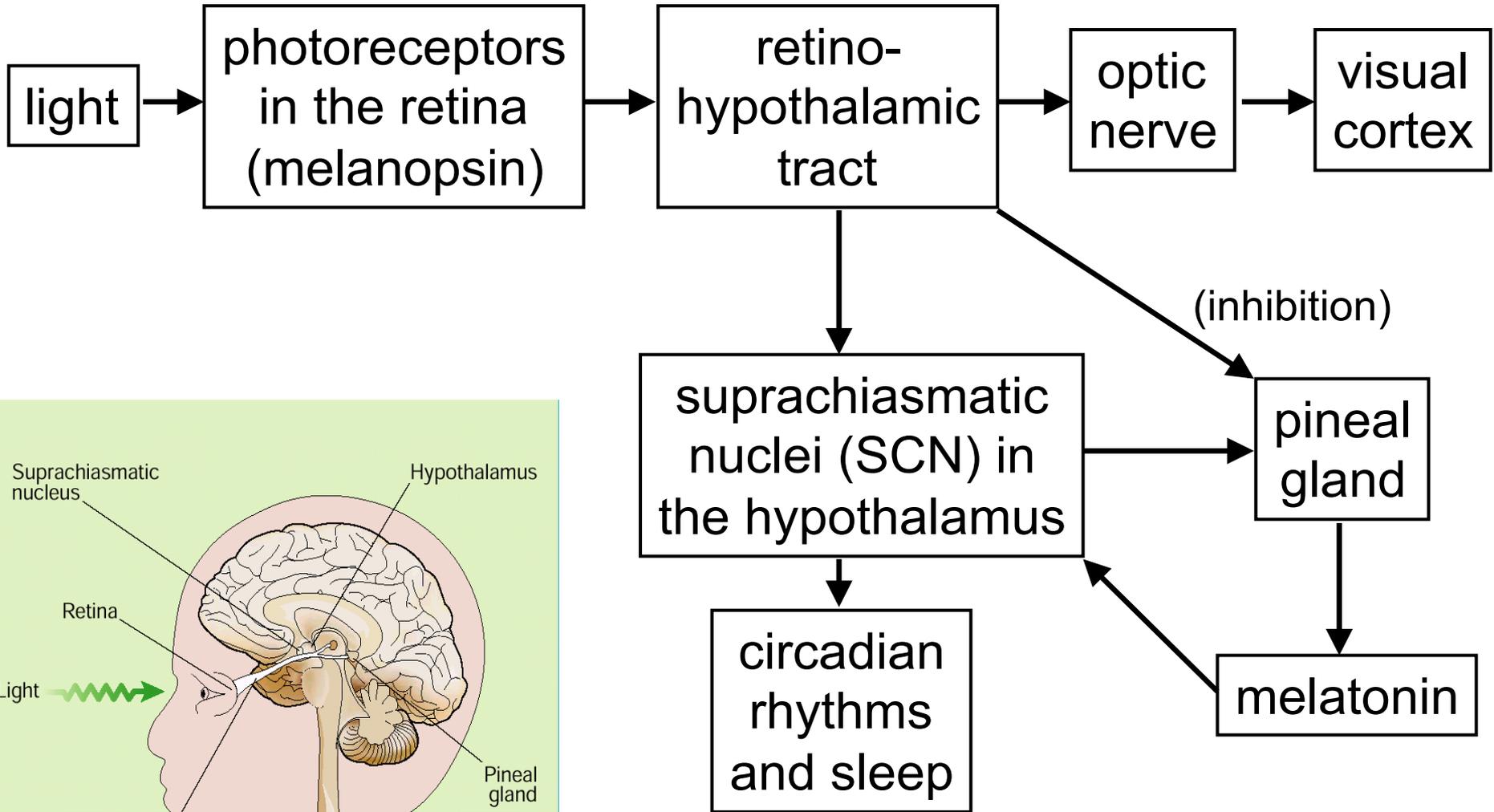
Fatigue from Sleep Loss and Circadian Misalignment: A Fatigue Risk Management Framework for Emergency Medical Services

Hans P.A. Van Dongen, Ph.D.

Director, Sleep and Performance Research Center
Research Professor, Elson S. Floyd College of Medicine
Washington State University Spokane



Biological Clock and Circadian Rhythmicity



Light input keeps the biological clock synchronized to external day and night

Sleep/Wake Regulation: Timing and Duration

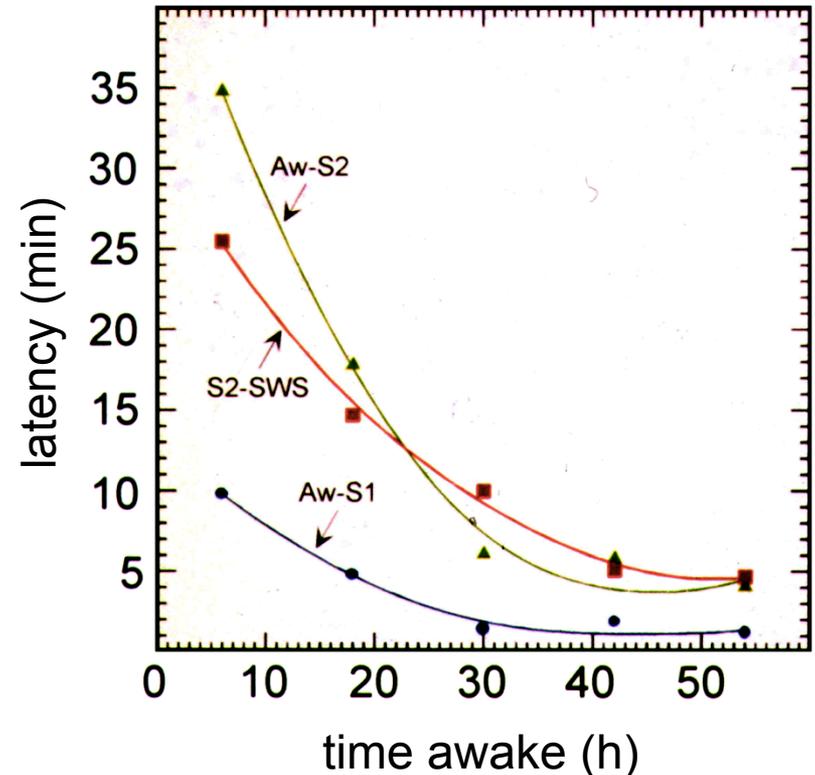
- Longer periods of wakefulness cause greater pressure for sleep
- Longer periods of sleep provide greater recovery from sleep pressure

➤ Homeostatic process

- There is greater pressure for sleep at night than during the day
- This is true even after sleep deprivation (“second wind”)

➤ Circadian process

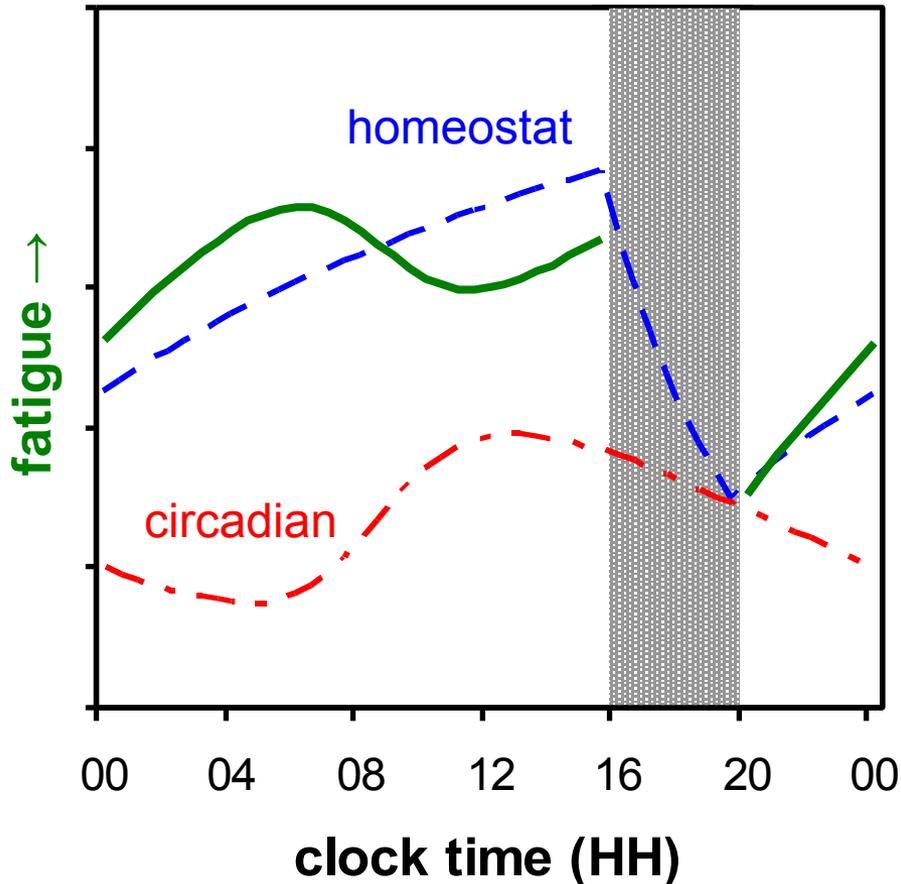
- The homeostatic and circadian processes interact, as formalized in the *two-process model of sleep regulation*



Borbély AA. Hum Neurobiol 1982, 1: 195-204.

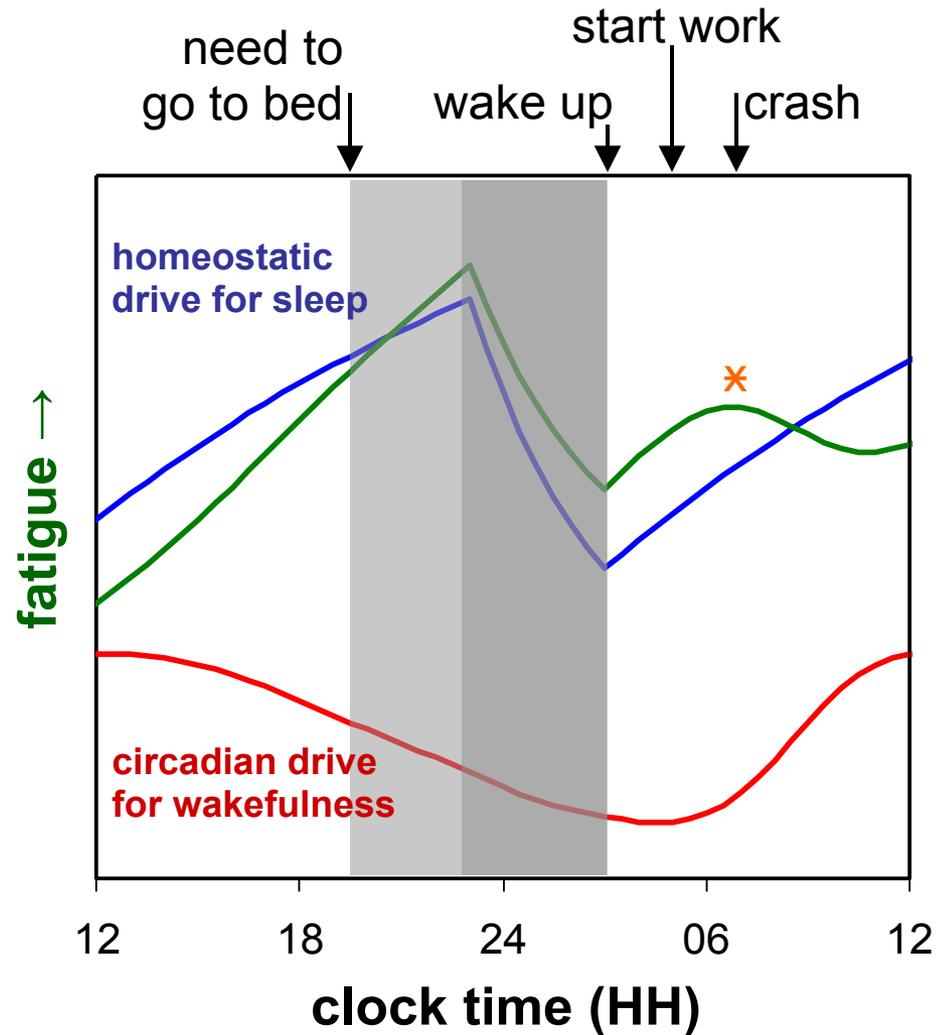
Dinges DF. Electroencephalogr Clin Neurophysiol 1986, 64: 224-227.

Working Nights: Dual Sleep and Fatigue Challenge

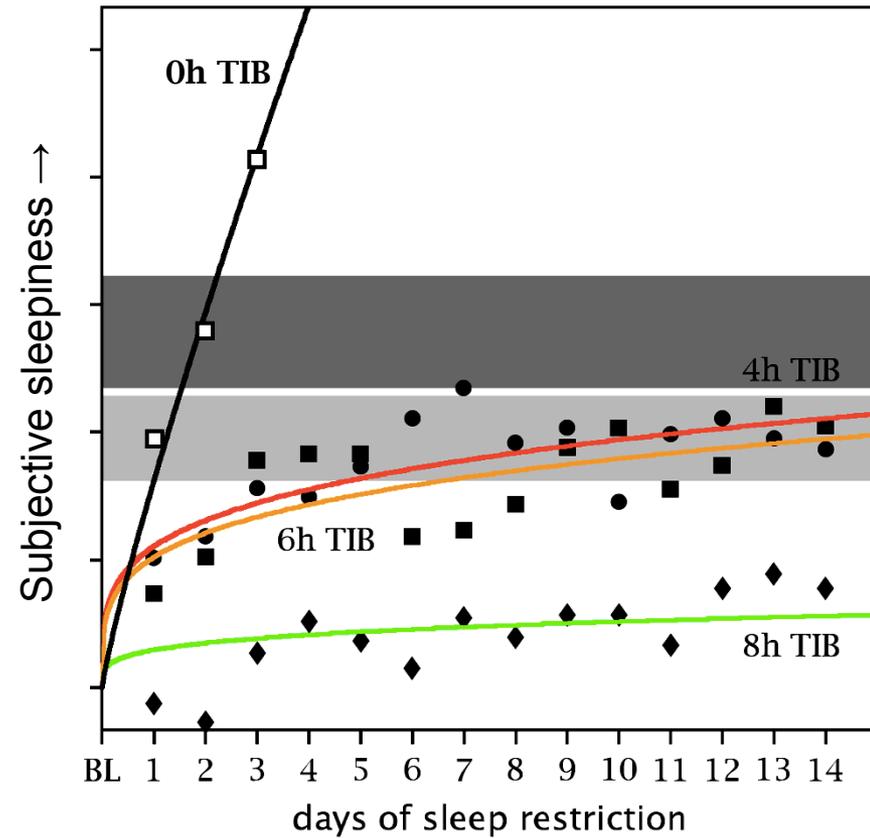
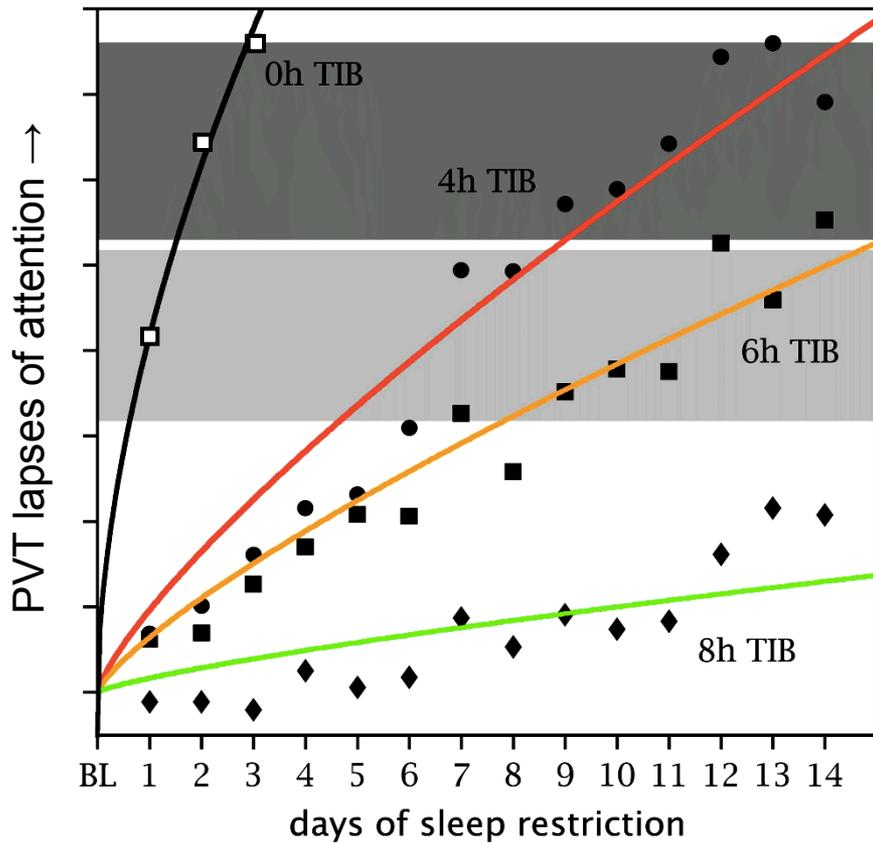


- The homeostatic drive for sleep builds up steadily over time awake
- At the same time, the circadian drive for wakefulness diminishes across the night and early morning
- Thus, the two effects amplify each other, and cognitive performance degrades across the work period
- In addition, the circadian process restricts sleep duration during the early evening, making it difficult to get enough sleep

Early Shift Start Case Study: MetroNorth Train Crash NY, Dec. 2013



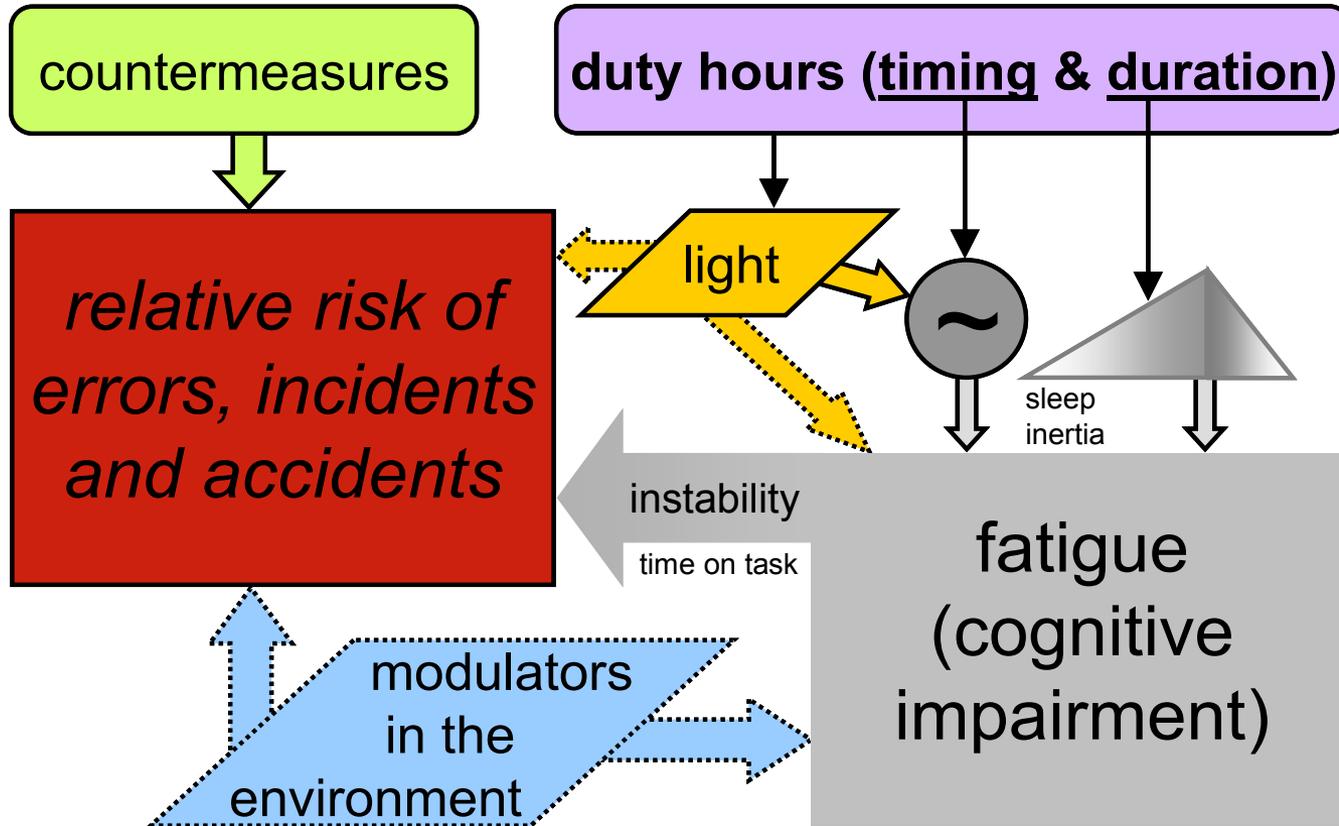
Cumulative Fatigue from Chronic Sleep Restriction



Graphs show
daytime averages



Duty Hours, Sleep/Wake Regulation and Fatigue Risk Management in EMS Settings



- *Neurobiological comes with the individual*
- *Operational comes with the task at hand*