

# How do adolescent sleep patterns and sleep needs affect driving?

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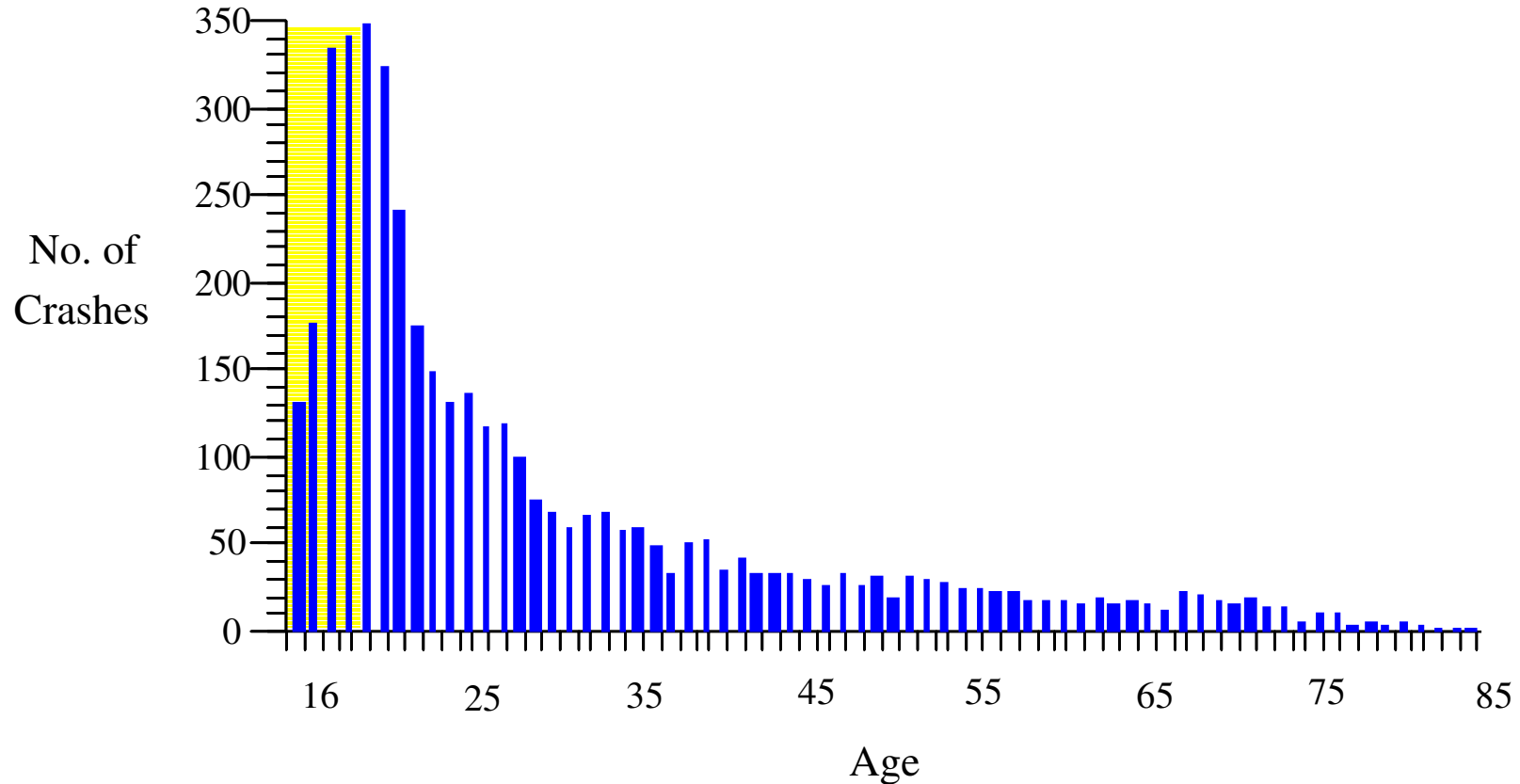
E.P.Bradley Hospital Sleep &  
Chronobiology Laboratory

# Why is sleep an issue?

- Sleep need
  - ~ 9.2 hr per night in high school students
  - ~ 8.4 hr per night in college students
- Nightly sleep
  - ~ 6.9-7.5 hr per night in high school student
  - ~ 7 hr per night in college students
- Insufficient sleep & excessive sleepiness

# Why is sleep an issue?

Age distribution of drivers in fall-asleep crashes.



# What accounts for short sleep?

- Biological factors
- Circumstantial/behavioral factors

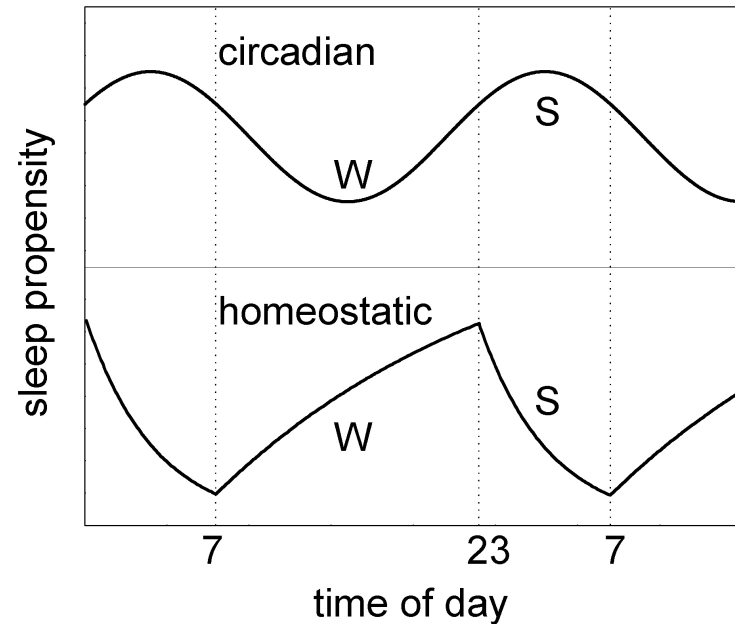
# Adolescent Development and Sleep/Wake Bioregulation

- Sleep/wake bioregulatory systems
  - Circadian rhythms
  - Sleep drive (sleep homeostasis)
- Both systems show maturational changes across adolescent development

# Two-Process Model of Sleep Regulation (Borbély, 1982)

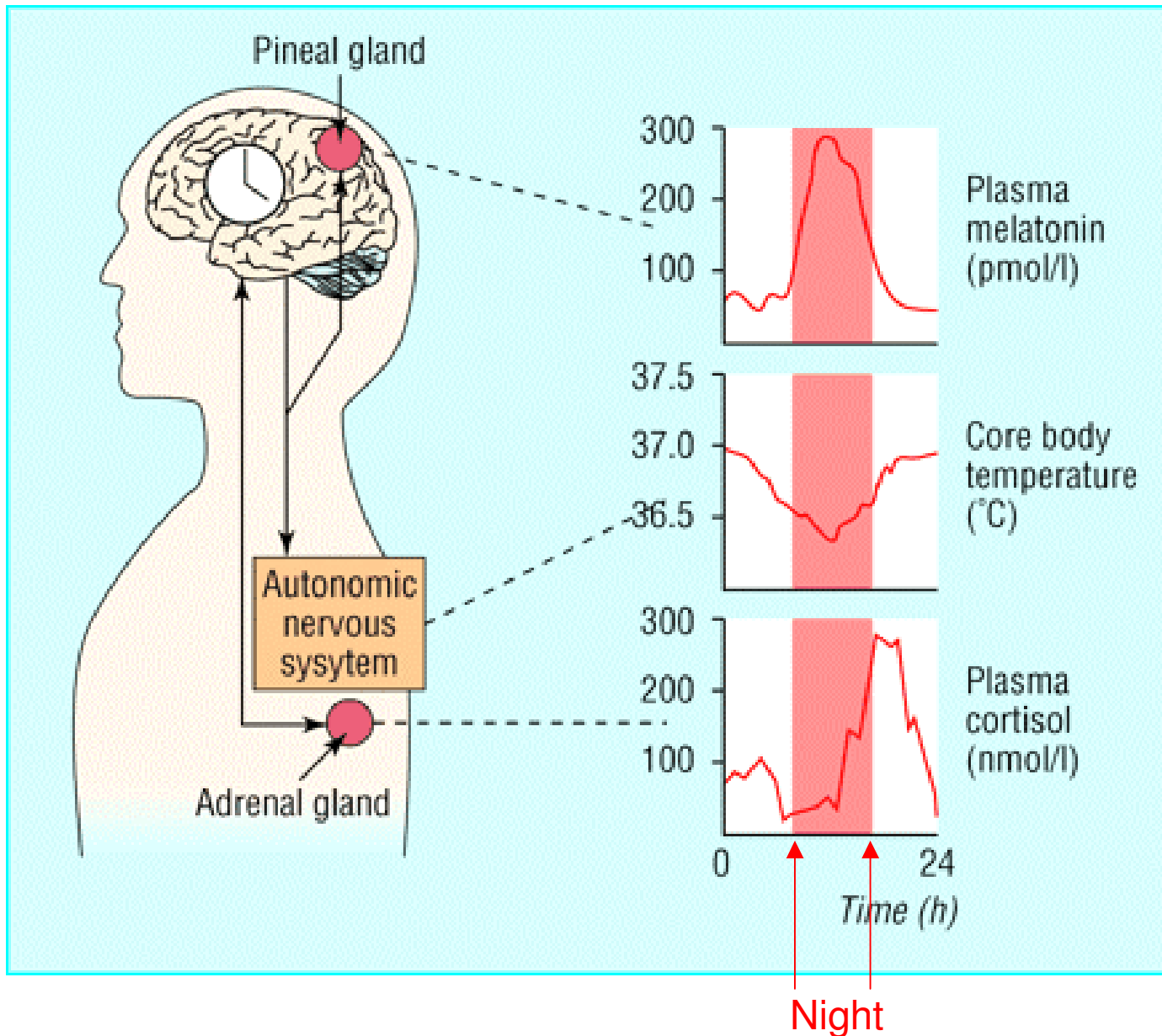
Sleep propensity oscillates with a daily (circadian) variation

Sleep propensity increases as waking accumulates and dissipates with sleep



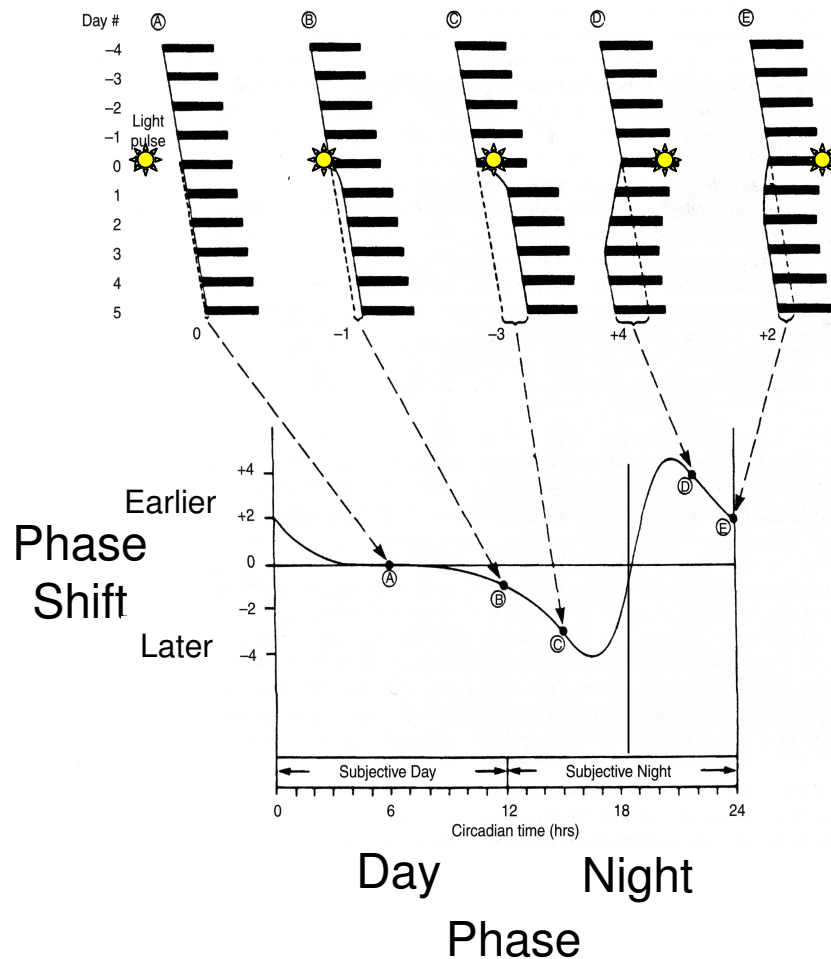
# Circadian Rhythm

- A self-sustained biological rhythm that, within the organism's natural environment, is normally synchronized to a 24-hour period.
- Circadian rhythms can be assessed by evaluating the timing of biological events.



Hastings, *British Med J*, 1997

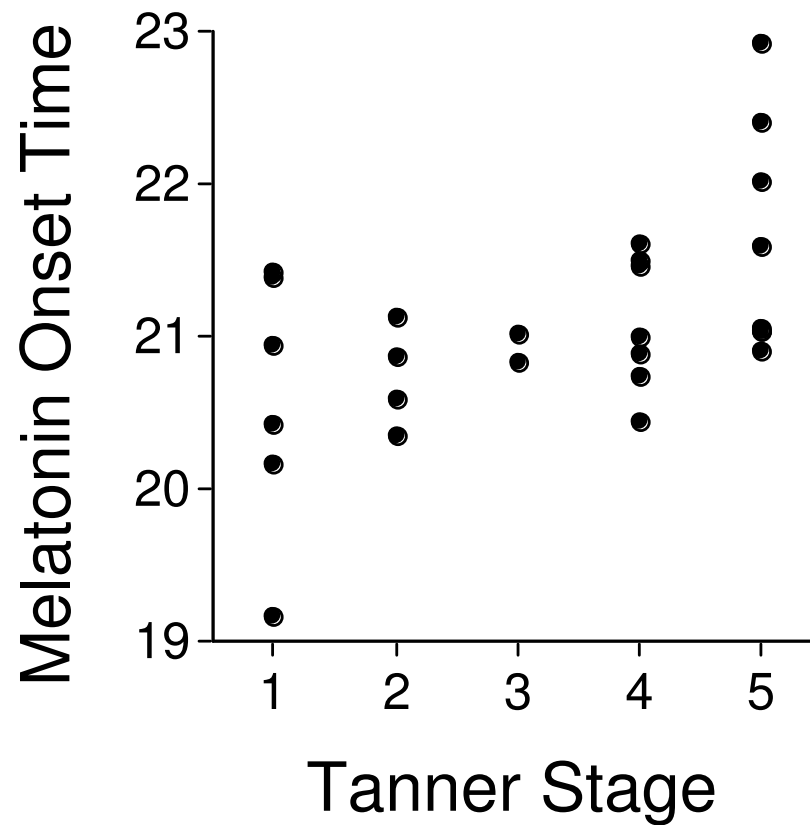
# Light is a Critical Zeitgeber



Light re-sets rhythms in a phase-dependent manner

- Evening light pushes phase later
- Morning light pulls phase earlier

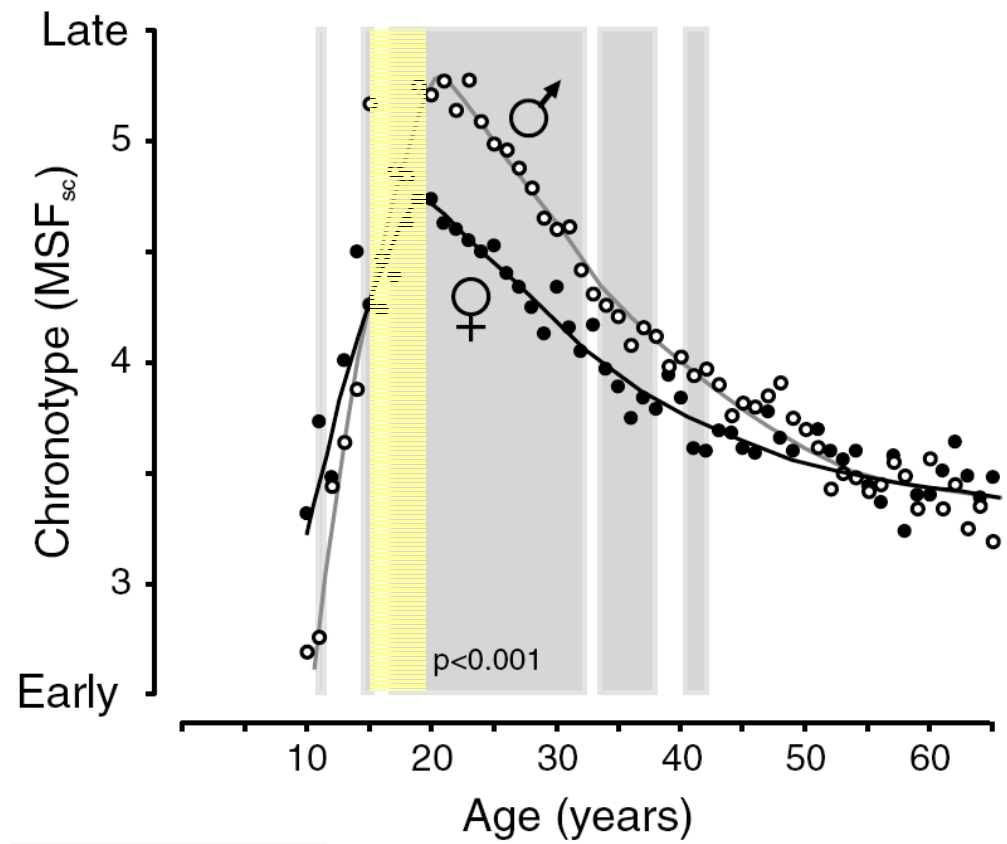
# Melatonin Phase and Puberty



# Chronotype and Age

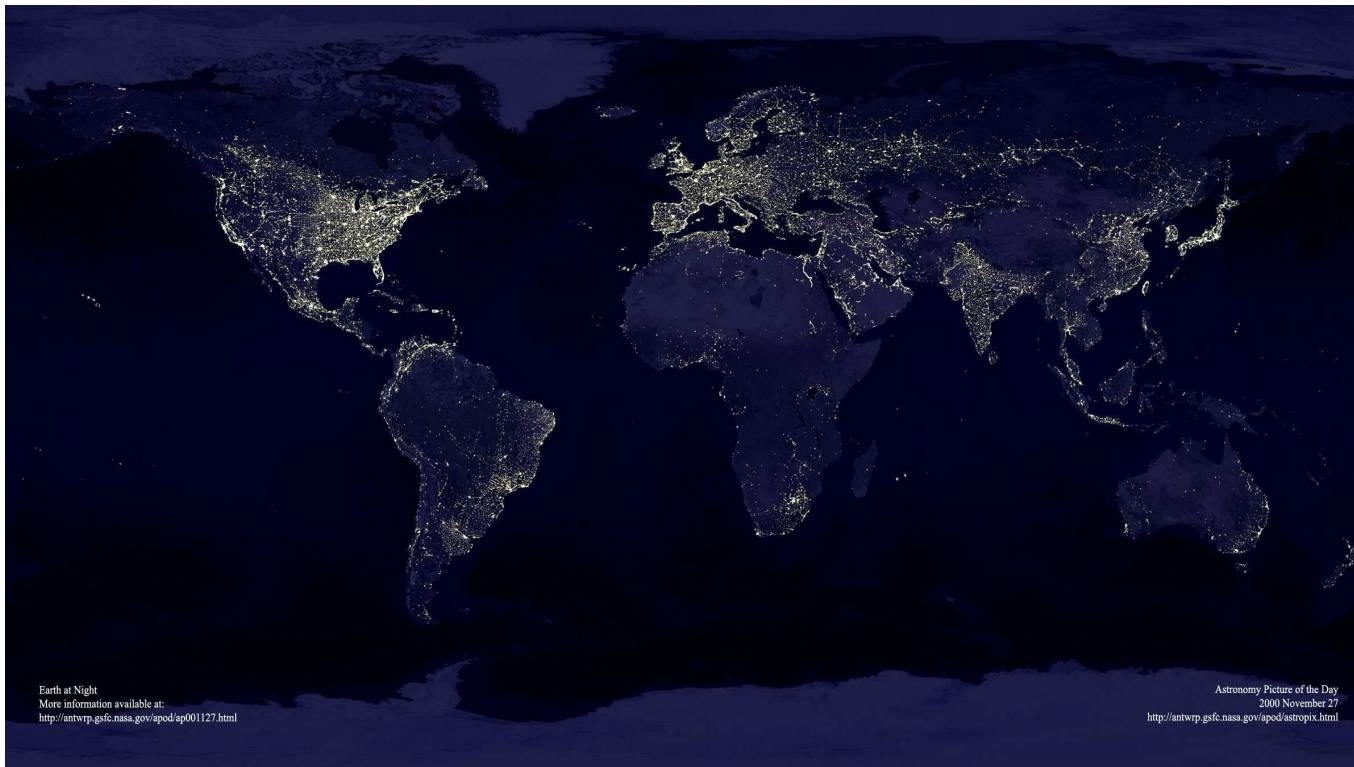
Evening Type

Morning Type

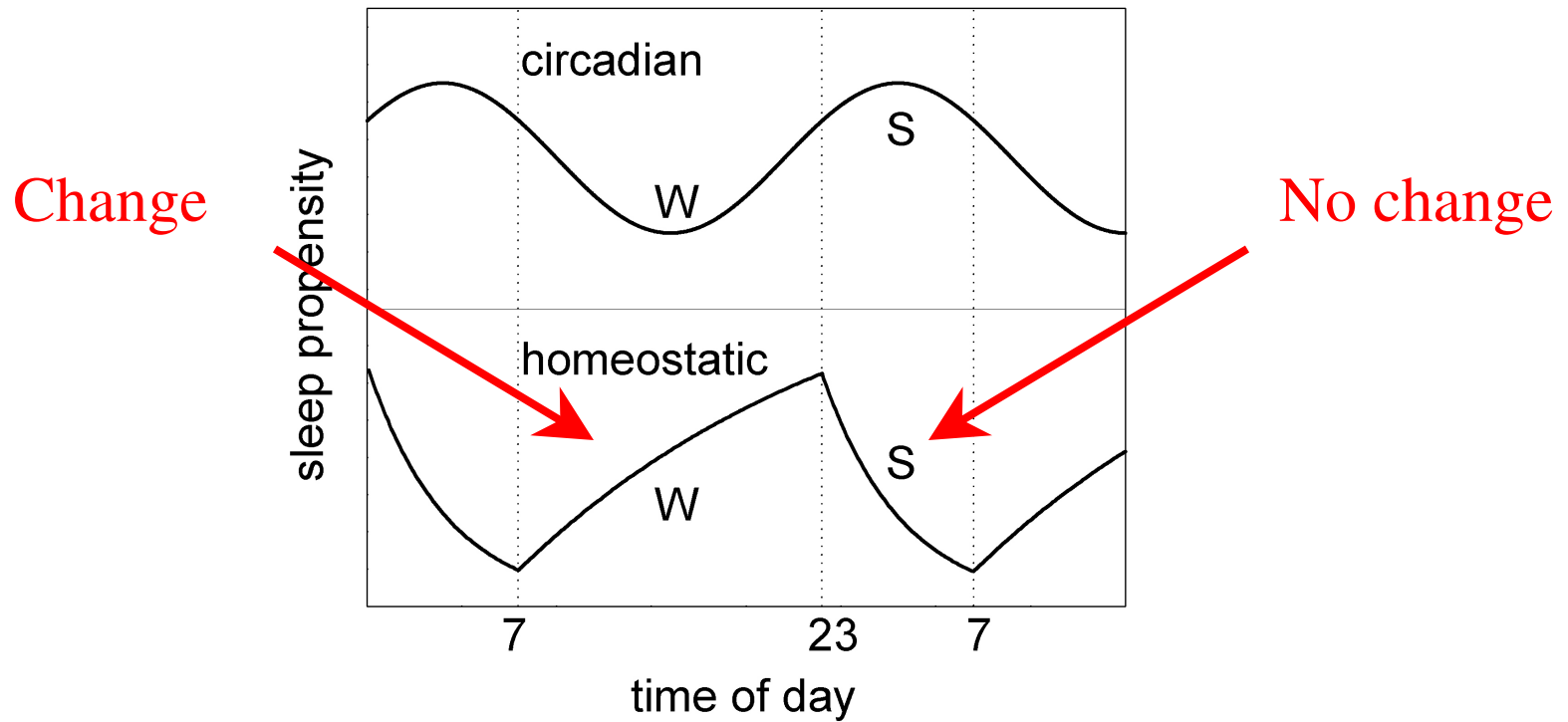


# Circadian Rhythms

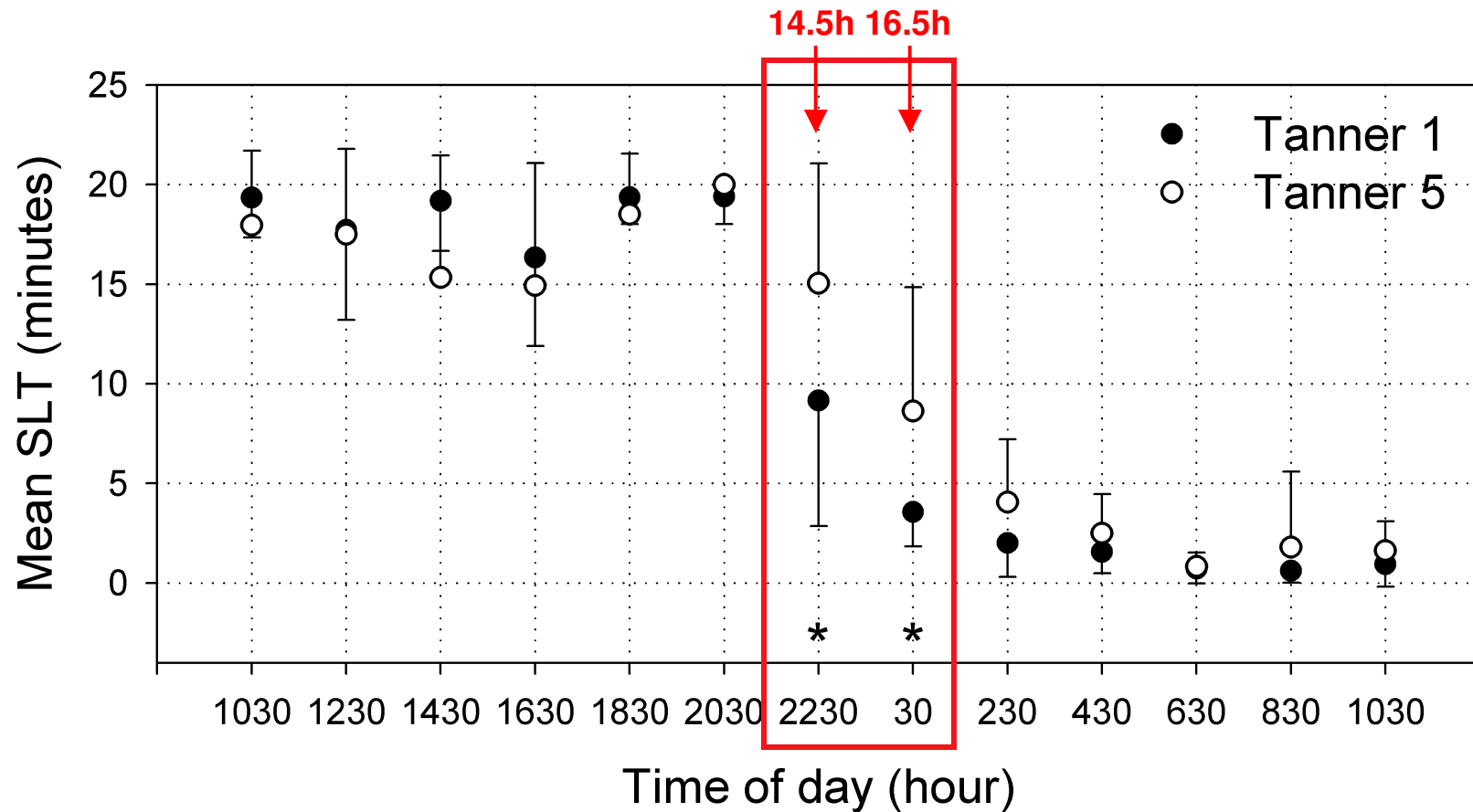
- Timing delays across adolescence
  - Developmental process
  - Enhanced by evening light exposure



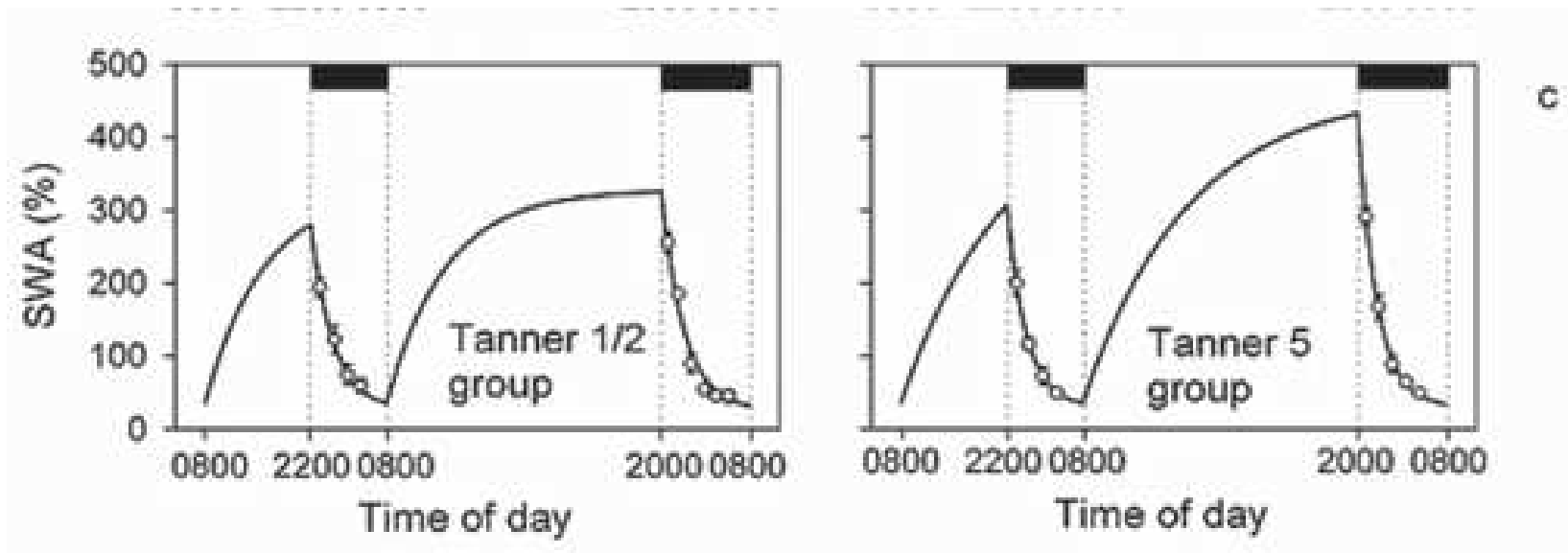
# Sleep Pressure System



# Sleep Tendency and Extended Wakefulness



# Process S: Model Fit from Recovery Sleep Data



$t_d = 2.8$  h Decay Time Constant     $t_d = 2.7$  h  
 $t_i = 8.9$  h Rise Time Constant     $t_i = 12.1$  h

# “Circumstantial/Behavioral” Factors

- Decreasing parental control
- Increasing academic obligations
- Increasing social opportunities
- Greater opportunities for employment
- Earlier school start time (adolescents)
- Greater availability of stimulating activities in the evening...in the bedroom

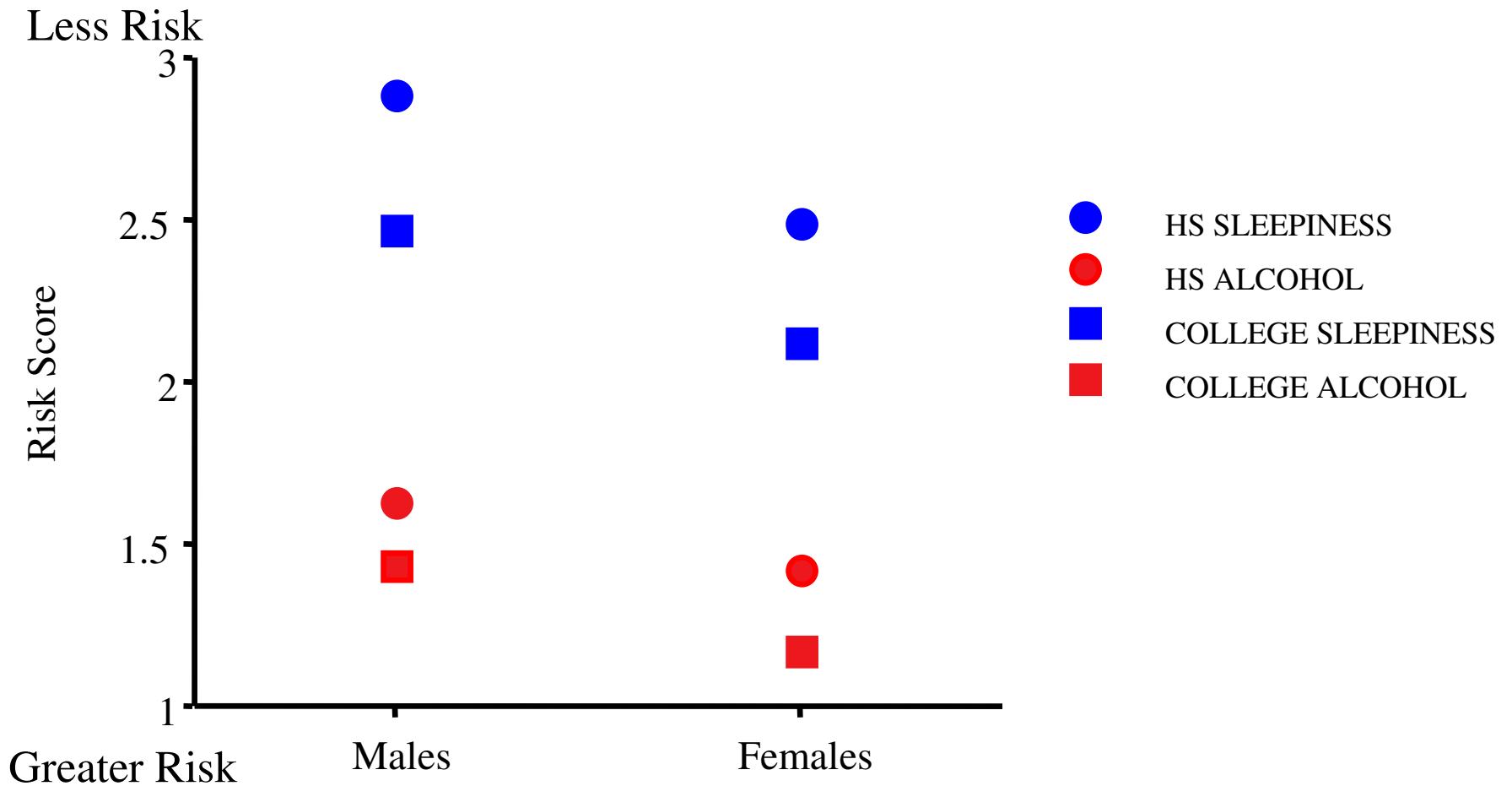
# Bedroom for sleep?

According to the National Sleep Foundation 2006  
“Sleep in America Poll” of 1602 adolescents (and  
a parent)

- 97% have at least one electronic appliance in the bedroom ( music player, TV, game, cell phone, computer, Internet access)
- Median number = 4 in 12th grade
- 4+ devices associated with *30 min less sleep* every day

What other issues arise in this  
age group?

# What is the risk of driving while impaired by sleepiness or alcohol?



# What are other “special” risks in adolescents?

- Driving at times of day associated with greater sleepiness
- Driving after extended wakefulness
- “Special” events, e.g., prom night (morning)
- Drowsiness, drinking, & driving

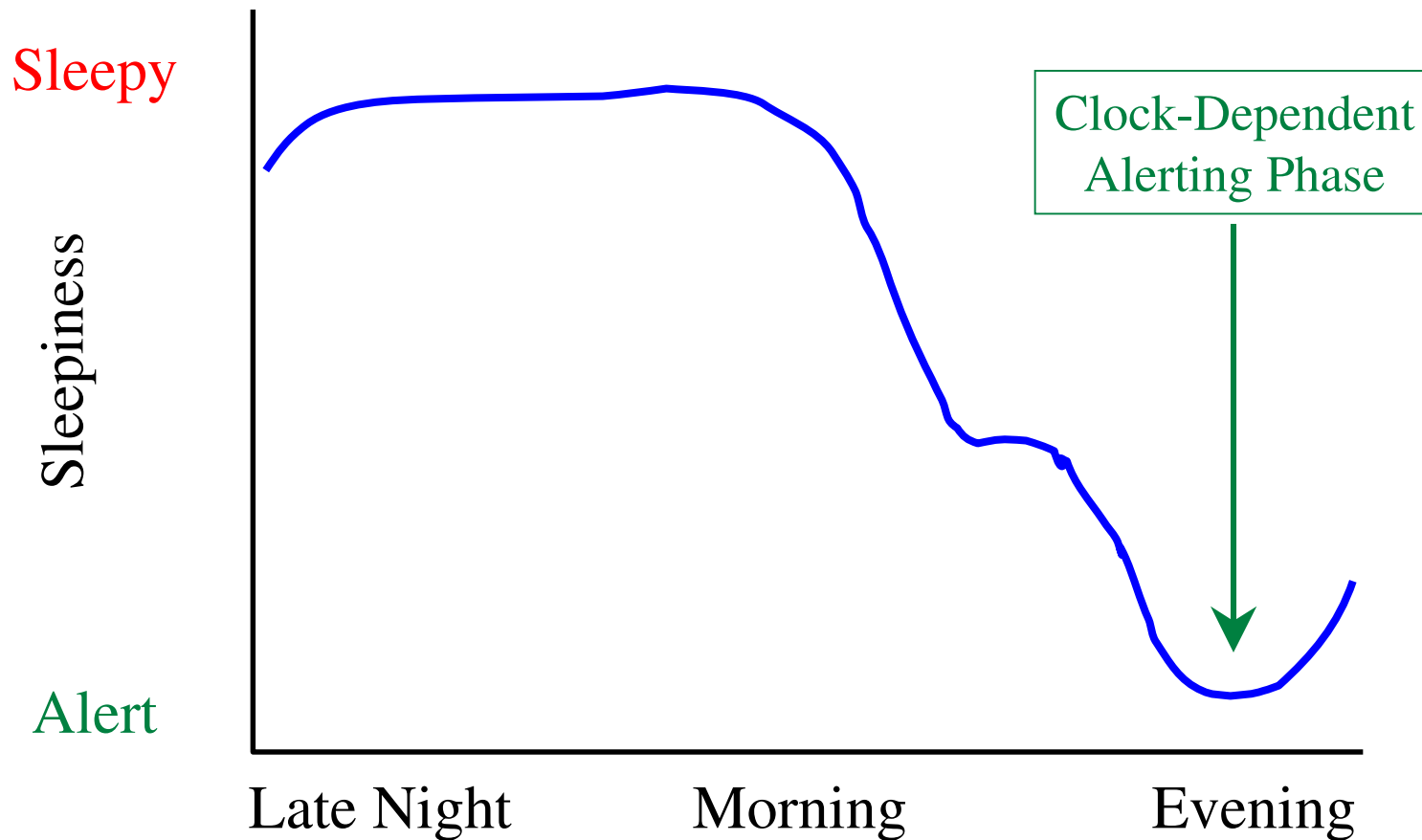
# Sleep vs. Alcohol

## Performance after...

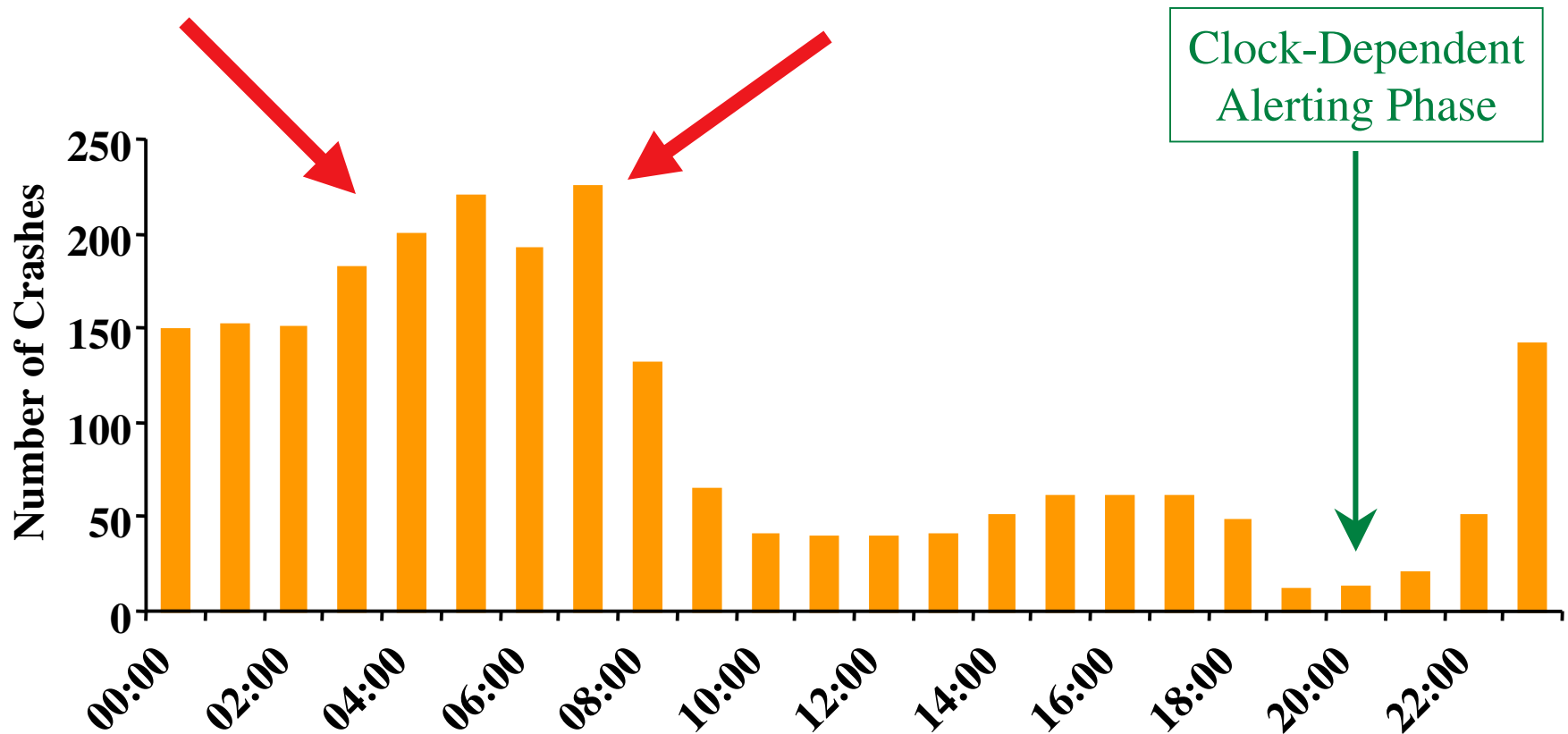
- 17 hours awake // .05% BAC (1130 pm)
- 24 hours awake // .10% BAC

**What are the times of greatest risk?**

# Circadian Timing + Daily Sleep Pressure + Too Little Sleep Chronically



## Times of occurrence of fall-asleep crashes in individuals ages 16-25 years



## Drowsy Driver Causes Accident Shutting Down I-15

May 11th, 2006 @ 3:29pm

(KSL News) – A drowsy driver lost control of her car on I-15 near 1100 North.

Utah Highway Patrol says the teenager fell asleep at the wheel, crossed the median and slammed head-on into another car.

Troopers say she wasn't wearing a seatbelt and was thrown from the car. She remained conscious and coherent and was in a lot of pain.

Both drivers were flown to the hospital in critical condition.



Northbound I-15 was closed at I-80 whi



**JOHN HENRY/JOURNAL STAR**

Jacquelin Mullenix and Jesse Van Brunt light candles at the memorial in remembrance of Paige Lawson on Wednesday alongside Manito Road where she died in a car accident Tuesday. Van Brunt worked with Lawson at the Burger King in Pekin.

## Driver may have fallen asleep

**Manito teen killed when car went off road and hit tractor**

Thursday, May 11,  
2006

→ Parkin said Johnson works nights at the Kmart in Pekin and believed he had gotten off work about 11 p.m. the night before the crash. Johnson lived one street away from Lawson; the couple had dated for more than a year, friends said.

## The bottom line...

Adolescents and young adults typically get too little sleep often at the “wrong” time; as a consequence, they are predictably at risk for drowsy driving episodes.

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