

SLEEP DEPRIVATION

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INTRODUCTION

- Sleep is important for cognitive function and memory consolidation
- But yet 1/3 individuals are chronically sleep deprived
- Both acute and chronic sleep deprivation can give rise to cognitive impairment
- Recovery sleep on weekend after chronic sleep deprivation does not completely restore performance back to normal baseline

MYTHS & MISCONCEPTIONS

- 1. Just one night without sleep is not going to hurt me
- 2. I only need 4-6 hours of sleep. I will be fine.
- 3. I can catch up my sleep on weekend!
- 4. I can cram for final exam week without a problem

WHY SLEEP

Sleep is considered to be important for energy conservation, thermoregulation, and tissue recovery

sleep is essential for cognitive performance, especially memory consolidation



1

SLEEP NEEDS



NEWBORNS
0-2 months

12 - 18 HOURS



INFANTS
3 months to 1 year

14 - 15 HOURS



TODDLERS
1 to 3 years

12 - 14 HOURS



PRESCHOOLERS
3 to 5 years

11 - 13 HOURS



SCHOOL-AGED CHILDREN
5 to 12 years

10 - 11 HOURS



TEENS AND PRETEENS
12 to 18 years

8.5 - 10 HOURS



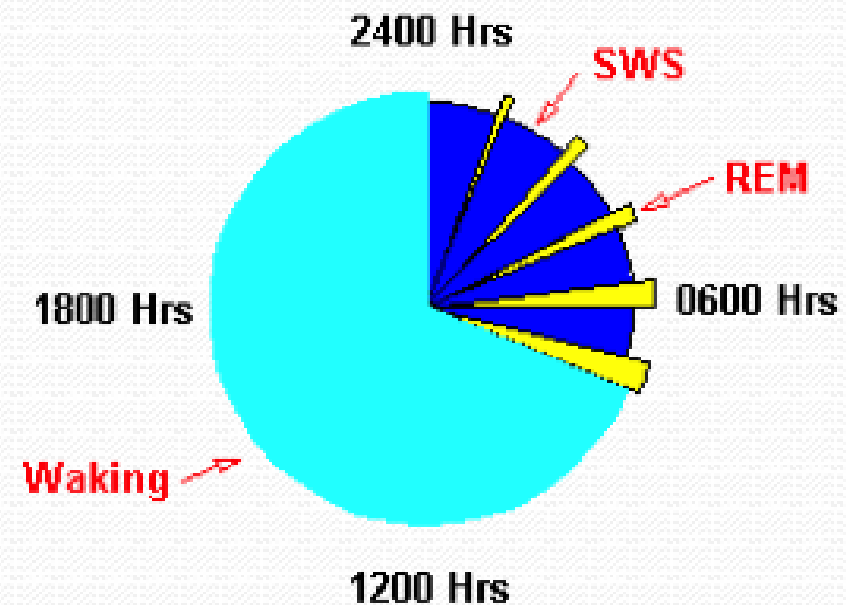
ADULTS
18+

7.5 - 9 HOURS

During a normal night of sleep, a person will alternate between periods of NREM and REM sleep. Each cycle is approximately 90 minutes long, containing a 20-30 minute bout of REM sleep

The 24 Hour Sleep/Wake Cycle

- The 24 hour sleep/wake cycle consists of sleep [slow wave sleep (SWS) alternating with rapid eye movement sleep (REM)] and waking.
- Sleep restores brain function, sustaining performance during subsequent waking.



SLEEP

REM sleep is considered important for learning, memory consolidation, neurogenesis, and regulation of the blood-brain barrier function

Non REM sleep is related to hormonal release (e.g., growth hormone secretion), the decline in the thermal set point ,and is characterized by a reduction of cardiovascular pressure parameters(e.g. ,lowering of blood

Prevalence

In 1990 the prevalence of insufficient sleep was 20.4% (16.2% in men and 23.9% in women).

Sleep. 2001 Jun 15;24(4):392-400

In 2005-2008 more than one-third of individuals reported sleeping less than seven hours per night on weekdays or workday nights

MMWR Morb Mortal Wkly Rep. 2011;60(8):239.

DISTURBING TRENDS

- 92 % of US teens have cellphones and 24 % report having multiple devices that they use simultaneously
- 72% brings their cellphones into their bedrooms and use them when they are trying to sleep
- 28% leave their phones on all night only to be awakened at night by texts, calls or email

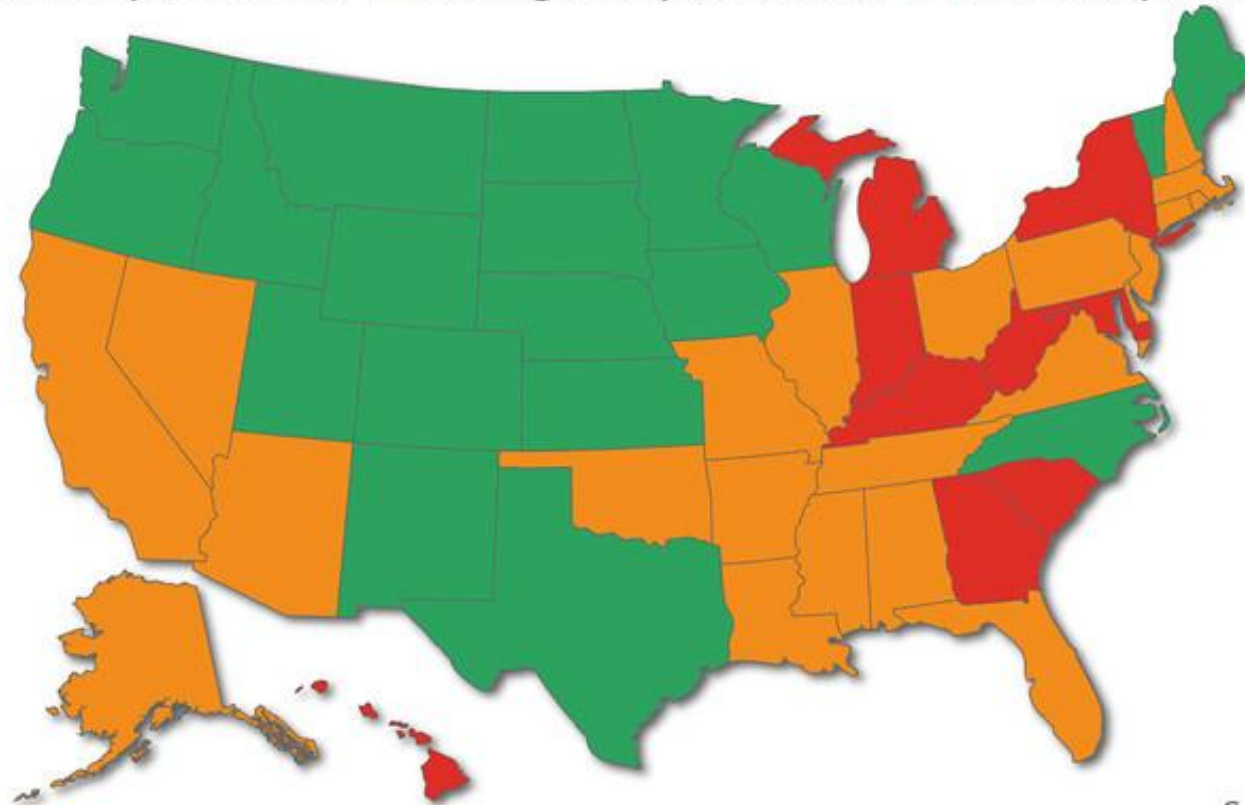
DISTURBING TRENDS CONTINUE

- 64% use electronic music devices, 60% use laptops and 23% play video games in the hour before they went to sleep
- >50% reported texting in the hour before they went to sleep
- They are less likely to get a good night's sleep and feeling refreshed in the morning

One in three Americans don't get enough sleep

Percentage of adults who reported seven or more hours sleep per 24-hour period

■ Least sleep (56%-61%) ■ Average sleep (62%-65%) ■ Most sleep (66%-71%)



Source: CDC



Risk groups

Males and females of all ages

Adolescents, among whom restricted sleep times are common

Caregivers who look after the needs of a family member who has a chronic illness

People who perform shift work

People who have a sleep disorder that causes insufficient sleep

People who have a medical condition that causes insufficient sleep

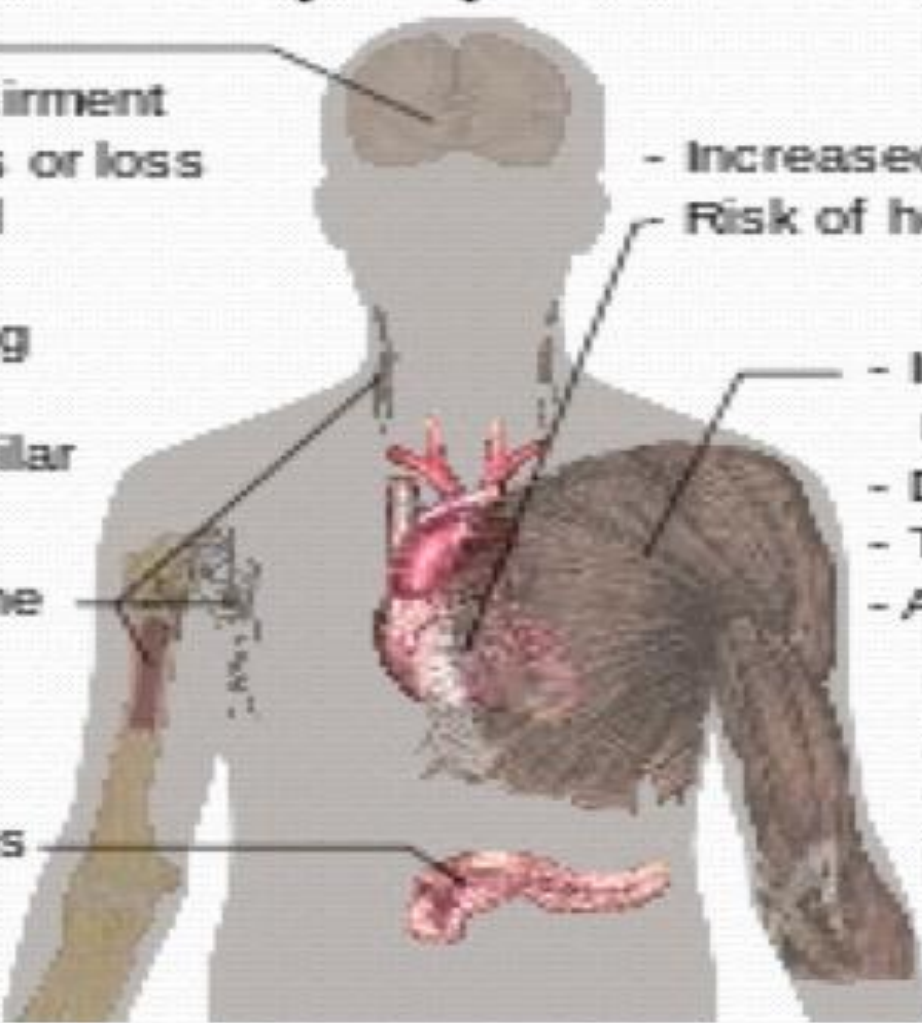




THE DANGERS
of **SLEEP**
DEPRIVATION

By A. Page

Effects of Sleep deprivation

- 
- Irritability
 - Cognitive impairment
 - Memory lapses or loss
 - Impaired moral judgement
 - Severe yawning
 - Hallucinations
 - Symptoms similar to ADHD
 - Impaired immune system
 - Risk of diabetes Type 2
- Increased heart rate variability
 - Risk of heart disease
 - Increased reaction time
 - Decreased accuracy
 - Tremors
 - Aches
- Other:*
- Growth suppression
 - Risk of obesity
 - Decreased temperature

Effects

Performance

- o Lack of concentration
- o Attention deficits
- o Fatigue o Restlessness
- o Lack of coordination
- o Poor decisions
- o Increased errors
- o Forgetfulness Distractibility
- o Lack of energy



DEFINITION

Sleep deprivation is the condition of not having enough sleep; it can be either chronic or acute.

Acute sleep deprivation refers to no sleep or a reduction in the usual total sleep time, usually lasting one or two days.

Chronic sleep deprivation (also called sleep restriction) exists when an individual routinely sleeps less than required for optimal functioning.



MYTH #1:

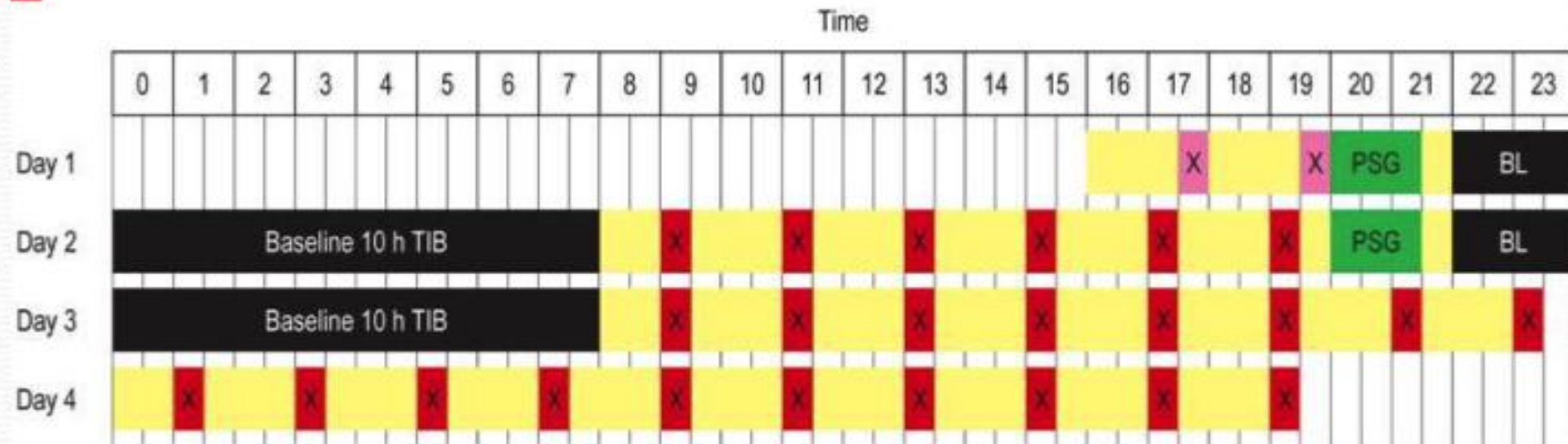
JUST ONE NIGHT WITHOUT
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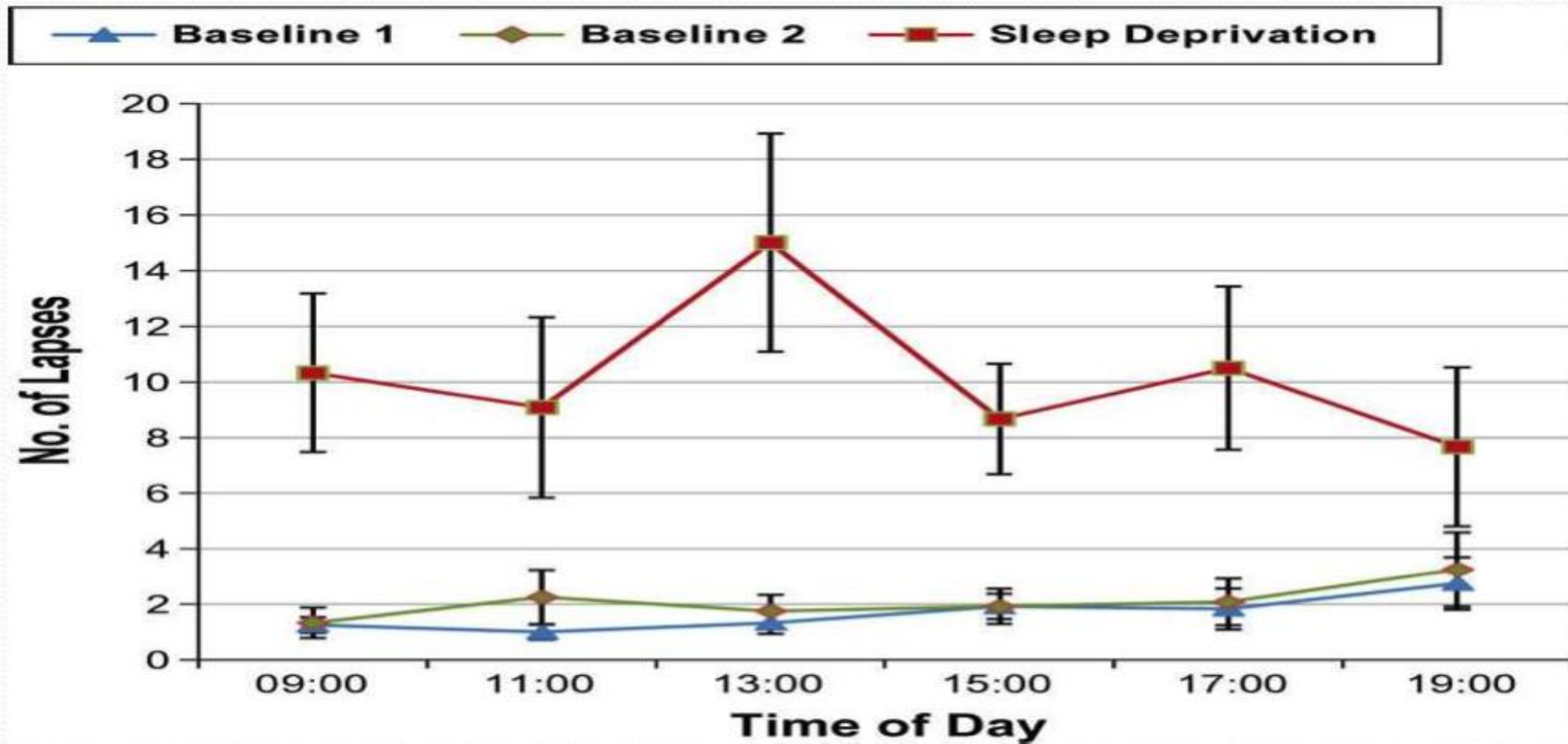
The Effect of One Night's Sleep Deprivation on Adolescent Neurobehavioral Performance

Twelve healthy adolescents (6 male), aged 14-18 years

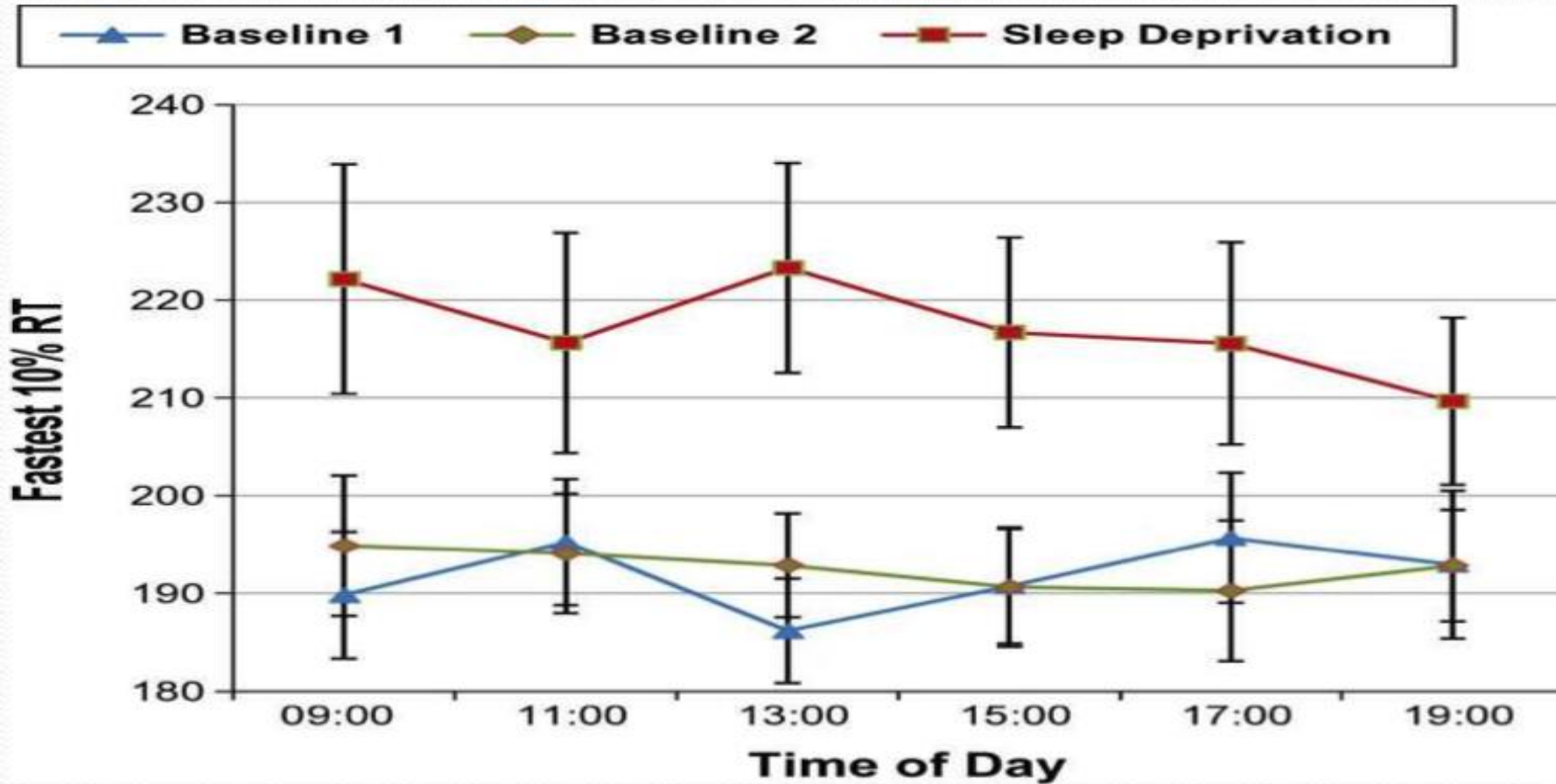
- Practice Neurobehavioral Test Battery (NTB)
- Neurobehavioral Test Battery



The estimated marginal means (\pm standard error) of Psychomotor Vigilance Task (PVT) lapses at each time point across baseline and sleep deprivation days.



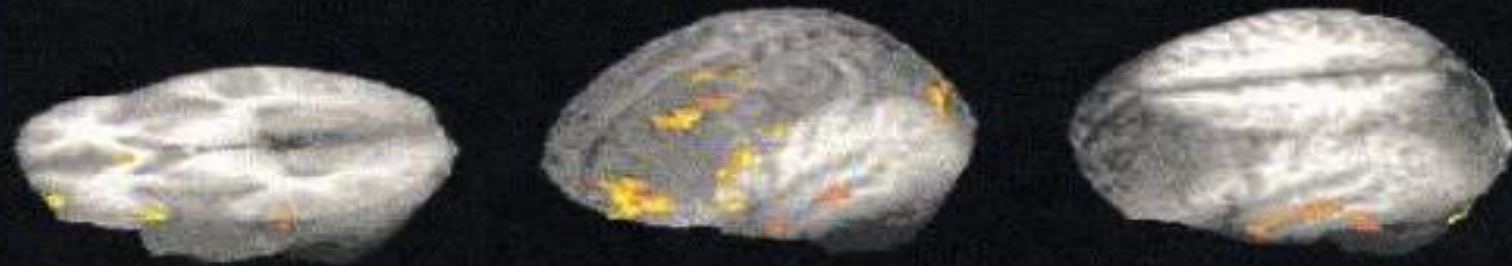
The estimated marginal means (\pm standard error) of Psychomotor Vigilance Task (PVT) fastest 10% reaction time at each time point across baseline and sleep deprivation days



With respect to cerebral activation, the results showed activation in

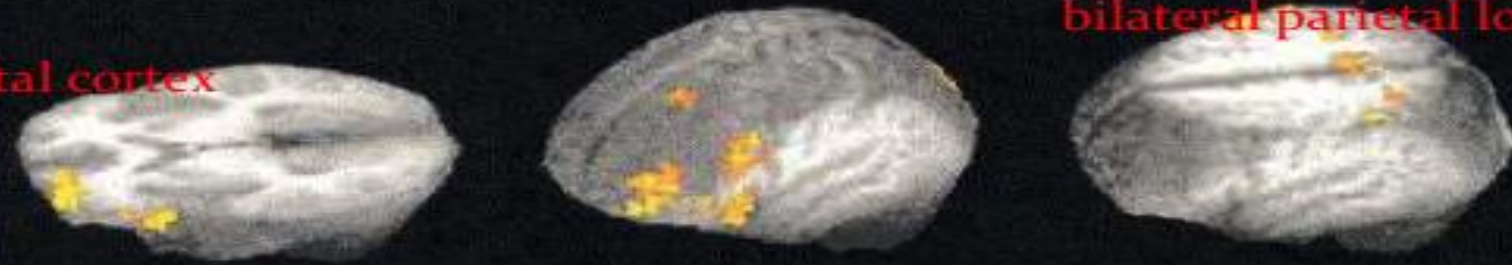
Normal > TSD (top)
TSD > Normal (bottom)

Normal night



prefrontal cortex

Total Sleep
Deprivation



bilateral parietal lobes

left inferior frontal gyrus

Divided attention

Divided attention task required more attentional resources following TSD than after normal sleep.

J Sleep Res. 2001 Jun;10(2):85-92

MYTH #2:

I ONLY NEED 4-6 HOURS
OF SLEEP. I WILL BE
FINE!



CHRONIC SLEEP DEPRIVATION

The chronic sleep restriction experiment involved randomization to one of three sleep doses (4 h, 6 h, or 8 h time in bed per night), which were maintained for 14 consecutive days.

The total sleep deprivation experiment involved 3 nights without sleep (0 h time in bed).

Each study also involved 3 baseline days and 3 recovery days

CHRONIC SLEEP DEPRIVATION

The neurobehavioral assessment included **psychomotor vigilance task** to measure behavioral alertness. The PVT measures simple reaction time to a visual stimulus, presented approximately 10 times/minute. Lapses (reaction times greater than 500 ms) indicative of reduced behavioral alertness.

CHRONIC SLEEP DEPRIVATION

The neurobehavioral assessment also include a computerized **digit symbol substitution task** to measure working memory.

This subject-paced task involves the matching of digits (0-9) to symbols (circle, triangle, etc.).

The number of correct responses in 1.5 min was counted to measure working memory performance.

A serial addition/subtraction task was included in the assessment to measure cognitive throughput.

Conclusion

Chronic restriction of sleep periods to 4 h or 6 h per night over 14 consecutive days resulted in **significant cumulative, dose-dependent deficits in cognitive performance on all tasks.**

Sleep. 2003;26(2):117.

MYTH #3

I CAN CRAM FOR THE
FINAL EXAM WEEK
WITHOUT A PROBLEM



Memory

Long-term memory can be divided between declarative and non-declarative .

REM is associated with the consolidation of non declarative (implicit) memories.

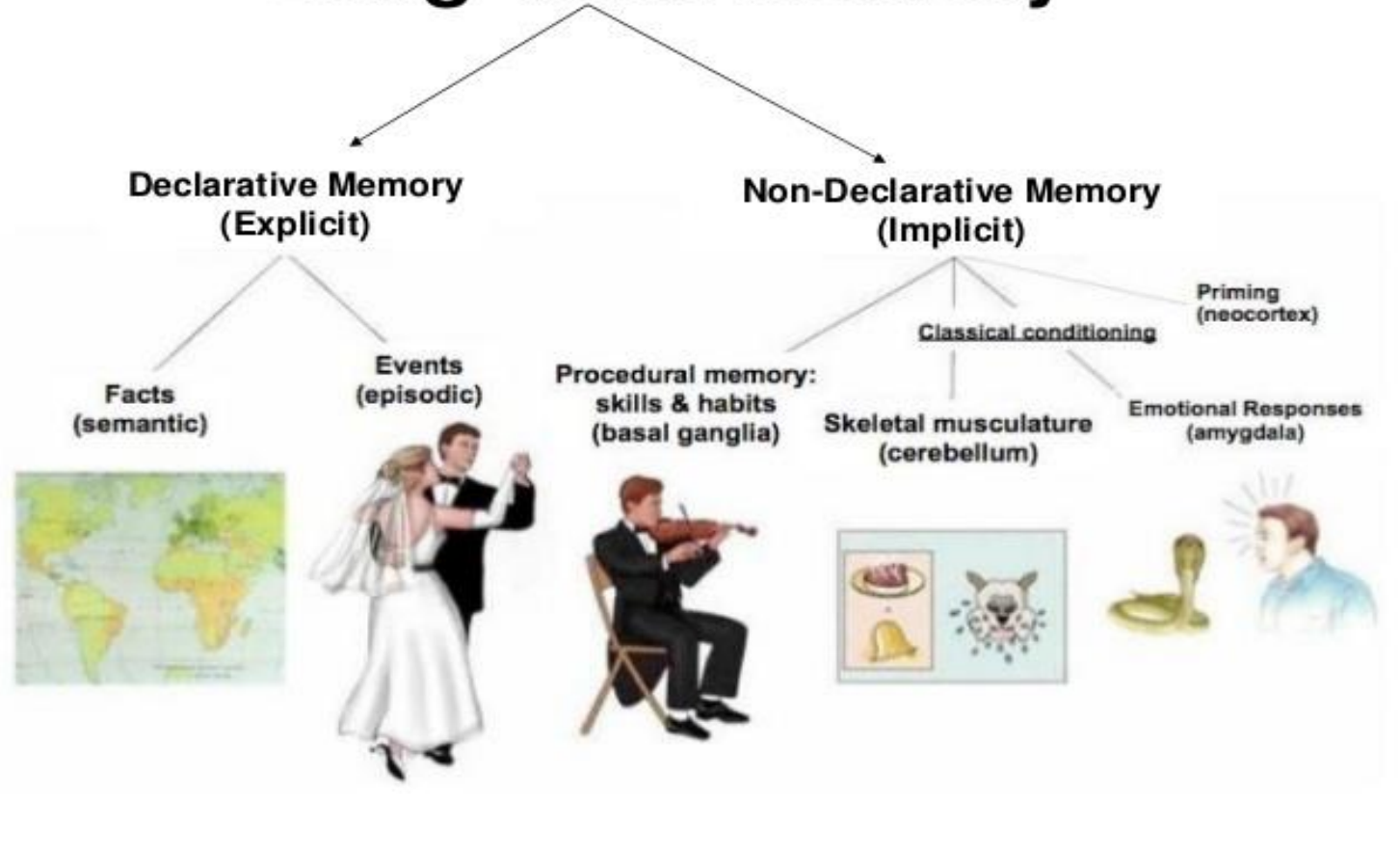
An example would be a task that we can do without consciously thinking about it, such as riding a bike.

Slow-wave, (NREM) sleep, is associated with the consolidation of declarative (explicit) memories.

These are facts that need to be consciously remembered, such as dates for a history class

Diekelmann, S., & Born, J. (2008)

Long-Term Memory

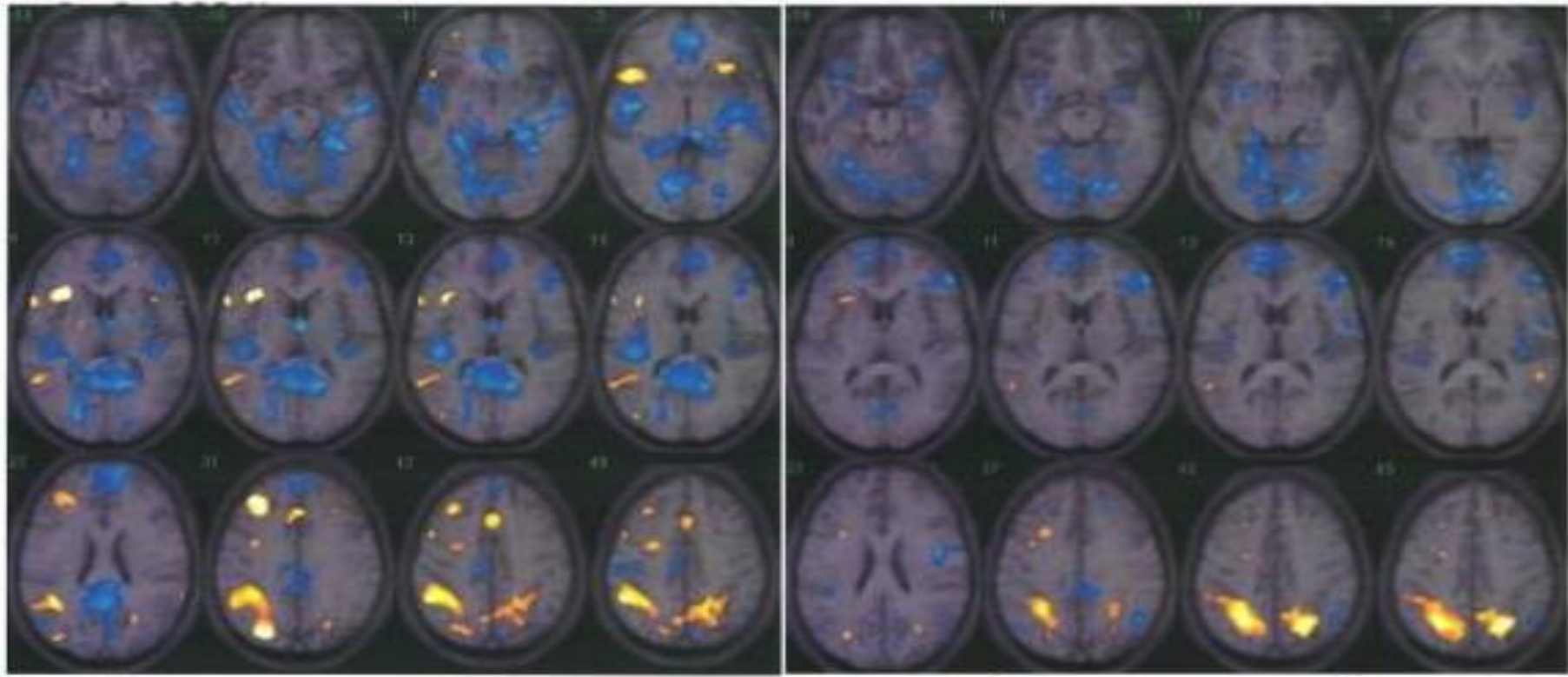


Preliminary fMRI findings in experimentally sleep-restricted adolescents engaged in a working memory task

20 healthy adolescents underwent a 3-week protocol which included a baseline week, followed in random order by a sleep restriction week (SR) and a healthy duration week (HD)

Behav Brain Funct. 2009;5:9

Composite activation/deactivation maps, showing contrast of 2-back task with 0-back task in each experimental sleep condition. Warm colors (orange to yellow)



Sleep Restriction Condition

Healthy Sleep Duration Condition

Conclusion

Regions that are normally active during an attention-demanding working memory task in the well-rested brain became even more active to maintain performance after chronic sleep restriction.

In contrast, regions in which activity is normally suppressed during such a task in the well-rested brain showed even greater suppression to maintain performance after chronic sleep restriction.

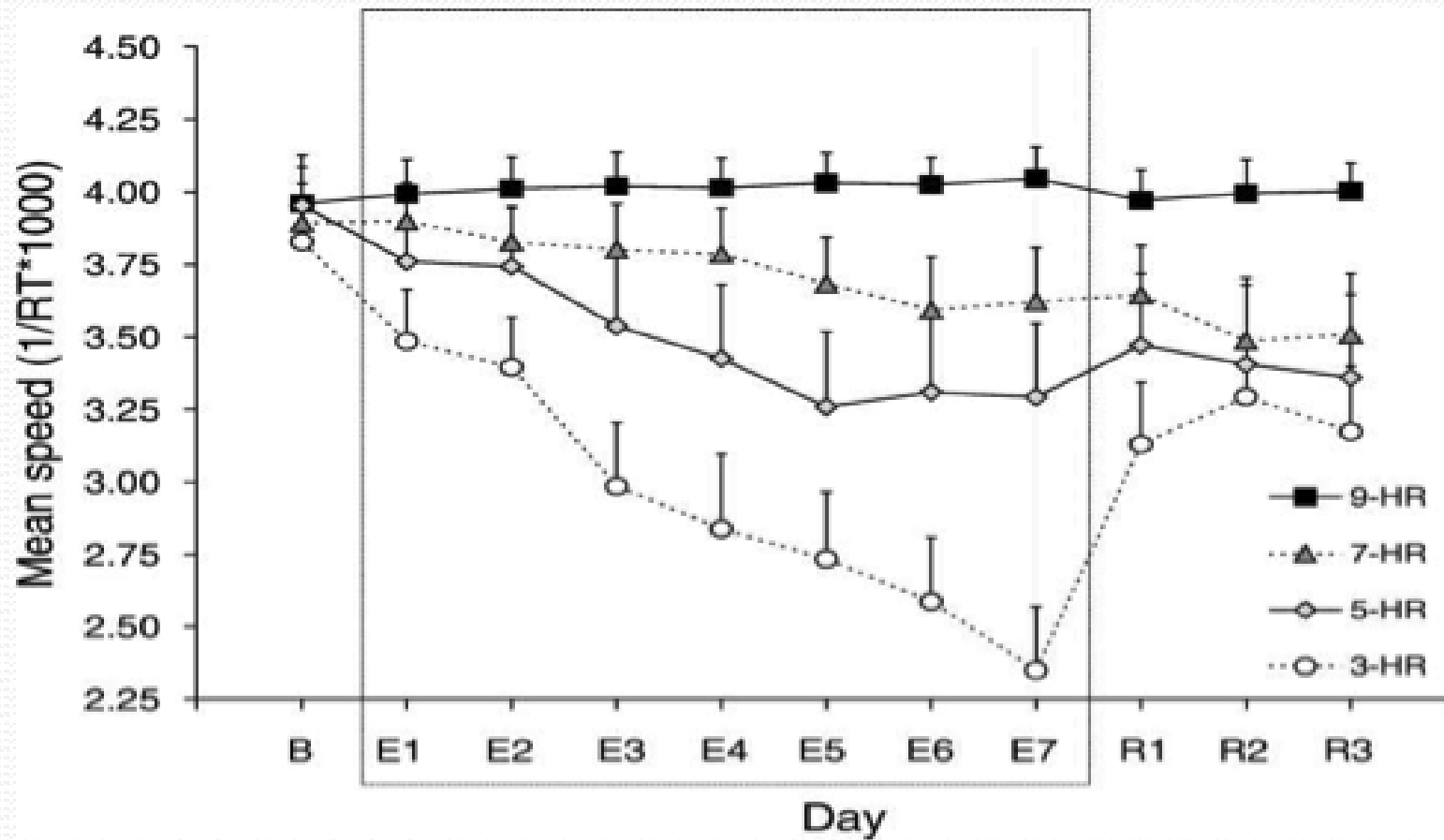
Behav Brain Funct. 2009;5:9

MYTH #4:

I CAN CATCH UP
WITH MY SLEEP ON
WEEKEND



With mild to moderate sleep restriction (7- and 5-h TIB), performance initially declined and, after a few days, appeared to stabilize at a lower-than-baseline level for the remainder of the sleep restriction period. In contrast, with severe sleep restriction (3-h TIB) performance declined continuously



Teenager Post # 12756

Me every night: I don't
need to sleep.

Me every morning:
I need to sleep for
3 days straight.

[/teenagerposts.tumblr.com](http://teenagerposts.tumblr.com)

CONCLUSION

- Sleep is important for cognitive function and memory consolidation
- But yet 1/3 individuals are chronically sleep deprived
- Both acute and chronic sleep deprivation can give rise to cognitive impairment
- Recovery sleep on weekend after chronic sleep deprivation does not restore performance back to normal baseline

THANK YOU

