

PSY3320 Sleep and Circadian Rhythm

Week 1 – Introduction to Sleep and Circadian Rhythms

Week 2 – Sleep: What is it, How much do we need and How do we measure it?

Week 3 – Neurobiology of Circadian Rhythms

Week 4 – Circadian Rhythm Disorders

Week 5 – Neurobiology of Sleep

Week 6 – Sleep Disorders and their Relationship with Obesity

Week 7 – Insomnia, Hypersomnia and Other Sleep Disturbances

Week 8 – Sleep Across the Lifespan

Week 9 – Sleep Deprivation and Cognition

Week 10 – Impact of Circadian Dysfunction

Week 11 – Impact of Sleep and Circadian Dysfunction in the Real World

Week 12 – Pharmaceuticals and their Complex Effects on Sleep

Week 2 – Sleep: what is it, how much do we need and how do we measure it?

Functions of sleep and sleep 'need'

- Sleep is a reversible behavioural state of perceptual disengagement from and unresponsiveness to the environment.
- Almost 20% of all serious car crash injuries in the general population are related to sleepiness
- Total cost of sleep disorders in 2010 was estimated to be \$818 million.

Why do we sleep

- All animals sleep: despite dangers
- Animals fully deprived of sleep die (biological necessity)
- Sleep is restorative: surges in growth hormones, brain plasticity (forming skills and memories), flushing metabolic waste from the brain.
- Necessary of proper functioning

Functions of sleep

- Conserve energy
- Enhance survival/adaptation
- Restorative/repair of injury
- Aid learning and memory consolidation (REM)
 - Tower of Hanoi task: when subjects are retested a week after training, a significant 40% improvement in performance is seen. But if REM is experimentally reduced the night after training, no such improvement is seen.
 - Sleep inactivates the transfer of storage from short- to long-term memory. Encoding of material before sleep onset is of insufficient strength to allow recall. The precise moment at which this deficit occurs is not known and may be a continuing process. E.g. inability to grasp the instant of sleep onset in your memory, forgetting a telephone call that had come in the middle of the night

How much do we need?

- Mean # of hours: 7.0 in 2001 and 6.7 in 2009
- In today's society we just accept being tired in the day
- How much sleep do we obtain with "unlimited" time in bed? Most sleep around 7hrs. After depriving participants of sleep for 1 night, the next night of sleep was much longer
- Adults should sleep 7 or more hours per night on a regular basis to promote optimal health.
- Sleeping less than 7h per night on a regular basis is associated with adverse health outcomes
- Sleeping more than 9h per night on a regular basis may be appropriate for young adults, individuals recovering from sleep debt, and individuals with illnesses. For others, it is uncertain whether sleeping for than 9h per night is associated with health risk.
- Lots of individual differences. Average is ~7.5h of sleep!

Week 4 – Circadian Rhythm Disorders

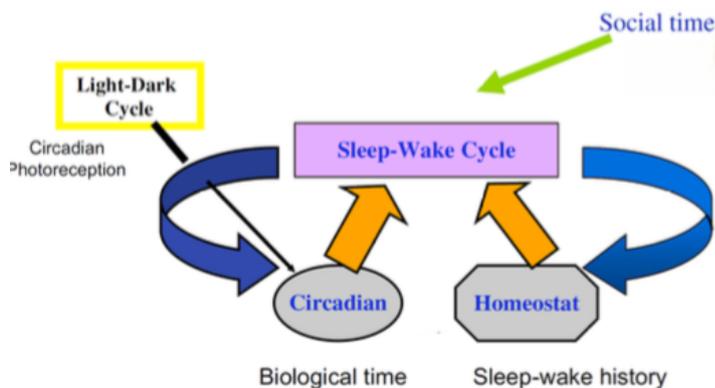
- The sleep-wake cycle is generated by a complex interaction of endogenous circadian and sleep homeostatic processes, as well as social and environmental factors
- In humans, daily variation in physiological sleep tendency reveals a biphasic circadian rhythm of wake and sleep propensity, with a midday increase in sleep tendency occurring at about 2-4pm, following by a decrease in sleep tendency and increase in alertness that lasts through the early to middle evening hours.

1. Overview of Circadian Rhythm Disorders

- Considerable differences between individuals in the secretion of melatonin, results in very different sleep/wake times.
- The closer melatonin release gets to sleep time, the more difficult it is to get to sleep.
- Becomes a sleep disorder when it alters your day to day functioning
- Disorders arise when there is either disruption of this internal timing mechanism or a misalignment between the timing of the circadian clock and the 24-hour social and physical environments
- Fall into 3 categories: (1) the terrestrial LD cycle may change relative to circadian timekeeping (shift work and jet lag), (2) circadian timekeeping may change relative to the terrestrial LD cycle (delayed-sleep-wake phase disorder), or (3) dysfunction in clock mechanisms (irregular sleep-wake rhythm).

Conceptual model of sleep-wake regulation

- Drive to sleep which is directly influenced by sleep/wake behavior
- Arousal drive



- Homeostatic sleep pressure and phase angle changes in adolescents. Younger adolescents are able to stay awake for ~1h after DLMO.
- Circadian rhythm sleep-wake disorders (CRSWD) is often under-recognised and should be considered in the differential diagnosis of any patient presenting with symptoms of insomnia or hypersomnia

Delayed Sleep Wake Phase Disorder

- Chronic alteration the circadian system, resulting in the inability of the circadian pacemaker to achieve a conventional phase relation with the external world
- Phenotypes are diagnosed based on the timing of sleep episodes.
- Isn't a problem with maintaining sleep.
- Advanced sleep phase disorder: much earlier than the desired sleep time but wake much earlier than normal