Sleep and Dreaming

Why We Sleep (Theories of Sleep)

- Repair and Restoration Theories
  - We sleep to give the body a chance to repair itself, remove toxins, and restore depleted chemicals.
  - We sleep to restore brain neurotransmitters, reorganize memory, and synthesize proteins.

- Evolutionary Theories
  - We sleep to conserve stores of energy and nutrients.
  - We sleep to reduce exposure to danger.

Evaluation of Sleep Theories

- Assessment:
  - Bodily restoration – the body could recover without sleep, just by resting.
  - Brain restoration – the brain is just as active during sleep as during waking.
  - Conservation – consistent with examples of hibernation, but still speculation.
  - Security – makes sense but remains to be demonstrated.

- Conclusion: We really don’t know for sure why we seem to need to sleep. Perhaps each of these views has some merit.
Main Types of Sleep

- Sleep comes in two main types:
  - Slow-wave sleep
    - Relatively slow, regular brain waves
    - Shallow, regular breathing
    - Slow wandering or no movement of eyes under closed lids
  - Rapid-eye-movement (REM) sleep
    - Also known as “paradoxical” sleep
    - Brain waves resemble those of an awake person
    - Rapid darting of the eyes under closed lids
    - Paralysis of the large, antigravity muscles
    - Deeper, more irregular breathing

Stages of Sleep and Brain Waves

- Awake
  - Low-amplitude, fast, irregular waves
- Slow-wave stage 1
  - Moderately low-amplitude, somewhat slower, more regular
- Slow-wave stage 2
  - Moderate amplitude, slower, fairly regular, punctuated by occasional “sleep spindles”
- Slow-wave stage 3
  - Large amplitude, slow, regular waves, occasional delta waves
- Slow-wave stage 4
  - Delta waves – large amplitude, very slow, regular waves
- REM stage
  - Return to low-amplitude, fast, irregular waves like those of waking

Example Electro-Encephalogram (EEG) Waveforms
Sleep Stages During a Typical Night

- Slow-wave and REM phases alternate, with REM occurring about every 90 minutes.
- Sleep gets shallower and REM periods lengthen as night progresses.

Is There a Need for Sleep?

- Lab rats deprived of sleep for long periods lose their ability to thermoregulate, die of hypothermia.
- Some human beings appear to require little sleep, others a great deal (7-8 hours is average).
- Prolonged sleep deprivation brings on hallucinations (waking dream-intrusions), inability to stay awake (microsleeps).
- Probably is a need, but unclear as yet what problem or problems sleep corrects.

REM Sleep

- Infants spend a high proportion of sleep in the REM stage. Proportion declines steadily with age.
- Selectively depriving an individual of REM sleep has two known consequences:
  - The person tends to get cranky.
  - REM rebound - when given the opportunity for a normal night's sleep, the person tends to "make up" for lost REM by doing more of it. Rebound does not occur for selective loss of slow-wave sleep.
Are Eye Movements During REM Related to Dream Content? Apparently Not.

- Dreams are not uniquely associated with REM sleep, yet rapid eye movements do not occur in other sleep stages.
- Newborn infants and people born blind have REM-associated eye movements.
- Rapid eye movements during REM sleep appear to be initiated by neurons in the pons.
- One theory – REMs may occur in order to keep the eyes wetted with tears.

Mechanisms of Sleep

Sleep is an active process. Certain brain mechanisms initiate rhythms that then begin to being about “cortical synchrony,” in which large groups of cortical neurons begin to fire more or less together. This is what causes the EEG waves to become slower, more regular, and of higher amplitude.

Special mechanisms in the pons switch on to produce REM sleep with its associated rapid eye movements, fast, low-voltage brain waves, and REM paralysis.

Some Disorders of Sleep

- Insomnia
- Narcolepsy
- Sleep Apnea
- REM Behavior Disorder
- Periodic Limb Movement Disorder
Insomnia

- Difficulty falling asleep or staying asleep
- Large number of causes:
  - Disrupted sleep rhythm (jet lag)
  - Excessive external stimulation (noise, too hot, etc)
  - Internal stimulation (pain, anxiety)
  - Irregular sleep habits
  - Certain disease processes
  - Aftereffects of sleeping medications
  - Etc.

Narcolepsy

- Characterized by
  - Sleep attacks during the day; extreme sleepiness
  - Cataplexy – attacks of muscle weakness
  - Sleep paralysis when falling asleep, awakening
  - Hypnagogic hallucinations
- Symptoms result from intrusions of REM processes into waking life.
- Caused by miswiring of a brainstem neurons orchestrating REM

Sleep Apnea

- Symptoms
  - Breathing stops for relatively long periods during sleep
  - Failure to get rested
  - Headaches and other problems due to oxygen starvation
- Causes
  - Airway collapse, especially in overweight people; usually associated with snoring
  - Immaturity of automatic breathing mechanism (infants); May be a cause of sudden infant death syndrome (SIDS)
REM Behavior Disorder

- Vigorous movement during REM periods
- Persons appear to be acting out their dreams
- Caused by damage to REM mechanism that normally induces REM paralysis.
- Symptoms have been duplicated experimentally in cats.

Periodic Limb Movement Disorder

- Repeated, involuntary movement of legs and sometimes of arms
- If frequent or prolonged, may cause awakening, leading to poor sleep
- Not the same as REM behavior disorder

Why Do We Dream?

- Several proposals:
  - Freud: To express forbidden impulses, ideas. Dreams allow these to appear in symbolic form.
  - Organize memories: In this view, dreams are bits of memory being activated and reorganized for more efficient retrieval. Brain weaves them into a more-or-less coherent story.
  - Activation-synthesis hypothesis: Spontaneous brain activity or external stimuli activate parts of brain; the brain then attempts to make sense of the resulting perceptions.
- Bottom line: We don’t know.