Sleep
Thur. October 6, 2016

I. How to Study and Measure Sleep
• Sleep is the absence of aver behavior & absence of consciousness.
• Measures are indirded
• Methods to measure:
  ➢ Electromyogram (EMG): muscle activity (face); legs
  ➢ Electroencephalogram (EEG): brain activity
    • Sleep has different stages depending on EEG waveforms
  ➢ Electrooculogram (EOG): eye movement
  ➢ Air flow measures: breathing
  ➢ Heart rate

II. Stages of Sleep
1. Drowsiness; heavy eyes; lasts 10 min; theta (θ) waves
2. Disconnected from the world; sensory disconnection; sleep spindles & K complexes; lasts about 15min
3 & 4. Loss of consciousness; delta (Δ) waves; lasts 60 min; aka Slow Wave Sleep
REM. Dreaming; loss of muscle; rapid eye movements; active in sexual organs; θ & β waves; desynchronized; lasts about 25 min.

III. EEG and Single Neurons
• Neurons undergo up and down states during Slow Wave Sleep (SWS); periods of activity and silence
  ➢ Down state: neurons are at rest; no action potential
  ➢ Up state: neurons are firing; memory consolidation

IV. Sleep has Cycles
• Sleep/wake cycle is not the same as day/night cycle
• Free running wake/ sleep cycles ~ 25 hrs.
• REM/ non-REM cycles every 90 min.; controlled by internal clocks
• REM has a refractory period about 1 hr.
  ➢ Increase of metabolic activity in CNS (neurons are active)
  ➢ Decrease in activity in PNS
  ➢ Sexual organs activity; dynamic dreams

V. Why do we Sleep
• **Two Theories:**
  ➢ **Sleep as a behavior (adaptive responses)**
    - Only mammals and birds have REM
    - Sleep is a protective behavior: it is dangerous to move at night
  ➢ **Sleep as a restorative process**
    - Resting of brain (not related to body activity)
    - Evidence:
      - Cortex: Metabolic activity & blood flow decreases by 25% (during SWS)
      - Highest activity when awake
      - Highest delta waves and lowest activity during SWS

VI. **Sleep Duration in Humans**
• Sleep needs vary (4-10 hrs.)
• Sleeps starts in utero
• Needs vary along life span; need less and less as we age

VII. **Slow Wave Sleep (SWS)**
• **Deprivation studies:**
  ✓ No significant physical consequences
  ✓ Loss of weight & death (rats)
  ✓ Not a proportional functional of recuperation
• SWS need is not related to physical exercise
• Brain metabolic activities decrease by 25%
  ➢ Δ waves occurs in the regions that were the most active in the wake state
• Related to mental state and “declarative memory” consolidation
  **E.g. Nap after learning**
• Related to body temperature:
  ➢ E.g. Aspirin/Ibuprofen low temperature -> prevents SWS
  ➢ Cytokines (immune response) high temperature -> increases SWS

VIII. **REM Sleep**
• **Deprivation studies:**
  ➢ Significant consequence of cognitive performance
  ➢ REM sleep shows rebound phenomenon after deprivation
  ➢ Brain metabolic activity increases
    **E.g. Infants REM=70% of sleep, development role?**
    **Adults REM=15% sleep, learning and memory consolidation? Forgetting**
  ➢ Dynamic dreams

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IX. Sleep Disorders

• Insomnia
  ➢ Sleep needs are variable (4-8 hrs) depending on genetic and environmental factors
  ➢ E.g. health, daily activity, mood
  ➢ Problem falling asleep
  ➢ Due to stress, psychological factors/drug rebounds
  ➢ Quantity of sleep v. quality of sleep (sleep apnea)

• REM Sleep Disorders
  ➢ Sleep attack
    ▪ Low arousal; few minutes sleep
  ➢ Cataplexy
    ▪ High arousal; no loss of consciousness (awake)
  ➢ Sleep paralysis (awake atonia)
    ▪ Just before or after sleep
  ➢ Hypnagogic hallucinations
    ▪ Awake; dreaming; usually nightmares
  ➢ REM sleep behavior disorder
    ▪ Acting out dreams
  ➢ Narcolepsy has genetic and hormonal (arexin) bases

• SWS Sleep Disorders
  ➢ Sleep walking
    ▪ Eyes open; no arms stretched; state of half-consciousness
    ▪ Usually no walking; usually stand or sit on the side of the bed
    ▪ Sleep related eating disorder: not fully aware that they’re eating
  ➢ Sleep talking
    ▪ Hypnosis; truth serum
  ➢ Night terror
    ▪ Fear of losing consciousness; no memory for the event
  ➢ Fatal familial insomnia
    ▪ Damage to the thalamus
    ▪ Insomnia, paranoia, hallucinations, dementia, death
    ▪ Related to “mad raw” diseases
    ▪ No cure; genetic
  ➢ Bed wetting
    ▪ Primarily in children
    ▪ Partly genetic and environmental