*KRCP Lecture 10*

*Consciousness*

**Anatomy of Consciousness**

* **Core Consciousness**: **Brainstem** and **Thalamus**, **Reticular Activating System** (RAS: reticular activating system: modulates arousal and attention through direct connections to the cortex)

(MRF: Medial reticular formation: suppressing action)

* **Extended Consciousness**: **Cerebral Cortex:** sense of self; memories, expectations

**Clinical Perspective**

* **Impairments**:
  + **Somnolence**: abnormal sleepiness, but acoustically arousable
  + **Sopor**: no spontaneous movements, reaction to pain stimuli adequate
  + **Coma**: no reaction to visual, acoustic or pain stimuli, EEG
  + **Brain death**: no EEG, dies if no life support
  + **Vegetative state**: transient or persistent, no voluntary behavior, unconscious, reflexive response, unresponsive to stimuli except pain, abnormal sleep-wake cycles, possibly open eyes, “normal” behavior.
  + **Locked-in-Syndrome**: patient is fully conscious, but cannot move or express himself, can use EEG or real-time fMRI to communicate
* **Terri Schiavo Case**: persistent vegetative state, without prospect of recovery, husband and parent fought whether her life support should be stopped, husband: no prospect if recovery, parents: some signs of consciousness (probably vegetative reflexes), died after 15 years

**Sleep**

* **Stages**:
  + **1**: light sleep, awoken easily **Theta** waves. Hallucinations + falling feeling
  + **2**: more **theta**, **sleep spindle** (high frequency, low amplitude) (burst of oscillatory brain activity generated in thalamus), **K-complexes** (high amplitude, stand out from the rest of the EEG) (suppressing cortical arousal in response to stimuli that the sleeping brain evaluates not to signal danger, aiding sleep-based memory consolidation, keep you asleep)
  + **3&4**: deep sleep, slow brain waves. High amplitude **Delta** waves. Somnanbulism
  + **REM** (Rapid Eye Movement)/**paradoxical sleep**: Increased activity in pons/reticular formation, temporal and parietal cortex, dreaming, cleaning up memory? (**Echidna** does not have REM sleep) Resembles waking activity. Muscles immobilized (MRF)
* **Eye movements and EEG** are recorded during sleep to differentiate between the stages
* **Sleep cycles through the stages**: starts with 1, then 2, then usually 3,4&2 mix up before going to REM sleep (20-25% of sleep), the usually change between 2,3 and REM. 4-5 times each – 90 min/cycle
* **Functions** of sleep: energy saving, brain restoration, memory: strengthen and weaken connections

Appeceptive agnosia: shapes: spatial grouping

Achromatopsia: colors: feature integration

Prosopagnosia: faces: part binding

Sementic dematia: semantic conceptual binding

Simultagnosia: (Balint’s syndrome): location binding

Akinetopsia: motion: serial binding

**Binding Problem**

* Refers to the process used by the brain to combine (or “bind”) the results of many sensory operations into a single percept
* Clinical neuropsychological evidence for the binding problem
* **Feature integration theory** (Treisman): object perception differs from object recognition and features are “registered early, automatically and in parallel, while object are identified separately”
* **Binding by neuronal synchronization**: binding is achieved in temporal dimension, Synchronous oscillation of neurons

**Free Will**

* **Readiness potential** (RP): Combination of EEG and MEG, 1 second before muscle activity (Kornhuber)
* **Libet**:
  + Experiment: measure time of decision making and compare with RP; move your finger when you want and remember position of clock 🡪 Determine relationship RP and subjective experience of free will
  + **RP** -550ms; **Will to move** -200ms; **EMG** (Muscle Activity) 0; **WS** (Correct will to move) -150ms
  + Brain initiates movement **350-400 ms before** you take the **decision**!
  + We **don’t have free will, we have free won’t**
* **Soon’s fMRI experiment**:
  + Stream of letters, choose when to stop it. **Correct prediction 7s before** decision made. **Correct for BOLD: 10s before!**
* **Qualia**:
  + **Chalmers**: easy problem and hard problem
  + **Nagel**: what is it like to be a bat?
  + **Inverted Spectrum problem**: maybe other people see white like we see black
  + **Mary the color scientist**: lived in a black and white world but know all about color, does she learn something new when experiencing color for the first time?