Week 2

Terry Sejnowski – A Critique of Pure Vision

- Upon review of literature it was realized that the current view of vision did not agree with the facts

- **Levels of investigation**
  - CNS > Systems > Maps > Networks > Neurons > Synapses > Molecules
  - In vision system, an image of the visual world is preserved on the retina, then on the cortex
    - **Signal Neurons**: fire for small patch of visual world (receptive field)
      - Receptive fields
        - Circular
        - in foveal region cells receive info from < 1 degree of visual field
      - Fovea moves according to area of fixation

- Hubel and Wiesel:
  - Recorded in V1 w/ individual neurons
  - Plotted receptive region
  - Cells have preferred orientation
  - Range of receptive field in cortex elongated
  - Firing rate of neurons dependent on orientation, color, motion, and depth
    - Cells are feature detectors

- In visual cortex information flow hierarchically
- **Grandmother Cell Theory**

- Early Goal of Vision Research
  - Create internal model of entire visual world and its properties – to accomplish any visual task

- Problems:
  - **Change Blindness**: people can miss obvious changes to field of vision
  - **Active Visions**
    - eyes saccade approx. every 100 ms
    - spend more time on hair, lips
  - **Top-down Processing**:
    - Eye movements vary based on information sought by viewer
    - Attention modulates firing for given stimulus
    - Visual spike also depends on expected reward
o **Temporal Difference Learning**

Seana Coulson – Lateralization of Function

- **Brain Anatomy**
  - Brain seen as extension of spinal chord
  - **Corpus Collosum**: connects left and right hemisphere
  - **Cerebellum**: coordinating muscle movements and sense
  - **Brain Stem**: regulates basic fn’s (heart rate, breathing, digestion)

- **Cerebral Cortex**
  - Two millimeters thick, area of 1.5 square meters
  - Can be separated into **frontal lobe**, **parietal lobe**, **temporal lobe**, and **occipital lobe**
    - **Central sulcus** and **silvian sulcus** divides parts of cortex
  - Frontal lobe (in front of central sulcus)
    - Important in decision making/judgement
  - Parietal lobe (behind central sulcus, above parietal lobe)
    - Touch, pressure temperature and pain
  - Temporal lobe (above auditor fissure)
    - Perception, Recognition, Auditory processing
  - Occipital Lobe (rear of brain)
    - Vision

- **Lateralization of Function**: one side of brain more crucial for given function/computational task (motor cortex, somatosensory cortex, language areas, etc.)
  - **Strong**: if one side of brain is damaged, very strong deficit results
  - **Weak**: if one side of brain is damaged, some initial deficit, but opposite side is able to compensate

- **Somatosensory** map
  - Area of the brain that responds to specific area of body sensation
  - Not proportional – huge amount of space use for mouth, lips, and hands

- **Language**:
  - **Wada test**: used to lateralize language
    - Most have left hemisphere dominant speech
    - Left-handed more likely to have bilateral speech areas or right hemisphere dominant
  - Brain damage studies responsible for most of localization of brain area functions
    - **Aphasia**: partial or total loss of ability to articulate ideas due to brain damage
  - Paul Broca’s patient “Tan”
• Unable to produce speech
• Examined brain and found damage on lower rear portion of frontal lobe, lower front portion of parietal lobe, and upper temporal lobe
• Frontal lobe damage most important (Broca’s Area: inferior frontal gyrus, Brodmann area44/45)
  • Brodmann characterized different brain areas using chemical stains to reveal differences in cells
  o **Wernicke’s Aphasia**
    • Deficit in comprehension of language
      • Talk excessively
      • Made-up words
      • Don’t understand
      • Wernicke’s area located in Posterior regions of left hemisphere
  o Sex differences in vulnerability to Broca’s vs. Wernicke’s Aphasia
    • Male: more vulnerable rearward damage(Wernicke’s)
    • Female: more vulnerable to frontal damage (Broca’s)

• **Wernicke-Geschwind Model**
  o Broca’s area stores motor representations of speech
  o Wernicke’s area stores auditory representation of speech sounds
  o Connected by arcuate fasiculus
  o Oversimplified

• Electrostimulus used to located naming area of brain; bilingual language representation – some points represent both languages, some points just one language or the other

• **Right Hemisphere Damage**
  o Possibly aspects of personality
  o Paralysis
    • Common with Anosagnosia – denial of problems experienced
    • Abnormal Body Image
  o Hemineglect: inability to attend to objects on one side of space (on left side if stroke is on right)
    • Usually hemineglect does not occur with left side stroke because right hemisphere contains representation from both sides of visual field
  o Dressing Apraxia
• **Language Effects on Signers**
  - LH damage results in aphasia in signers, while RH damage leads to visuo-spatial deficits but largely intact language