Lecture 1

Tuesday, September 15, 2015 10:02 AM

Overview of Cognitive Neuroscience

- Relation between brain and nervous system (CNS).
- Memory, reasoning all deal with information processing.
- Identify commonalties and categories.
- Computational neuroscience.
- George Miller and Michael Gazzaniga (1970s)

Course Outline

- Cognitive Neuroscience (3rd ed.): Wadsworth
- Midterm 1: Oct 20 (25%)
- Midterm 2: Dec 1 (25%) -not cumulative but builds on previous lectures
- Paper Topic: Nov 17 (10%)
- Paper: Dec 4 (35%) Debate paper or research proposal- 2000 words
- Participation (5%)

Neurophysiology

Brain cells: glia and neurons.

Neurons

- Neurons located throughout the body: sensory, interneuron and motor neurons.
- Soma (cell body) sustain cell life and involved in synthesis of neurotransmitters.
- Dendrites receive signals and are postsynaptic. Different shapes due to type of information being processed.
- Axon carries electrochemical signals and are the white matter of the cell. Two types of myelin sheath (glia): Oligodendrocytes (CNS) and schwann cells (PNS), it insulates the axon for faster conduction. Nodes of Ranvier are the spaces between myelin sheath where the action potential is regenerated.
- Synaptic Terminals are where signals are delivered (presynaptic). Terminal button releases neurotransmitters. The cleft is the space between pre and post synaptic neurons.

Glia

- CNS: astrocytes, oligodendrocytes and microglial cells.

- Support cells
- PNS: Schwann cells
- Astrocytes provide a blood brain barrier and protects the CNS. Involved in Parkinson's disease, DA cannot cross BBB so use L-Dopa.
- Oligodendocytes and Schwann cells form myelin (white matter) around axon. Schwann only myelinate one cell but oligo. meylinates several cells. Involved in MS and dementia.
- Microglia aids in repair and removal of damaged tissue and has an irregular shape.

Neuron signals

- Action potential generated from voltage difference (40mv)
- Resting potential the voltage is -70mv.
- Difference in particles inside and outside cell. Na+ outside K inside.
- Na-K pumps uses ATP to keep different balance- pumps 2K inside cell and 3Na outside. (Inside cell is more negative and outside).
- Channels only open and close.

Action Potential

1. Resting potential at -70mv, then signal is received to threshold (-55mv).
2. At threshold, NA channels open and Na rushes into cell and makes it more positive (40mv)-Action potenial reached.
3. Then K channels start to open and leave the cell and NA channels close.
4. As K leaves the cell, inside gets negative and goes below -70mv- refractory period (hyperpolarisation) so action potential can only travel one way.
5. K channels close and returns to resting potential.

- Action potential gets regenerated at nodes of ranvier.
- Self-propagating
- Constant strength (40mv)
- All or nothing firing
- Firing frequency determines strength of signal.

Synapse

- Neurotransmitters are either reuptake or deactivated by enzymes or degraded by glial cells. Also bind to auto receptor or diffuse out.
- Need to remove neurotransmitter from cleft so cell doesn't keep firing. Some drugs elevate neurotransmitter density in cleft (cocaine blocks DA from being reuptake and keeps on firing).

Post synaptic Potentials

- Weak signals within post-synaptic neurons (.5-5mv). Strength is graded as it moves along the dendrite (since they are not myelinated) unlike action potential where it is constant.

- Can be excitatory (more likely to fire) release more positive ions (depolarisation) or inhibitory (less likely to fire) release more negative ions (hyperpolarise).
- Summation of PSP (action potentials add up at the axon hillock).