

Lecture 1 – Nerve Cells and Behavior – Kandel

A. Two key issues:

1. signaling properties of the individual neuron
2. how we move from understanding individual nerve cells to an appreciation of the highest human cognitive functions, e.g. comprehension and expression of language

B. Three interrelated questions concerning the signaling capabilities of the neuron:

1. What types of electrical signals do neurons generate?
2. What is the function of each of the electrical signals generated by the nervous system?
3. Where within the neuron is each of these signals generated?

C. Design of typical neuron:

1. Graded **input** transduction **function** in response to stimulation at input component of the neuron. In the monosynaptic knee jerk reflex, this would be generator (receptor) potential at ending of sensory neuron in muscle spindle and synaptic potential in cell body of motor neuron in spinal cord.
2. Additive **integrative function** at trigger zone (initial axon segment).
3. All-or-none long range **conductile function** via action potential that propagates along axon.
4. Graded transmitter **secretory or output function** at synapse.
5. Neurons with this similar basic design take on different functions because they are connected to each other and the periphery in differing ways.

Examination of 1) the mechanisms by which neurons produce their stereotyped actions, 2) the ways in which neurons are interconnected, 3) how different patterns of connections give rise to different forms of behavior and 4) how the patterns of interconnection are modified by experience, should tell us how the nervous system works.

D. Localization of Function Within Brain

1. Sensory and motor maps or representations within brain, e.g. electrical stimulation of adjacent areas of primary motor cortex in frontal lobe causes movement of adjacent body areas.
2. Neurons with similar properties come to assume different functions, in part, because they are assigned embryologically to different positions in relation to the various maps.
3. Studies of aphasia (disorders of language) provided early evidence for localization of function.
 - a. Broca's area
 - i. left frontal lobe near motor cortex
 - ii. lesion in this area undermines speech but not language comprehension (Broca's aphasia)
 - b. Wernicke's area
 - i. left hemisphere at border between parietal and temporal lobes
 - ii. lesion in this area undermines comprehension but not speech (Wernicke's aphasia)
 - c. arcuate fasciculus
 - i. fiber tract connecting Wernicke's and Broca's areas
 - ii. interruption of this tract results in disconnection between comprehension and resulting speech (conduction aphasia)
 - d. homologous areas in right hemisphere control affective components of language

Relevant reading: chapters 1, 2 and 3 in "Principles"