Cognitive Psychology

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Contents

Chapter 1

Cognitive Neuroscience

1.1 Chapter Summary

(1) Cognitive neuroscience is the study of the physiological basis of cognition.

(2) Ramon y Cajal's research resulted in the abandonment of the neural net theory in favor of the neuron doctrine, which states that individual cells called neurons transmit signals in the nervous system.

(3) Signals can be recorded from neurons using micro-electrodes. Adrian, who recorded the first signals from single neurons, determined that action potentials remain the same size as they travel down an axon and that increasing stimulus intensity increases the rate of nerve firing.

(4) The idea of localization of function in perception is supported by the existence of a separate primary receiving area for each sense, by the effects of brain damage on perception (for example, prospoganosia), and by the results of brain imaging experiments.

(5) Brain imaging measures brain activation by measuring blood flow in the brain. Functional magnetic resonance imaging (fMRI) is widely used to determine brain activation during cognitive functioning. One result of brain imaging experiments has been the identification of areas in the human brain that respond best to faces, places, and bodies.

(6) Research on brain-damaged patients by Broca and Wernicke provided evidence for localization of function for language. Based on the patients' symptoms, they identified two different conditions, Broca's aphasia and Wernicke's aphasia, as involving problems in language production and language understanding, respectively. These two conditions were associated with damage to different areas of the brain.

(7) Recent research has resulted in modification of the Broca/Wernicke model. Behavioral research has shown that patients with Broca's aphasia can, under certain conditions, have difficulty understanding language. Physiological research, involving both studying brain-damaged patients and recording the event-related potential, suggests two processes for language processing, one involving the form of language and the other involving meaning.

(8) The idea of distributed processing is that specific functions are processed by many different areas in the brain. This principle is illustrated by the finding that faces activate many areas of the brain and by the simpler example of the rolling red ball, which also activates a number of areas.

(9) Distributed processing also occurs for other cognitive functions, such as memory, decision making, and problem solving. A basic principle of cognition is that different cognitive functions often involve similar mechanisms.

(10) Objects and properties of the environment are represented by electrical signals in the nervous system.

(11) Research indicating that individual neurons in the visual system fire to specific simple stimuli, such as oriented bars, led to the idea of feature detectors. This research suggests that a particular object is represented by the firing of many neurons, creating a unique "chorus" of electrical signals for that object. The pattern of neural firing that represents an environmental stimulus is called the neural code.

(12) Among proposals regarding the nature of the neural code are specificity theory, which includes the idea of grandmother cells, and distributed coding. Current evidence favors the idea of distributed coding. Thus, a particular face would be represented by the pattern of firing across a number of neurons. This is similar to the idea of a neural chorus.

(13) The idea of a distributed neural code also applies to memory and other cognitive functions. The code for memory involves stored information.

(14) Computer programs have recently been developed that can, with a surprising degree of accuracy, use data from brain imaging, collected as a person is observing pictures of different objects, to identify from a group of objects the specific object that a person is seeing.