Cognitive Psychology

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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.

Chapter 2

Memory

2.1 How was the understanding of memory evolved?

2.1.1 Pioneer in Memory Research

- Hermann Ebbinghaus discovered that most information loss occurs relatively quickly. Afterwards, further forgetting occurs at a much slower rate.

2.1.2 Behaviorist Perspective

- Subsequently, psychology was dominated by the behaviorist perspective, which ignored the mind in their investigations, preferring instead to only study things that can be observed directly: Stimuli in the environment and the organism's behavioural response.
- Because behaviourists avoided studying the contents of the **Black Box**, topics like memory remained unexplored until the so called **Cognitive Revolution** in psychology.

2.1.3 Cognitive Perspecitive

- Cognitivists once again became interested in memory because they had a new metaphor for the mind. Instead of a mysterious black box, they likened the mind to an important new invention: A computer. To Cognitivists, the brain was like the hardware of a computer and the mind was like the software of a computer.
- The computer metaphor is particularly strong in modern approaches to memory, which is conceptualized to have three processes. Information must first be **Encoded** into memory. Then it must be **Stored** in memory, until finally it must be **Retrieved** from memory. Encoding enters information into memory; Storage maintains information

in memory; and Retrieval recalls information from memory in order to use it in some way that is useful to us.

- Although the metaphor for a computer has been useful for inspiring research, it does not perfectly describe how memory works. For instance, when you retrieve the file holding your class paper from your computer, you don't expect that it has changed at all since you last saved it. You would be surprised if passages were deleted, or had been changed in some way, or if new passages had suddenly been added. However, this is exactly the nature of memory.

2.2 How reliable is memory?

2.2.1 Errors in Memory

- Memories must be **Reconstructed** in your mind each time they are used.
- Memories can lose details, or change details in subtle ways, or even add details that never actually happened. These are called **Omissions**, **Substitutions**, and **Insertions** respectively.
- In fact, some memories can be entirely false, having never happened at all. This is called **Confabulation**. Confabulations can occur when you hear about someone else's experience and then you later mistake it as your own. This type of confabulation results from **Source Amnesia**. You recall the information, but forget where it came from, in this case, mistaking it as coming from you instead of someone else.
- Because memory is a reconstructive process, it necessarily accumulates errors over time.
- We tend to be over confident regarding the accuracy of our memories and oblivious to all the changes that are introduced over time.
- Our least accurate memories are those that we think about the most. Because memories must be reconstructed each time you use them, and errors are introduced each time a memory is reconstructed.

2.2.2 Eyewitness Testimony

- A **Leading Question** presupposes the truth about what kind of answer is likely to be correct. The problem with leading questions is that they influence memory reconstruction, introducing more errors.

2.3 The first process of memory: Encoding

- The first process of memory converts various types of information into neuronal impulses. This process is called **Encoding**.
- Encoding is **Passive** when no effort is invested in remembering the information, which is typically what happens when you are watching television, or reading a book. Because this is a very shallow form of encoding, some information can be remembered, but most will be lost or remembered inaccurately.
- Encoding is **Active** when effort is expended to process the information for later use. This is more reflective of what happens when you are taking notes, reflecting on information, or studying for an exam. These forms of encoding lead to superior memory performance later on because they require deeper levels of processing.
- Some forms of active encoding can lead to deeper processing (and better memory) than others.
  - **Structural** encoding questions asked participants something about the physical structure of a word.
  - **Phonemic** encoding questions asked participants something about what the word sounds like.
  - **Semantic** encoding questions asked participants something about the meaning of the word.
- **Elaboration** is a form of semantic encoding that aids the recall of new information by connecting it to existing information. For example, using a metaphor to draw parallels between new concepts and existing concepts.
- **Self Referent Encoding** is a form of semantic encoding that aids the recall of new information by connecting it to oneself. Information that is connected to us is easier to remember. For example can you think of somebody famous born on your birthday?
- **Dual Encoding** is a form of semantic encoding that aids recall of information by producing redundant (more than one) codes. For instance, if you were tasked to remember the word "Frog", you might create a mental image of Kermit the Frog. Now you would have two codes for the same information, a word and a mental image. Either one (or both) can lead you back to the information.

2.4 The second process of memory: Storage

Research in psychology has identified three different memory stores: Sensory memory, Short-term memory, and Long-term memory.

2.4.1 Sensory Memory

- As the sensory organs collect information, it is held briefly in a sensory register. Collectively, these registers make up **Sensory Memory**.