CHAPTER 1
The Study of Memory

Chapter Overview

Chapter 1 introduces students to different types of memory and describes historical events related to the study of memory. In addition, Chapter 1 provides a review of basic neuroscience concepts that are related to topics will be discussed later in the book.

Memory is the record of information, whereas **learning** is the process of acquiring that information. In this text, we distinguish between **short-term memory** and **long-term memory**, **implicit memory**, and **explicit memory**, and within explicit memory, **generic memory** and **autobiographical memory**. Many of the divisions of memory relate to differences in conscious experience during recall.

Plato and Aristotle both presented views on memory in Ancient Greece. During the **Enlightenment**, **associationist** philosophers revived Aristotle's ideas but it would take Darwin's theory of evolution and Fechner's work in psychophysics before Ebbinghaus would test Aristotle's associationist views empirically (and confirm them). Ebbinghaus would go on to publish the first scientific theories of memory—including the **learning curve**, the **forgetting curve**, and the concept of **savings**—in the late-nineteenth century.

In the **behaviourist era** of the 1920s through the 1950s, memory research and theories related to observable aspects of memory only, and revolved around predicting memory behaviour. Early events in the history of the study of the neuroscience of memory include Lashley's refuting Semon's concept of **engrams**, the publication of Donald Hebb's a two-stage model of memory formation in 1949, the publication of Penfield's homunculus in 1952, and the case of Henry Molaison in the mid-1950s.

During and after the **cognitive revolution** of the 1960s, researchers began using rigorous experimental methods developed by the behaviourists to study internal cognitive events. The 1970s introduced the modal model of memory, the notion of multiple memory systems, the episodic/semantic memory distinction, and the explicit/implicit memory distinction. Applied memory research began to appear in the 1970s and has become increasingly popular in recent years.

There are currently three approaches to studying memory today. Proponents of the **systems approach** to memory argue that we have many different memory systems each specialized for a different task. Proponents of the **processing approach** argue that differences in memory performance can often be explained by differences in the depth of processing during encoding. Finally, proponents of the **principles approach** argue that the best way to understand memory is to consider seven principles of memory that have emerged from memory research. All three of these approaches have advantages, and each perspective is reflected in the text in its own way.

Before proceeding with the neuroscience discussions within the text, students need to understand the **neuron**, **synapses**, **the action potential**, **neurotransmitters**, **long-term potentiation**, and the role that different lobes of the brain and the cortex play in memory.

Learning Objectives

After reading this chapter, students should be able to:

- Compare and contrast different definitions of the term *memory*.
- Explain how Plato, Aristotle, and the associationist philosophers viewed memory
- Describe how Darwin's theory of evolution influenced the study of memory
- Describe Ebbinghaus's method for studying memory
- Explain how the cognitive revolution influenced the study of memory
- Compare and contrast the systems view, the processing view, and the principles view of memory

Key Concepts/Terms

action potential: the brief reversal of polarity in a neuron that occurs when a neuron is stimulated

associationist: a philosopher who believes that ideas are brought to consciousness through associations with other ideas

behaviourist era: a time in the history of psychology when the majority of research focused on the observable effects of experience on behaviour

cognitive revolution: the period in the early 1960s during which psychologists began to use the experimental methods developed by the behaviourists to develop theories about cognitive functioning

engram: a specific location in the brain holding the trace of a specific memory

Enlightenment, The: an era from the 1650s to the 1780s in which cultural and intellectual forces in western Europe emphasized reason, analysis, and individualism rather than traditional lines of authority

forgetting curve: a negatively accelerated function over time predicting that most forgetting occurs soon after learning, and that as time goes on less and less additional forgetting occurs

learning curve: a negatively accelerating function in which additional practice is very helpful in the early stages of learning but has less benefit over time

learning: a behaviour that facilitates the acquisition of new information

long-term potentiation (LTP): a persistent strengthening of a synapse based on recent patterns of activity

memory: a record of learning

processing approach: an approach to memory that presumes that memory traces vary based on how the to-be-remembered information has been processed

principles approach: an approach to memory that looks to commonalities in memory research across different experimental settings

rationalist: a person who believes that using reason, rather than experience, authority, or spiritual revelation, provides the primary basis for knowledge

synapse: the location where a nervous impulse passes from one neuron to another neuron

Discussion Ideas

1. **What are some ways that memory helps with your survival?**

   Encourage students to discuss the different roles that memory plays in our day-to-day lives, and our survival. Touch on short-term memory, long-term memory, implicit memory, and explicit memory. Note that each type of memory assists with a different aspect of life. Short-term memory helps with immediate issues, and long-term memory allows for learning. Implicit memory is central to memory for actions while explicit memory is central to conscious recall.

2. **What questions do you have about your own memory?**

   Brainstorm questions students have about their own memory such as "Do we ever forget traumatic events?" or "How can I better remember people's names?" and record the questions, noting those that will be answered in the course. As the course progresses, bring up the question again and have the class attempt to answer it based on recent readings.

3. **What do you think the future of memory research holds and why?**

   Have students generate ideas about the future of memory research based on their reading of Chapter 1. Two key themes from the chapter are that memory research is becoming more applied in nature and that memory research will probably begin to focus more on neuroscience.

4. **Class Activity: Ebbinghaus's Forgetting Curve**

   The objective of this activity is to have students replicate the forgetting curve first developed by Ebbinghaus in the 1880s. For this activity, you will need to generate 20 random syllables such as DAK, TEB, MIP, KUW, BOR, etc. which will be presented on a PowerPoint slide. You will need to record individuals' recall scores multiple times throughout the course.

   Without explaining that you are studying the forgetting curve, have students study the syllable list for two minutes. Do not allow students to write down the syllables. Immediately after the study period, have students recall as many syllables as possible for two minutes. After the recall period, have students compute their immediate recall score and submit it as the first of several recall data points that you will enter in a chart. In the next class, take another recall test and compute the short-delay recall score. About one week later, take a recall test and repeat again after one month. Compile the data, exclude outliers, and compute the average and plot into a line graph with proportion correct on the *y*-axis and delay (to scale) on the *x*-axis. The data should mirror the forgetting curve, with a steep decline in recall at one day and a gradual decline (if any decline) after that point.

   Discuss the extent to which the data maps onto a typical forgetting curve. Also discuss what the forgetting curve suggests about how you should study by directing students to the following website: https://examstudyexpert.com/ebbinghaus-forgetting-curve/

Homework Assignments and Review Questions

1. **A researcher presented participants with random words and personally relevant words (such as a participant's birth month, school, etc.) and found that participants were significantly better at recalling personally relevant words. Review the description of the three different theoretical approaches to studying memory in Chapter 1 and explain this finding from a systems view, a levels-of-processing view, and a principles view.**

   Correct answers include the following points:
   - Systems: Personal relevance improves rehearsal which improves LTM
   - Levels: Participants process personally relevant material at a deeper level which improves LTM.
   - Principles: There are more cues associated with personally relevant material (cue-driven principle)

2. **Compare and contrast noetic consciousness, autonoetic consciousness, and anoetic consciousness and discuss how these concepts relate to memory**

   Correct answers include the following points:
   - anoetic consciousness: a state of mind associated with pure perception and emotion without cognitive content
   - autonoetic consciousness: the ability for one to imagine oneself in past, future, or counterfactual situations
   - noetic consciousness: a state of mind associated with knowledge and intellect

   Tulving (1989) argues that different types of memory are associated with different types of conscious states. Implicit memory is associated with noetic consciousness, semantic memory is associated with anoetic consciousness and episodic/autobiographical memory is associated with autonoetic consciousness.

3. **Connect research discussed in Chapter 1 to at least four of the seven principles of memory.**

   Answers will vary.

List of Teaching Aids

Web links:

- Using Ebbinghaus' Forgetting Curve to Study More Effectively
  https://examstudyexpert.com/ebbinghaus-forgetting-curve/
- Wikiversity Fundamentals of Neuroscience
  https://en.wikiversity.org/wiki/Fundamentals_of_Neuroscience
- Heritage Minutes: Wilder Penfield (Youtube)
  https://www.youtube.com/watch?v=pUOG2g4hj8s

Further readings:

- Collins, A. M., & Quillian, M. R. (1969). Retrieval time from semantic memory. *Journal of verbal learning and verbal behavior*, *8*(2), 240–247.
- Cowan, N. (2001). The magical number 4 in short-term memory: A reconsideration of mental storage capacity. Behavioral and brain sciences, 24(1), 87–114.
- Craik, F. I., & Lockhart, R. S. (1972). Levels of processing: A framework for memory research. *Journal of verbal learning and verbal behavior*, *11*(6), 671–684.
- Ebbinghaus, H. (2013). Memory: A contribution to experimental psychology. Annals of neurosciences, 20(4), 155.
- Murre, J. M., & Dros, J. (2015). Replication and analysis of Ebbinghaus' forgetting curve. PloS one, 10(7), e0120644.
- Tulving, E. (1987). Multiple memory systems and consciousness. Human neurobiology, 6(2), 67–80.
- Thorndike, E. L. (1908). Memory for paired associates. *Psychological Review*, *15*(2), 122.
- Wechsler, D. (1945). A standardized memory scale for clinical use. *The Journal of Psychology*, *19*(1), 87–95.