Chapter 1

The Study of Memory

**Multiple Choice Questions**

1. In your textbook, “memory” is defined as \_\_\_\_\_\_\_\_.
   1. the use of past experiences to guide behaviour
   2. a body of knowledge
   3. the ensemble of neural connections modified and/or created by an experience
   4. a combination of actionable past experiences, bodies of knowledge, abilities and neural changes, as suitable to the specific context of discussion
2. The difference between “memory” and “learning” is \_\_\_\_\_\_\_\_.
   1. learning is long-term while memory is short-term
   2. learning is the acquisition of new information while memory is the existing record of the same
   3. learning is only explicit while memory can be implicit or explicit
   4. learning is the modifiable while memory is fixed
3. Short-term memory \_\_\_\_\_\_\_\_.
   1. is not available to consciousness
   2. has a limited capacity
   3. cannot hold the meaning of a word or sentence
   4. can only hold representations of visual information
4. Implicit memory \_\_\_\_\_\_\_\_.
   1. evolved first
   2. requires the intervention of an active consciousness
   3. has no survival value
   4. is not observed in mammals
5. The following statement is *not* true if referred to explicit memory: \_\_\_\_\_\_\_\_.
   1. It is a form of memory requiring consciousness
   2. It requires dedicated neural circuits
   3. It simply takes information from the senses and matches this information to previously stored records
   4. It can be communicated more flexibly to other individuals
6. Plato believed that \_\_\_\_\_\_\_\_.
   1. memory can be described by a “wax tablet,” on which words can be carved
   2. observation is more important than reasoning
   3. knowledge can only derive from observation
   4. memory is formed when items are closely linked in space or time
7. The most important contribution of Aristotle to the study of memory was \_\_\_\_\_\_\_\_.
   1. the idea that knowledge is innate
   2. the idea that reasoning is more important than observation
   3. the discovery of optical illusions
   4. the discovery of associations
8. Aristotle was the first to introduce \_\_\_\_\_\_\_\_.
   1. the distinction between implicit and explicit memories
   2. the distinction between semantic and episodic memories
   3. both the distinction between implicit/explicit and that between semantic/episodic memories
   4. the method of loci
9. The philosophers Hobbes, Locke, and Hume are important because \_\_\_\_\_\_\_\_.
   1. they revived and developed the idea that associations are important for memory
   2. they started experimental psychology as an independent discipline
   3. they introduced the distinction between body and mind
   4. they popularized Greek philosophy in the English-speaking world
10. The work of Charles Darwin had a revolutionary impact on society because \_\_\_\_\_\_\_\_.
    1. it considered humans with a fundamental identity and in continuity with other animals
    2. it described fundamental experiments on memory
    3. it demonstrated that also animals possess memory
    4. it was not accepted by the religious authorities
11. Fechner’s work in psychophysics is relevant to memory studies because \_\_\_\_\_\_\_\_.
    1. it established that empirical methods could be used to derive theories that predicted human experience
    2. it showed a method to measure the amount of memories stored
    3. it indicated that also animals learn to plan actions ahead of time
    4. it described the first example of classical conditioning
12. The work of Ebbinghaus is still relevant to memory studies because \_\_\_\_\_\_\_\_.
    1. he used extensively and successfully animals as study subjects
    2. he proposed a relationship between sleep and learning
    3. he invented nonsense syllables as tools for memory work
    4. he invented nonsense syllables and control groups, and separated from treated groups, as research tools
13. The central dogma of the behaviourist approach was that only \_\_\_\_\_\_\_\_.
    1. observable events could be studied
    2. humans could be used for memory research
    3. mathematical models could explain behaviour
    4. if engrams in neural substrates could be shown memory could be investigated
14. The difference between physical and cognitive skills is \_\_\_\_\_\_\_\_.
    1. cognitive skills require strategizing while physical skills involve movement
    2. cognitive skills do not use any movement, in contrast to physical skills
    3. physical skills are not learned, in contrast to cognitive skills
    4. cognitive skills are hereditary, in contrast to physical skills
15. The main contribution of the “Gestalt” psychology school to modern psychology is \_\_\_\_\_\_\_\_.
    1. the discovery of the difference between physical and cognitive skills
    2. the discovery of the phenomenon of “transfer”
    3. having stressed the importance of internal organization of materials in memory development
    4. the use of the “information theory” in memory studies
16. Francis Gall is famous because he\_\_\_\_\_\_\_\_.
    1. proposed that specific functions, including memory, are localized to specific areas of the brain
    2. discovered the brain areas of language
    3. identified the cortical visual areas
    4. proposed the engrams as neural traces of memory
17. The memory deficit induced by a lesion in Wernicke’s area is \_\_\_\_\_\_\_\_.
    1. the forgetting of the emotional context for an event
    2. the inability to understand the meaning of words
    3. a linguistic loss of grammar rules
    4. amnesia for second languages
18. The conclusion reached by Lashley regarding the brain location of “memory engrams” was \_\_\_\_\_\_\_\_.
    1. all parts of the brain contributed equally to the formation of memories
    2. engrams are too small to be identified surgically
    3. they are localized in the hippocampus
    4. they are localized in the frontal lobe
19. Donald Hebb envisioned the process of memory formation as \_\_\_\_\_\_\_\_.
    1. a rapid buildup of neural changes
    2. a two-step process, in which experiences first induce structural neural changes, followed by a permanent change in electrical activity
    3. a specific, localized alteration of brain chemistry
    4. a two-step process, in which experiences first induce a transient, reverberating electrical activity in the brain, followed by a consolidation period
20. Penfield’s homunculus is important because \_\_\_\_\_\_\_\_.
    1. it established beyond reasonable doubt that brain function can be precisely localized
    2. it is fixed, therefore it ruled out that memory can be localized
    3. it provides a vivid illustration for textbooks
    4. for the first time showed differences in functional organization between male and females brain
21. The case of H.M. revolutionized the study of memory because \_\_\_\_\_\_\_\_\_.
    1. it showed that amnesias can be reversible
    2. it guided future research on implicit memory systems
    3. it demonstrated that multiple independent memory systems are operating in the brain
    4. it indicated the location of the memory engrams
22. The main impact of the cognitive revolution on memory research was \_\_\_\_\_\_\_\_.
    1. it changed the nature of memory research from that which described overt behaviour to that which fostered the development of models of how information is coded
    2. it promoted the use of human subjects
    3. it encouraged the interest in the neurosciences
    4. it allowed the discovery of the molecular mechanisms of memory
23. The modal model of memory \_\_\_\_\_\_\_\_.
    1. is in conflict with the cognitive revolution
    2. rules out any role for the medial temporal lobe
    3. proposes that information flows from sensory to short-term, and from short-term to long-term memory, and vice versa
    4. is not compatible with current neuroscience
24. The main contribution of Endel Tulving to the research on memory was \_\_\_\_\_\_\_\_.
    1. he proposed the distinction between episodic, semantic, and procedural memory as distinct systems
    2. he clarified the role of amygdala in emotional learning
    3. he proposed the modal model of memory
    4. he discovered that the procedural memory requires the cerebellum
25. “Ecologically valid” memory research refers to \_\_\_\_\_\_\_\_.
    1. research methods that are respectful of the environment
    2. research that examines the effect of the environment on memory
    3. a combination of methods that are respectful of the environment with studies on the effect of the environment on memory
    4. applied research
26. The “system approach” to the study of memory \_\_\_\_\_\_\_\_.
    1. proposes a systematic approach to the study of memory
    2. does not assume that dedicated neural structures are required for each memory system
    3. believes that distinct memory systems, independently supported by dedicated neural structures, operate in the brain
    4. does not imply that the proposed memory system must be functionally incompatible or distinct
27. The “principle approach” to the study of memory \_\_\_\_\_\_\_\_.
    1. points to the importance of the seven principles in memory, as illustrated by Neath and Surprenant
    2. does not assume that memory is constructive in nature
    3. does not believes that tasks that require information about the context in which a memory was learned will be more susceptible to interference or forgetting
    4. points to the importance of ethical principles while conducting memory research in both human and non-human animals
28. Neurons are separated by tiny spaces called \_\_\_\_\_\_\_\_.
    1. engrams
    2. neurotransmitters
    3. lobes
    4. synapses
29. The phenomenon of long-term potentiation \_\_\_\_\_\_\_\_.
    1. is observed across every brain structure
    2. can be observed in a single neuron
    3. does not require AMPA and NMDA receptors
    4. is a persistent strengthening of a synapse
30. The medial temporal lobes are crucial for memory, as illustrated by the H.M. case. Structure that are part of the medial temporal lobes do *not* include \_\_\_\_\_\_\_\_.
    1. the dentate gyrus
    2. the cingulate gyrus
    3. the subiculum
    4. the perirhinal cortex

**Short Answer Questions**

What are three examples of short-term memory (STM) use, and three examples of long-term memory (LTM) use?

Why is *implicit* memory more primitive than *explicit* memory?

Why is Plato’s philosophy important in memory research?

What are some of the reasons that made Darwin’s work influential in memory research and still relevant today?

Why are the “nonsense syllables” proposed by Ebbinghaus still used today?

Which contribution(s) of behaviourists is/are still relevant today?

In what ways is the work of Francis Gall still relevant today?

Why is the case of H.M. important for modern memory research?

**Essay Questions**

1. What is memory and how does it work?
2. Why did Karl Lashley fail to localize the memory engrams?
3. How do neurons work to transmit information in the brain? How do they get modified to store memories?

Answer Key

**Multiple Choice Questions**

1. **d** (p. 2)
2. **b** (p. 2)
3. **b** (p. 3)
4. **a** (p. 3)
5. **c** (p. 4)
6. **a** (p. 5)
7. **d** (p. 5)
8. **c** (p. 5)
9. **a** (p. 7)
10. **a** (p. 8)
11. **a** (p. 8)
12. **d** (pp. 8–9)
13. **a** (p. 10)
14. **a** (p. 11)
15. **c** (p. 12)
16. **a** (p. 13)
17. **c** (p. 13)
18. **a** (p. 13)
19. **d** (p. 13)
20. **a** (p. 14)
21. **c** (p. 15)
22. **a** (p. 15)
23. **c** (p. 16)
24. **a** (p. 17)
25. **d** (p. 19)
26. **c** (p. 20)
27. **a** (p. 22)
28. **d** (p. 24)
29. **d** (p. 25)
30. **b** (p. 26)

**Short Answer Questions**

1. Examples of short-term memory include (1) holding a new phone number in mind until used, (2) rehearsing a short speech, (3) holding somebody’s name in mind at a party. Examples of long-term memory include (1) remembering my own phone number, (2) acting a part in a play, on a stage, (3) remembering the name of my mother (pp. 2–3)
2. Implicit memory only requires the appropriate sensory stimulus to be triggered, while explicit memory relies on the development of consciousness—a late arrival in evolution! (pp. 3–4)
3. He proposed the first model for memory, the wax tablet, widely revisited in the following centuries. This model even accounts for strength of memories and forgetting. (p. 5)
4. (1) the idea of the continuity between animals and humans, thus allowing extrapolation of animal data to humans, (2) the discovery of implicit memory, (3) the idea of “natural selection,” which inspired the development of operant conditioning. (p. 8)
5. Nonsense syllables are designed to lack meaning in the language relevant for the study, thus avoiding any type of bias—positive or negative. (pp. 8–9)
6. The methodological rigour that was developed during the behaviourist era in order for a behaviourist to conclude, with confidence, that the observed change in behaviour was the result of the experimental manipulation, helped legitimize psychology in the realm of science and remains a crucial element of quality memory research to this day. (pp. 10–11)
7. He forcefully and influentially indicated that all brain functions have a precise localization, including memory. (p. 13)
8. This case is important for at least two sets of reasons: (1) the observation that he developed amnesia while all his intellectual faculties remained intact indicated that memory is a separate, independent brain function; (2) the further observation that his amnesia affected only explicit memories whereas implicit memory and learning remained intact demonstrated that there are distinct, independent memory systems. (p. 15)

**Essay Questions**

1. Students should be encouraged to discuss broadly all the possible uses of the concept. The book provides a good starting point, enumerating, for example, the distinct but distinct overlapping ideas of “ability,” “body of knowledge,” and so forth. For each, student should provide at least one example from their daily life. Next, for the second part, students should explain how memory works. Graphical representations should be encouraged, and/or mathematical models. Depending on the type of background and scope of the course, this answer should be based on cognitive constructs, or on neural mechanisms. (pp. 2–4)
2. Students should be invited to read some of original works by this author, and compare and contrast assumptions, methodologies, and conclusions with present-day approaches to similar problems. First, he relied mainly on cortical lesions. Second, maze learning—particularly complex mazes as those used by Lashley—involves multiple parallel memory systems, including the explicit/hippocampal and the implicit/striatal systems. Furthermore, within these systems, stages of progressive training lead to shifts in the use of certain substructures. The spatio-temporal complexity of these circuits may well account for the observation that a gradual loss of memory was seen as a results of progressive larger lesions. Thus Lashley’s conclusion that memory is distributed is no longer the only possibility from his work. (p. 13)
3. Neurons are specialized cells of the brain, spinal cord, and peripheral nervous system, capable of efficiently transmitting and storing information. They are highly organized through their shape, electrical and biochemical properties to receive, compute, and transmit information to other neurons (or muscle cells). They receive information from other neurons via synapses, and send it to other neurons via synapses: these are crucial, mainly chemically operated structures linking functionally neurons. Within each neurons, information is transmitted quickly via action potentials, rapidly travelling perturbations of the membrane potential of each neurons. Information is stored in specialized areas of the brain such as the hippocampus, in which neurons and their synapses can be modified by experience. Confirming the early theoretical intuition by Hebb, co-activation of hippocampal synapses leads to a strengthening of the same synapses, through a complex set of mechanisms involving distinct subtypes of glutamate receptors, such as the NMDA and AMPA receptors, signalling pathways and gene regulation. This mechanism has been shown to be required for memory storage, since its suppression with a variety of methods lead to amnesia. (pp. 24–25)