

Chapter 1: A Brief History of Cognitive Neuroscience

LEARNING OBJECTIVES

- 1.1 Explain the origins of the field of cognitive neuroscience.
- 1.2 Describe the roots of the debate over localization of function.
- 1.3 Explain the ways in which brain structure was studied.
- 1.4 Understand the philosophical origins of cognitive psychology.
- 1.5 Discuss behaviorism and its principal tenets.
- 1.6 Explain how and why cognitive psychology came to the forefront of the psychological fields.
- 1.7 Identify the different methods that are used to measure brain function and structure.

MULTIPLE CHOICE

1. What term was coined by Thomas Willis as a consequence of the case of Anne Green?
 - a. psychopathology
 - b. cognition
 - c. neurology
 - d. psychosis

ANS: C DIF: Easy REF: 1.1 A Historical Perspective
OBJ: 1.1 MSC: Remembering

2. Aside from saving Anne Green's life, Thomas Willis and Christopher Wren also
 - a. created very accurate drawings of the brain.
 - b. came up with the names of a number of brain structures.
 - c. took the first steps that led to cognitive neuroscience.
 - d. All of the answer options are correct.

ANS: D DIF: Medium REF: 1.1 A Historical Perspective
OBJ: 1.1 MSC: Understanding

3. Each of the following are reasons why Willis is considered one of the early figures in cognitive neuroscience EXCEPT:
 - a. He named many brain parts.
 - b. He gave frequent lectures on specific brain regions.
 - c. He was among the first to link behavioral deficits to brain damage.
 - d. He created very accurate brain images.

ANS: B DIF: Medium REF: 1.1 A Historical Perspective
OBJ: 1.1 MSC: Remembering

4. While studying brain function, it is often useful to think of development in terms of _____, which is the perspective of _____.
 - a. cognition; cognitive neuroscience
 - b. survival; evolution
 - c. blood flow; magnetic resonance imaging
 - d. dysfunction; psychopathology

ANS: B DIF: Difficult REF: 1.1 A Historical Perspective

OBJ: 1.1 MSC: Analyzing

5. Which stance would most likely hold an assumption that physical elements of the brain are responsible for the conscious mind?
- a. monism
 - b. behaviorism
 - c. dualism
 - d. relativism

ANS: A DIF: Medium REF: 1.1 A Historical Perspective
OBJ: 1.1 MSC: Analyzing

6. René Descartes posited that the mind was separate from the body. However, he implicated a single brain structure, the pineal gland, as having what function?
- a. regulating feelings and emotions
 - b. connecting the mind and the body
 - c. moderating cognitive processes
 - d. adjusting behavior

ANS: B DIF: Easy REF: 1.1 A Historical Perspective
OBJ: 1.1 MSC: Remembering

7. Considering the perspective recommended for approaching cognitive neuroscience, which of the following would best explain how a cognitive function may have developed?
- a. learning and reward
 - b. integration with technology
 - c. neurological dysfunction
 - d. hunting and gathering

ANS: D DIF: Difficult REF: 1.1 A Historical Perspective
OBJ: 1.1 MSC: Analyzing

8. A central issue of modern cognitive neuroscience is whether specific human cognitive abilities
- a. arise from networks of brain areas working together.
 - b. are determined by the shape and size of the human skull or the brain beneath.
 - c. are best studied using the scientific method.
 - d. can be best identified using the Golgi silver method of staining or fMRI.

ANS: A DIF: Medium REF: 1.2 The Brain Story
OBJ: 1.2 MSC: Understanding

9. The discipline of phrenology was founded by
- a. Broca and Wernicke.
 - b. Fritsch and Hitzig.
 - c. Ramón y Cajal and Sherrington.
 - d. Gall and Spurzheim.

ANS: D DIF: Easy REF: 1.2 The Brain Story
OBJ: 1.2 MSC: Remembering

10. Phrenologists believed that the contour of the skull could provide valuable information about an individual's cognitive capacities and personality traits. This approach was based on the assumption that
- a. skull protrusions are caused by disproportionate development of the brain areas beneath them, which are responsible for different specific functions.
 - b. certain traits such as aggressiveness lead to life experiences and injuries that alter the shape of the skull in specific ways.
 - c. life experiences and injuries that alter the shape of the skull in specific ways lead to certain traits, such as aggressiveness.
 - d. the development of the skull bones directly influences the configuration of the soft brain areas beneath them, which are responsible for different specific functions.

ANS: A DIF: Difficult REF: 1.2 The Brain Story
OBJ: 1.2 MSC: Evaluating

11. Localizationist is to _____ as holistic is to _____.
- a. Wernicke; Gall
 - b. Gall; Flourens
 - c. Flourens; Broca
 - d. Broca; Wernicke

ANS: B DIF: Medium REF: 1.2 The Brain Story
OBJ: 1.2 MSC: Understanding

12. Gall's method for investigating phrenology was flawed because
- a. he used the wrong language to explain the characteristics he observed.
 - b. he did not tell Napoleon Bonaparte that he possessed noble characteristics.
 - c. he sought only to confirm, not disprove, the correlations he observed.
 - d. he used his own skull as the base model.

ANS: C DIF: Easy REF: 1.2 The Brain Story
OBJ: 1.2 MSC: Remembering

13. The view known as *aggregate field theory*, which stated that the whole brain participates in behavior, is most associated with
- a. Broca.
 - b. Hughlings Jackson.
 - c. Brodmann.
 - d. Flourens.

ANS: D DIF: Easy REF: 1.2 The Brain Story
OBJ: 1.2 MSC: Remembering

14. The key observation leading John Hughlings Jackson to propose a topographical organization in the cerebral cortex was that
- a. speech disturbances could be identified by left-hemisphere lesions.
 - b. the two hemispheres of the brain served different functions.
 - c. seizures begin in a localized region of the cortex.
 - d. focal brain damage causes specific behavioral deficits.

ANS: C DIF: Difficult REF: 1.2 The Brain Story
OBJ: 1.2 MSC: Analyzing

15. In developing phrenology, Gall's main failure was that
- a. he did not seek disconfirming evidence.
 - b. he was not a scientist.
 - c. his method was correlational.
 - d. All of the answer options are correct.

ANS: D DIF: Difficult REF: 1.2 The Brain Story
OBJ: 1.2 MSC: Analyzing

16. Giovanni visits his local phrenologist. What is this person likely to tell him?
- a. You are a domineering person.
 - b. Your father was a very domineering person.
 - c. Your brother is a domineering person.
 - d. Your mother was a very domineering person.

ANS: A DIF: Medium REF: 1.2 The Brain Story

OBJ: 1.2 MSC: Applying

17. The view developed by Marie Jean Pierre Flourens, based on the idea that processes like language and memory cannot be localized within circumscribed brain regions, was known as
- a. the neuron doctrine.
 - b. aggregate field theory.
 - c. rationalism.
 - d. the law of effect.

ANS: B DIF: Easy REF: 1.2 The Brain Story
OBJ: 1.2 MSC: Remembering

18. John Hughlings Jackson proposed a _____ organization in the cerebral cortex, based on his work with people with _____.
- a. holistic; aphasia
 - b. topographic; aphasia
 - c. topographic; epilepsy
 - d. holistic; epilepsy

ANS: C DIF: Medium REF: 1.2 The Brain Story
OBJ: 1.2 MSC: Understanding

19. _____ was one of the first brain scientists to realize that specific cognitive functions can be localized to specific parts of the brain and that many different functional regions can take part in a given behavior.
- a. Broca
 - b. Hughlings Jackson
 - c. Flourens
 - d. Brodmann

ANS: B DIF: Medium REF: 1.2 The Brain Story
OBJ: 1.2 MSC: Remembering

20. Which 19th-century scientist suggested that the frontal lobe contributes to language and speech production?
- a. Flourens
 - b. Wernicke
 - c. Broca
 - d. Brodmann

ANS: C DIF: Medium REF: 1.2 The Brain Story
OBJ: 1.2 MSC: Remembering

21. Patient Leborgne was nicknamed "Tan" because that was the only word he could utter. Leborgne had developed an aphasia due to a lesion in which area of the brain?
- a. frontal cortex
 - b. Broca's area
 - c. cerebellum
 - d. Wernicke's area

ANS: B DIF: Easy REF: 1.2 The Brain Story
OBJ: 1.2 MSC: Remembering

22. Which of the following things would have been the most difficult for the famous individual studied by Paul Broca to do, compared to before his stroke?
- a. listening to a piano recital
 - b. appreciating a painting
 - c. reading a book aloud
 - d. playing a game of cards

ANS: C DIF: Medium REF: 1.2 The Brain Story
OBJ: 1.2 MSC: Applying

23. Which of the following things would have been the most difficult for the famous individual described by Carl Wernicke to do, compared to before his stroke?
- a. understanding a speech
 - c. singing a song

- ANS: A DIF: Medium REF: 1.2 The Brain Story
OBJ: 1.2 MSC: Applying

- right frontotemporal area
- left frontotemporal area
- right temporoparietal area
- left temporoparietal area

- understanding speech; speaking
- speaking; understanding speech
- aggregate field theory; topographic organization
- aggregate field theory; aggregate field theory

- fine motor control; the sense of touch
- the sense of touch; fine motor control
- the production of language; the perception of language
- the perception of language; the production of language

- a. most early investigators were limited to postmortem studies to localize lesions.
- b. investigators did not know the brain was separated into two hemispheres until the 20th century.
- c. most early investigators focused on studying the brain–behavior relationship in animals rather than in humans.
- d. there was little interest in this field until the 20th century.

a. phrenological; cytoarchitectonics
b. phrenological; chronometrics
c. tissue staining; cytoarchitectonics
d. tissue staining; chronometrics

ANS: C DIF: Easy REF: 1.2 The Brain Story
OBJ: 1.3 MSC: Remembering

29. Each of the following contributions led to the establishment of the neuron doctrine EXCEPT:

- a. Golgi's silver method.
- b. Purkinje's description of the first nerve cell.
- c. Thorndike's observation of adaptive response.
- d. Brodmann's cortical maps.

ANS: C DIF: Medium REF: 1.2 The Brain Story
OBJ: 1.3 MSC: Understanding

30. Researchers Fritsch and Hitzig found support for the idea that specific functions are localized to discrete parts of the cortex in an experiment using electrical stimulation of a dog's brain. More specifically, they found __ systematic relationship between the portion of the cortex stimulated and specific _____.

- a. a; movements
- b. a; vocalizations
- c. no; movements
- d. no; vocalizations

ANS: A DIF: Medium REF: 1.2 The Brain Story
OBJ: 1.3 MSC: Understanding

31. Cytoarchitectonic maps distinguish different cortical regions by

- a. the structure of their surface convolutions.
- b. their structure at the cellular level.
- c. the complex functions they perform.
- d. the basic functions they perform.

ANS: B DIF: Easy REF: 1.2 The Brain Story
OBJ: 1.3 MSC: Remembering

32. Yvette wants to figure out whether cells in two different layers of the occipital lobe have different functions. What would she have done if she had been a scientist in the early 20th century?

- a. look at a CAT scan
- b. observe the tracts that connect each layer
- c. study living patients with damage to those cells
- d. look at the layers under a microscope

ANS: D DIF: Medium REF: 1.2 The Brain Story
OBJ: 1.3 MSC: Applying

33. The neuroanatomist who described 52 distinct cortical areas based on cell structure and arrangement, and whose classification scheme is often used today, was

- a. Purkinje.
- b. Helmholtz.
- c. Brodmann.
- d. Hyde.

ANS: C DIF: Easy REF: 1.2 The Brain Story
OBJ: 1.3 MSC: Remembering

34. Which of the following terms refers to the idea of a continuous mass of tissue that shares a common cytoplasm?

- a. synapse
- b. syncytium
- c. striatum
- d. claustrum

ANS: B DIF: Easy REF: 1.2 The Brain Story

OBJ: 1.3 MSC: Remembering

35. *La reazione nera*, or “the black reaction,” refers to
- a cell stain developed by Golgi.
 - a perceptual phenomenon described by the Gestalt psychologists.
 - a ganglion preparation developed by Arvanitaki.
 - a type of reinforcement-based learning described by the behaviorists.

ANS: A DIF: Easy REF: 1.2 The Brain Story
OBJ: 1.3 MSC: Remembering

36. Which of the following scientists contributed to modern neuroscience in the 19th century?
- Paul Broca
 - Sir Charles Sherrington
 - Gustav Theodor Fritsch
 - Santiago Ramón y Cajal

ANS: A DIF: Medium REF: 1.2 The Brain Story
OBJ: 1.3 MSC: Remembering

37. Which of the following statements best describes the “neuron doctrine”?
- The nervous system consists of a fused network of interconnected fibers.
 - The brain can be subdivided into regions that are distinct in cytoarchitectonics yet functionally interactive.
 - The nervous system consists of physically distinct cells that are functionally interactive.
 - The brain can be subdivided into functionally autonomous modules.

ANS: C DIF: Medium REF: 1.2 The Brain Story
OBJ: 1.3 MSC: Understanding

38. The neuron doctrine is usually credited to _____, who used a staining technique pioneered by _____.
- Purkinje; Brodmann
 - Brodmann; Purkinje
 - Golgi; Ramón y Cajal
 - Ramón y Cajal; Golgi

ANS: D DIF: Easy REF: 1.2 The Brain Story
OBJ: 1.3 MSC: Remembering

39. The primary contribution of Golgi to the field of cognitive neuroscience was that he
- developed a staining technique that permitted full visualization of individual neurons.
 - showed experimentally that the nervous system is composed of a net of physically interconnected neuronal units.
 - discovered that cells in different regions of the cortex also differ in shape and size.
 - demonstrated that nerves can release chemicals that have an activating effect on nearby muscle cells.

ANS: A DIF: Medium REF: 1.2 The Brain Story
OBJ: 1.3 MSC: Understanding

40. The term *synapse*, coined by Sherrington, refers to the junction between
- a blood vessel and surrounding neurons.
 - two different cytoarchitectonic regions in the brain.
 - two adjacent neurons.
 - an axon and the cell body of a neuron.

ANS: C DIF: Easy REF: 1.2 The Brain Story
OBJ: 1.3 MSC: Remembering

41. *Rationalism* is the philosophical position that knowledge
- originates from sensory experience.
 - must be experimentally tested.
 - must be deduced and justified through reason.
 - is globally distributed in the cortex.

ANS: C DIF: Easy REF: 1.3 The Psychological Story
OBJ: 1.4 MSC: Remembering

42. *Empiricism* is the philosophical position that all knowledge
- must be deduced and justified through reason.
 - originates from sensory experience.
 - must be experimentally tested.
 - is globally distributed in the cortex.

ANS: B DIF: Easy REF: 1.3 The Psychological Story
OBJ: 1.4 MSC: Remembering

43. Which of the following is NOT true of empiricism?
- It is primarily associated with the British philosophers Hobbes, Hume, and Mill.
 - It was a foundation for the associationist–behaviorist school of psychology.
 - It postulates a special role for reason and induction in human thought.
 - It emphasizes sensory experience in the development of knowledge.

ANS: C DIF: Medium REF: 1.3 The Psychological Story
OBJ: 1.4 MSC: Understanding

44. Ebbinghaus, who is considered the father of modern memory research, was among the first to demonstrate that
- different types of brain lesions can produce different types of memory deficits.
 - in terms of cognition, the whole is greater than the sum of its parts.
 - behavior is best understood in terms of stimulus–response relationships.
 - internal mental processes can be measured in rigorous and reproducible ways.

ANS: D DIF: Difficult REF: 1.3 The Psychological Story
OBJ: 1.4 MSC: Analyzing

45. All of the following are representative of the emergence of the field of cognitive science in the second half of the 20th century EXCEPT
- new developments in computer technology and artificial intelligence.
 - a philosophical shift in the field toward empiricism and associationism.
 - Chomsky’s work arguing that behaviorist theories cannot explain language acquisition.
 - Miller’s work showing that internal processes like short-term memory can be quantified.

ANS: B DIF: Difficult REF: 1.3 The Psychological Story
OBJ: 1.4 MSC: Evaluating

46. Thorndike’s law of effect
- stated that much knowledge is innately specified due to natural selection.
 - was written to oppose Darwin’s theory of natural selection.

- c. stated that a behavior that is followed by a reward is likely to occur again.
- d. was written to oppose the behaviorists.

ANS: C DIF: Easy REF: 1.3 The Psychological Story
OBJ: 1.5 MSC: Remembering

47. _____ is the idea that all knowledge comes from sensory experiences, while _____ holds that truth is intellectual.
- a. Empiricism; rationalism
 - b. Empiricism; logic
 - c. Rationalism; empiricism
 - d. Rationalism; logic

ANS: A DIF: Medium REF: 1.3 The Psychological Story
OBJ: 1.5 MSC: Understanding

48. John Watson famously argued that newborn babies
- a. are incapable of forming memories.
 - b. have an intelligence comparable to our nearest primate cousins.
 - c. can be raised to become anything.
 - d. will develop different intellectual abilities according to innate differences.

ANS: C DIF: Difficult REF: 1.3 The Psychological Story
OBJ: 1.5 MSC: Analyzing

49. According to associationist Herman Ebbinghaus, complex processes such as memory
- a. can be understood by combining different pieces of information.
 - b. are best understood in terms of a stimulus's emergent properties.
 - c. cannot be measured because they are not behaviors.
 - d. can be measured in an analytic fashion.

ANS: D DIF: Difficult REF: 1.3 The Psychological Story
OBJ: 1.4 MSC: Evaluating

50. According to Edward Thorndike, which of the following is NOT true about rewards?
- a. They indicate which creatures have malleable structures in the brain.
 - b. They help to stamp things into the mind.
 - c. They lead to adaptive learning.
 - d. They are part of the law of effect.

ANS: A DIF: Difficult REF: 1.3 The Psychological Story
OBJ: 1.5 MSC: Evaluating

51. "Cells that fire together, wire together" was first proposed by Donald Hebb as an explanation for
- a. epileptic seizures and their effects.
 - b. cytoarchitectural variation.
 - c. the way in which the brain codes new learning.
 - d. amnesia caused by brain damage.

ANS: C DIF: Medium REF: 1.3 The Psychological Story
OBJ: 1.5 MSC: Understanding

52. Noam Chomsky argued that the structure of human languages is _____, in contrast to

a. innate; learned c. universal; rational
b. learned; universal d. rational; innate

ANS: A DIF: Easy REF: 1.3 The Psychological Story
OBJ: 1.6 MSC: Remembering

- ANS: B DIF: Easy REF: 1.3 The Psychological Story
OBJ: 1.6 MSC: Remembering

- ANS: B DIF: Difficult REF: 1.4 The Instruments of Neuroscience
OBJ: 1.7 MSC: Analyzing

- ANS: D DIF: Medium REF: 1.4 The Instruments of Neuroscience
OBJ: 1.7 MSC: Applying

- ANS: A DIF: Medium REF: 1.4 The Instruments of Neuroscience
OBJ: 1.7 MSC: Analyzing

- ANS: B DIF: Medium REF: 1.4 The Instruments of Neuroscience
OBJ: 1.7 MSC: Understanding

58. Suppose you are investigating neurological function, and one of the initial portions of your procedure is to inject radioactive oxygen-15 into the patient's bloodstream. Which of the following methods are you most likely using to measure neurological activity?

- a. electroencephalography (EEG)
- b. computerized axial tomography (CAT)
- c. positron emission tomography (PET)
- d. magnetic resonance imaging (MRI)

ANS: C DIF: Difficult REF: 1.4 The Instruments of Neuroscience
OBJ: 1.7 MSC: Applying

59. A group of investigators is conducting research on brain tumors, and they need to obtain three-dimensional brain views to localize the tumors. Which instrument will provide the least invasive way to obtain their objective?

- a. electroencephalography (EEG)
- b. computerized axial tomography (CAT)
- c. positron emission tomography (PET)
- d. magnetoencephalography (MEG)

ANS: B DIF: Difficult REF: 1.4 The Instruments of Neuroscience
OBJ: 1.7 MSC: Applying

60. Imagine that you are one of the researchers who advanced the field of cognitive neuroscience by developing a new instrument to measure the brain. Computerized axial tomography (CAT) has already been developed, but your team wants to expand the CAT to develop an instrument that will provide information about brain function. Which method are you most likely developing?

- a. electroencephalography (EEG)
- b. functional magnetic resonance imaging (fMRI)
- c. positron emission tomography (PET)
- d. magnetic resonance imaging (MRI)

ANS: C DIF: Difficult REF: 1.4 The Instruments of Neuroscience
OBJ: 1.7 MSC: Applying

SHORT ANSWER

1. Draw a diagram demonstrating the approach known as the scientific method. Your diagram should indicate the general procedures used and the order in which they are performed.

ANS:

Answers will vary. Each should include the following:

- make an observation
- ask why it came about
- form a hypothesis
- design and perform an experiment
- draw a conclusion
- may also include replication

DIF: Difficult REF: 1.1 A Historical Perspective OBJ: 1.1
MSC: Creating

2. Describe how and why the term *cognitive neuroscience* was chosen for this field. Be sure to mention the two fields that combined to create this new field of study.

ANS:

Answers will vary.

DIF: Easy REF: 1.1 A Historical Perspective OBJ: 1.4
MSC: Remembering

3. Localizationists argued that higher cognitive functions were the product of brain activity in specific areas. Give evidence that they used to support their claims.

ANS:

Answers will vary.

DIF: Easy

REF: 1.2 The Brain Story

OBJ: 1.1

MSC: Remembering

4. Paul Broca and Carl Wernicke discovered two different forms of aphasia. Compare and contrast them.

ANS:

Answers will vary.

DIF: Medium

REF: 1.2 The Brain Story

OBJ: 1.2

MSC: Understanding

5. Describe the main tenets of the Neuron Doctrine.

ANS:

Answers will vary.

DIF: Easy

REF: 1.2 The Brain Story

OBJ: 1.2

MSC: Remembering

6. Describe the evidence that led Marie-Jean-Pierre Flourens to move the field away from localization toward aggregate-field theory.

ANS:

Answers will vary.

DIF: Easy

REF: 1.2 The Brain Story

OBJ: 1.2

MSC: Remembering

7. A major question in cognitive neuroscience is the extent to which regions of the brain are independent or integrated. Which of these two viewpoints is most valid? Present evidence to support your view.

ANS:

Answers will vary.

DIF: Difficult

REF: 1.2 The Brain Story

OBJ: 1.2

MSC: Evaluating

8. Associationism and empiricism are two main philosophical positions. Pick the one you think best describes how humans come to know things and explain why you think this.

ANS:

Answers will vary.

DIF: Medium

REF: 1.3 The Psychological Story

OBJ: 1.4

MSC: Remembering

9. Describe the transition from behaviorist to cognitive approaches in psychology.

ANS:

Answers will vary.

DIF: Easy REF: 1.3 The Psychological Story OBJ: 1.4
MSC: Understanding

10. Noam Chomsky wrote an article titled “Three Models for the Description of Language.” Describe how the findings he reported moved the field of cognitive psychology forward.

ANS:

Answers will vary.

DIF: Medium REF: 1.3 The Psychological Story OBJ: 1.4
MSC: Remembering

11. Describe two principal methods used to measure brain structure.

ANS:

Answers will vary.

DIF: Easy REF: 1.4 The Instruments of Neuroscience
OBJ: 1.7 MSC: Remembering

12. You would like to understand at what point in time an event took place in the brain. What neuroimaging method would you choose? Explain why you would choose this method and what information you would be missing.

ANS:

Answers will vary.

DIF: Easy REF: 1.4 The Instruments of Neuroscience
OBJ: 1.7 MSC: Understanding