

Exercise walk-through

1.4

The Brain

AP Psychology

The Brain

The brain is studied from the bottom up, because the lower structures handle the most basic jobs.

- The **brain stem**, including the **medulla**, controls breathing and heart rate.
- The **reticular activating system** controls alertness and arousal.
- The **cerebellum** controls coordination, balance, and some **procedural learning**.
- The **limbic system** sits inside the cerebral cortex and includes the **thalamus** (a relay station for the senses), the **hypothalamus** (hunger, thirst, temperature), the **pituitary gland**, the **hippocampus** (forming new memories), and the **amygdala** (fear and emotion).

The Brain, continued

The **cerebral cortex** is divided into two **hemispheres** and four lobes: the **occipital lobes** process vision at the rear; the **temporal lobes** process hearing and language at the sides; the **parietal lobes** hold the **somatosensory cortex** for touch; and the **frontal lobes** handle higher-order thinking and **executive function**.

Language sits mainly in the left hemisphere: **Broca's area** for speech production and **Wernicke's area** for comprehension.

Choose a brain method for the question

Two research aims, different measurements

A researcher wants to identify rapid electrical patterns that distinguish sleep stages. Another wants to compare where blood-oxygen signals change during a memory task and a comparison task. Which aim fits EEG, and which fits fMRI? What would each measurement leave uncertain?

Both methods can track changes over time. “Activity over time” alone does not distinguish them.

Distinguish the signal from the conclusion

EEG records electrical patterns using electrodes on the scalp. Its fine timing helps identify sleep-stage patterns; locating the precise source of activity is more limited.

fMRI commonly tracks regional blood-oxygen changes associated with activity. It provides useful spatial detail, but this is an indirect, slower-changing signal, not a direct recording of each neuron's firing.

A regional change during a task does not, by itself, prove that region is necessary for the task or reveal a person's exact thoughts. A method's strength must match the research question.

Research aim → signal measured → useful inference → limitation.

Studying the brain, and what sleep does

Lesioning

Lesioning destroys tissue deliberately in animal studies; in humans, natural damage plays the same role – and **prosopagnosia**, the inability to recognise faces, is one such case.

REM and NREM

NREM sleep deepens through three stages; **REM sleep** brings vivid dreams with the body paralysed – and **REM sleep behavior disorder** is that paralysis failing.

Why we sleep

Restoration repairs the body, and **memory consolidation** moves the day's learning into long-term storage.

Dream theories

Activation-synthesis theory says the cortex weaves a story from random brain-stem activity; **hypnagogic sensations** are the falling jolts at sleep onset.

Each dream theory makes a different prediction about *content*. That is how they can be told apart.

Exercises 2.1-2.2

2.1 State one function of the cerebellum and one of the amygdala. [2]

2.2 Explain what is meant by plasticity. [2]

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2.1

- cerebellum: coordinates balance and practised movement; amygdala: supports emotional processing, especially fear
-

2.2 Explain what is meant by plasticity. [2]

2.2

- the brain's capacity to reorganise its structure and connections in response to experience or injury; greatest in childhood but continuing across life

Exercise 2.3 (a)

2.3 A patient recovers some speech after damage to a language area.

(a) State the property of the brain that makes this possible.

[1]

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- plasticity

Exercise 2.3 (b)

2.3 A patient recovers some speech after damage to a language area.

(b) State one reason recovery is usually more complete in a child.

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(b) State one reason recovery is usually more complete in a child. [1]

(b)

- a child's brain reorganises more readily, so other regions can take over the function

Exercises 3.1-3.2

3.1 A researcher needs millisecond timing of a brain response. The best method is [1]

☐

A fMRI

B EEG

C a lesion study

D a case study

3.2 The claim that people are “left-brained” or “right-brained” is best described as [1]

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A well supported by hemispheric specialisation

B an oversimplification of a difference of degree

C true only for language

D a finding from fMRI

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3.1 A researcher needs millisecond timing of a brain response. The best method is [1]

- ☐ **A** fMRI
B EEG
C a lesion study
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3.1 B

- EEG records electrical activity directly, with excellent temporal resolution

3.2 The claim that people are “left-brained” or “right-brained” is best described as [1]

- ☐ **A** well supported by hemispheric specialisation
B an oversimplification of a difference of degree
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3.2 B

- specialisation is a difference of degree between connected hemispheres

Exercise 3.3 (a)

3.3 A patient with hippocampal damage can hold a conversation but cannot recall it an hour later.

(a) State the memory function the hippocampus supports.

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- forming new long-term memories

Exercise 3.3 (b)

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(b) Explain what this case shows about how memory is organised.

[2]

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(b) Explain what this case shows about how memory is organised. [2]

(b)

- memory is not a single system: the ability to form new memories can be lost while immediate conversation and older memories remain intact

Exercise 3.4 (a)

3.4 Applied research task. A patient recovering from a stroke can understand everything said to her and knows exactly what she wants to say, but her own speech comes out slowly and in short, effortful fragments. She is also unsteady on her feet, and she no longer forms new memories of events reliably, although she remembers her childhood clearly.

- (a) Identify the brain area most likely damaged in each of the three symptoms. [3]

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- Effortful, fragmented speech with comprehension intact – **Broca's area**, in the left frontal lobe (1). Unsteadiness and loss of balance – the **cerebellum** (1). Failure to form new memories of events – the **hippocampus** (1)

Exercise 3.4 (b)

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(b) Explain how you can tell from the description that Wernicke's area is intact. [1]

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- Wernicke's area governs the **comprehension** of language, and she understands everything said to her, so it must be undamaged (1)

Exercise 3.4 (c)

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(c) Explain why she can recall her childhood but not form new memories, naming the structure involved and the process it performs. [2]

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(c)

- The hippocampus **consolidates** new information into long-term memory (1); once memories are consolidated they are stored elsewhere in the cortex, so old memories survive the damage while new ones can no longer be laid down – anterograde amnesia (1)

Exercise 3.4 (d)

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(d) A researcher proposes using fMRI rather than a lesion study to investigate her case. State **one** advantage of fMRI here.

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(d)

- fMRI shows activity in the **living** brain while she performs a task, so the researcher can see which areas are and are not recruited without waiting for post-mortem examination, and can compare her activity with that of healthy participants (1)