

Title: Biological Approach

2.1 Localization of Brain Function

Key Question: How are different parts of the brain responsible for different behaviours?

WHAT YOU NEED TO KNOW

You will need to be able to do the following:

1. Explain one research study into localization of brain function.
 - a. Study: Maguire et al (2000) – hypothalamus and spatial memory

Introduction

Localization of brain function refers to the theory that different parts of the brain are responsible for different aspects of human functioning, such as behaviours. This relates directly to the assumption of the biological approach that cognitions, emotions and behaviours are products of the anatomy and **physiology** of our **nervous** and **endocrine** **systems**.

Localization of brain function

Psychologists investigating **localization of brain function** from the biological approach use brain-imaging techniques to investigate the **correlation** (relationship) between brain processes and structures and human behaviour. Before these were available, psychologists used post-mortem examination of the brains of people with certain problems, in order to try and find damage that correlated with the problem, such as lack of speech or amnesia. For example, **Broca (1861)** discovered one of the important areas in the brain that is responsible for speech, now called “Broca’s area”. He discovered this by performing an autopsy on a patient who had the nickname “Tan” because of his inability to say anything other than this sound. At the post-mortem examination, abnormalities were found in this region of the patient’s brain, suggesting that this was responsible for his aphasia. However, although post-mortem investigation is sometimes still used, it is now more usual to use **MRI**, **fMRI** or **PET scans** to research the correlation between a particular part of the brain and human behaviour.



Key Study 7: Maguire et al. (2000)

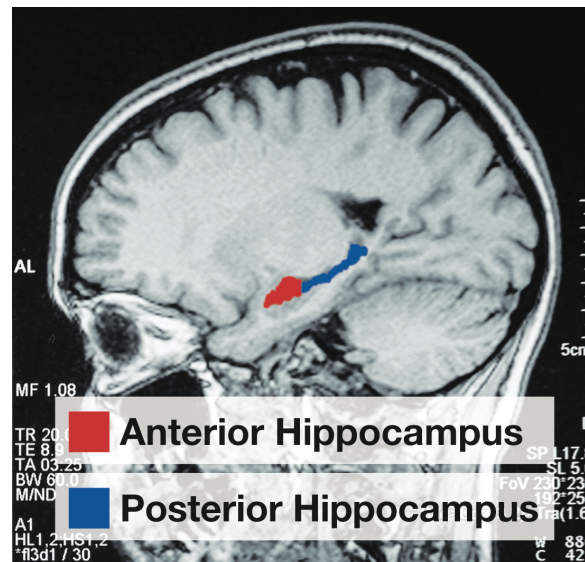
Aim: To examine whether structural changes could be detected in the brain of people with extensive experience of spatial navigation.

Method: Structural **MRI scans** were obtained from 16 right-handed male London taxi drivers who had been driving for more than 1.5 years. The MRI scans of 50 right-handed males who did not drive taxis were included for comparison. The mean age did not differ between the two groups.

Results: 1) Increased grey matter was found in the brains of taxi drivers, compared with controls, in two brain regions, the right and left hippocampi. The majority of the increased volume was found in the right posterior (rear) **hippocampus**.
2) Changes with navigation experience – a correlation was found between the amount of time spent as a taxi driver with volume in the right posterior hippocampus.

Conclusion: The results provide evidence for structural differences between the **hippocampi** of London taxi drivers and control participants. Therefore, the environment (driving a taxi in London, at a time when a GPS was not used, and drivers had to memorise the location of all the streets) affected the brain structure.

This is evidence of **localization of function** – as it suggests that spatial memory is located in the posterior hippocampus. It is also evidence of **brain plasticity**, as the hippocampus clearly changed in response to the environment (see Section 2b).



Evaluation

Strengths: Many extraneous variables are controlled: the mean age, the handedness and the gender of the two groups were the same. However, the results only show a correlation: it is possible that people with larger than normal posterior **hippocampi** are attracted to careers that use their spatial abilities, including taxi driving. But the fact that there was a **positive correlation** between the number of years spent as a taxi driver and the volume in the right posterior **hippocampus** would tend to counteract this argument. The researchers were also careful to only choose brain scans from healthy non-taxi drivers as a control group.

Limitations: The MRI scans of these non-taxi drivers were obtained from a London hospital, which raises ethical issues regarding informed consent and use of data.

Critical Thinking Points

What about the small sample size and the gender of the participants?

Would the same results have been found with women taxi drivers? Sixteen people are not many from which to develop a theory regarding spatial learning and the posterior hippocampus.

Possible Exam Questions

Short answer question

1. Explain one study investigating localization of brain function.
(Remember for this answer, you will need to say exactly how **Maguire et al's** study demonstrated localization of brain function).

Essay questions

2. Discuss how psychologists investigate localization of brain function, using relevant research to support your answer.
(More than one study would be needed for this answer, but **Maguire et al** would be a good study to use).