Recalling Routes Around London: 
Activation of the Right Hippocampus in Taxi Drivers 

Maguire, Frackowiak, and Frith (1997)
Bell Ringer

• Pick a landmark locally in North Fort Myers/ Cape Coral
• Write down the landmark on a sheet of paper.
Bell Ringer Continued

• Now, write out detailed directions on how to get to that landmark, with the starting point being the school. Be as detailed as possible with streets AND landmarks!
Key Terms

- **Topographic memory** involves the ability to orient oneself in space, to recognize and follow an itinerary, or to recognize familiar places. Getting lost when traveling alone is an example of the failure of topographic memory.

- **Semantic Memory**: refers to the memory of meanings, understandings, and other concept-based knowledge, and underlies the conscious recollection of factual information and general knowledge about the world.
PET-Positron emission tomography (PET) is a nuclear medical imaging technique that produces a three-dimensional image or picture of functional processes in the body.
This study looks at the brains of London taxi drivers and examines the role of the hippocampus in helping them to navigate their way around the city.
HIPPOCAMPUS

• A small, curved formation in the brain that plays an important role in the limbic system
• Your brain is symmetrical so the hippocampus is found in both hemispheres
• The hippocampus is involved in several functions:
  – Consolidation of new memories
  – Emotional responses
  – Navigation
  – Spatial orientation
BACKGROUND

- Black-Cab drivers are required to have the knowledge: a detailed mental map
- 25,000 streets within a six-mile radius of Charing Cross as well as a more general knowledge of the major routes throughout the rest of London
- This requires a great deal of topographical memory
BACKGROUND

- Spatial memory or topographic memory is the part of memory responsible for recording information about one's environment, to orient oneself in space, to recognize and follow an itinerary, or to recognize familiar places (landmarks).
AIM

• To examine semantic topographical memory retrieval and to determine if recall of well established spatial layouts activates similar brain regions as noted in other studies.

• Examine topographical (landmarks, spatial layouts) versus non-topographical memory and see if common brain regions were activated.
Activity

• Create an experimental design to show how you will be able to prove or disprove this hypothesis.
SAMPLE

- Opportunity sample
- 11 licensed London taxi drivers
  - Male
  - Right-handed
  - Aged (M 44)
  - Healthy medical, neurological & psychiatric profile
METHOD

• IV: Task while being scanned: 1. Navigating to a known location; 2. thinking of a famous landmark which they had never been to, 3. thinking of a plot from a movie, and 4. thinking of a still frame from a movie

• DV: Activity of various brain regions as measured by PET scan
PROCEDURE

• Questionnaire (Areas of London which they were most familiar with, Movies that were common among all, Landmarks they had visited in person and could envision in their head)

• 2 topographic tasks that the drivers were asked to complete were as follows: to recall the plot of a film at a certain point and describe the shortest legal route between a starting point and a destination.

• Arrived for scans, participants were blindfolded and speech was recorded visually

• One stimulus at a time

• PET scans
PET Scans

• Positron Emission Tomography (PET)
• uses radiation, or nuclear medicine imaging, to produce 3-dimensional, color images of the functional processes within the human body.
Results

• All spoke about same amount of time
• High accuracy on all tasks
• Navigation task, routes chosen were similar
• During tasks, subjects stated they visually noted the paths, landmarks, and movies
Conclusions

- Routes: Activation of the hippocampus in topographic memory retrieval. Specifically the right hippocampus. Since real world environments were used, the study suggests that this may reflect the role of the hippocampus in high level spatial manipulation and decision making.

- Landmarks: The main difference between activation patterns for routes and landmarks was that the right hippocampus was activated only in the routes task but not during recall of landmarks. The landmarks lacked a location within a large-scale spatial framework and thoughts of navigation between them were not possible, again suggesting a role for the right hippocampus in the crucial complex stage of facilitating navigation in large-scale space.

- Semantic memory: Except for cerebral activity, the brain regions activated during recall of movie plots was different from routes tasks. Most brain activity was on the left side of the brain.
Bell Ringer

4. (a) Outline what is meant by ‘application of psychology to everyday life’. [2]

Using the studies from the list below, answer the questions which follow.

Billington et al (empathising and systemising)
Rosenhan (sane in insane places)
Maguire et al (taxi drivers)

(b) Describe how each of these studies is useful. [9]

(c) What problems may psychologists have when they try to create useful studies? [9]

11. In the study by Maguire et al (taxi drivers), ethical guidelines were followed. Identify two ethical guidelines and describe how they were followed in the study. [4]
4 (a) Outline what is meant by ‘application of psychology to everyday life’.

1 mark partial, 2 marks full.

This is whether a study has ecological validity – 1 mark.
This is whether a study is realistic and has good ecological validity – 2 marks.

OR

This is the usefulness of a study – 1 mark.
This is how useful a study is due to its ecological validity – 2 marks.
(c) What problems may psychologists have when they try to create useful studies? [9]

Emphasis on problem. Answers supported with named (or other) studies. Each problem does not need a different study; can use same study.

**Indicative content:**
May be difficult to create studies that are ecologically valid.
May create unethical studies.
May be difficult to find a representative sample.
May be difficult to create a valid measuring device.
Ps may respond to demand characteristics if the study is unnatural.
The findings may offer a reductionist explanation so are less useful in life.
May be difficult to replicate research due lack of control.
May be difficult to control variables.
Or any other relevant problem.
11 In the study by Maguire et al. (taxi drivers), ethical guidelines were followed. Identify two ethical guidelines and describe how they were followed in the study.

- *informed consent*: gained in writing
- *confidentiality*: names of taxi drivers and control participants not known / control participants from anonymous database of scans
- *conduct / competence / avoiding harm*:
  - approved by ethical committee: by local hospital
  - certificated by the Administration of Radioactive Substances Advisory Committee
- *deception*
- *debriefing*
- *right to withdraw*

1 mark partial (state guideline), 2 marks full (expansion) × 2.
**STRENGTHS**

- Ethics: Participants applied to be included in the study. Fully informed consent was gained.
- Highly controlled experiment, therefore it is replicable.
- Reliable because an expert analyzed the scans.
- Real world routes and landmarks.
- All overly qualified (3 years training min.).
- All from same area (familiar with routes).
- Questionnaire.
WEAKNESSES

• Ecological validity
• Very small sample size
• It only considers one factor, the hippocampi, in relation to navigational skills.
  – Probably this complex memory skill is governed by many separate areas of the brain.
Reflective

- **How acquiring The Knowledge changes the brains of London cab drivers**
- Read the Article silently.
- Divide out by shortest to tallest.
  - Hypothesize how you would begin to learn that many streets in a 6 mile radius.
  - Analyze the statement “Maguire likens the brain to a muscle – exercise it and it gets stronger”.
  - Create a list of three other jobs that could result in an increase in the size of your hippocampus. Explain what aspect of this job would cause this to occur.
  - Does this scenario end the nature v. nurture debate or only further complicate it? Explain.