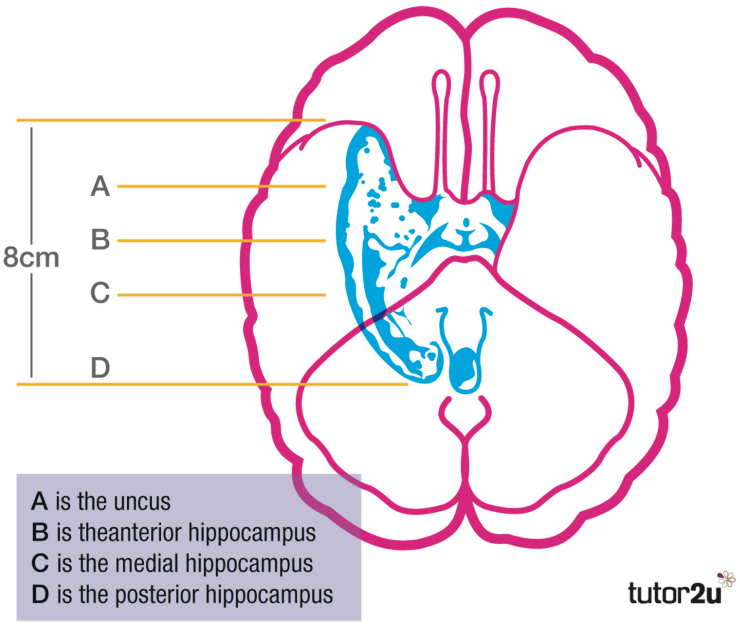
Key Study: Scoville and Milner (1957)

Effect of hippocampal damage on memory



Background information: Scoville performed experimental surgery on H.M.'s brain to stop the severe epileptic seizures he had been suffering since a fall off his bicycle many years previously. Specifically, he removed parts of HM's temporal lobes (part of his hippocampus along with it). The seizures reduced drastically but H.M. suffered from amnesia for the rest of his life. Milner, who was a PhD student of Scoville's, followed up the surgery with cognitive testing for fifty years after the original operation. Hers is a cognitive longitudinal case study of H.M.'s anterograde (after the surgery) and partial retrograde (before the surgery) amnesia. The biological part of the H.M. study is the correlation between the brain damage and the amnesia, which was assumed in the 1950s, and not verified until later brain scans in the 1990s (see Corkin, 1997, below)

Aim: In 1953 Scoville performed surgery on the then 27-year-old H.M. to cure him of his epileptic seizures. *[Note: this is a surgical procedure – it only became a study later when the memory damage was noted].*

Method: The surgery involved what was called a *partial medial temporal lobe resection.* Scoville removed 8 cm of brain tissue from the anterior two thirds of the hippocampus, and believed he "probably destroyed …. the uncus and amygdala" as well (Scoville and Milner, 1957). Once the extent of the memory loss was realised, Scoville and Milner wrote about this, along with the results from this type of surgery on nine other patients, in a prominent neurosurgical journal, and Milner started her cognitive studying of H.M.

Results: H.M. lost the ability to form new memories. This is called anterograde amnesia. He could do a task, and even comment that it seemed easier than he expected, without realising that he had done it hundreds of times before. His anterograde procedural memory was totally affected. He also lost his memory for events that had happened after his surgery: he could not remember moving house, nor that he had eaten a meal thirty minutes previously. He had also suffered some retrograde amnesia of events preceding the surgery, such as the death of his uncle three years before. However, his early childhood memories remained intact. His intelligence also remained as before, at slightly above average.

Conclusion: The surgery to remove part of the hippocampus, the uncus and the amygdala resulted in total anterograde amnesia and partial retrograde amnesia.

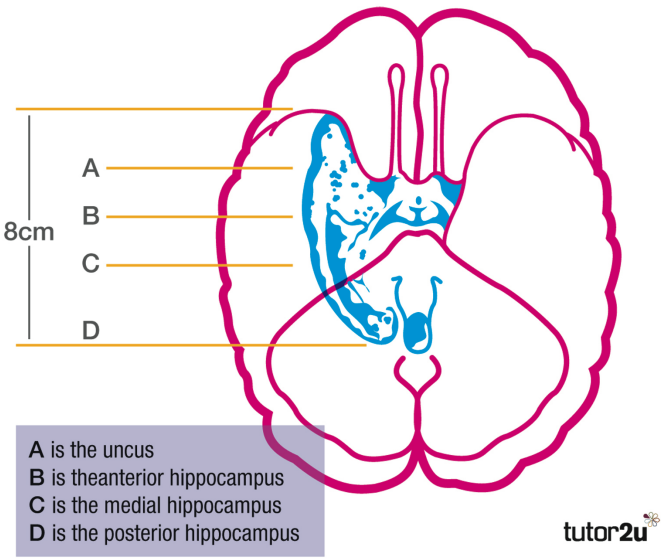
Evaluation:

This is the assumption, based on the results with other patients as well as H.M. In the absence at that time of brain-scanning equipment, other possibilities were also present. The high doses of anti-epileptic drug he was taking before, and the lower doses after the surgery, may have resulted in some memory loss. Also, so far as we can see, no memory tests were conducted on H.M. before the surgery, and the initial memory loss was largely reported by his mother, with whom he lived.

Key Study: Corkin (1997)

Effect of hippocampal damage on memory

Background information: Corkin had known H.M. since 1962, during which time he had never recognised her from one visit to another. Corkin and her colleagues used MRI scanning in 1992 and 1993 (written up in their 1997 article) to determine if Scoville's estimated lesioning of H.M.'s temporal medial lobe area had been as he stated (see the diagram under Scoville and Milner), and whether this could be sufficient to have resulted in the drastic memory loss suffered by H.M.



Aim: To investigate the extent of the hippocampal and medial temporal lobe damage to H.M.'s brain and to determine whether this could be sufficient to have resulted in the drastic memory loss suffered by H.M.

Method: One MRI scan was conducted on H.M. in 1992 and one in 1993. Before the 1992 scan, H.M. completed an IQ test and a memory test. The IQ test showed that he had normal intelligence, but the memory test showed his memory quotient (MQ) was 37 points lower than his IQ and showed he had severe amnesia.

Results: Both scans showed that the lesioning (also called ablation or cutting) of H.M.'s brain was 3cm less than Scoville had estimated. It therefore did not extend as far into the posterior hippocampal region as he thought, although there was surrounding damage, as stated, to the uncus and the amygdala. Approximately 50% of the posterior hippocampus on each side remained, but this had shrunk considerably on the right side. Corkin et al. believe this could be due to both the removal of the rest of the hippocampus, and also to the drugs and continuing (though much reduced) epileptic seizures.

Conclusions: The small amount of normal hippocampus remaining in the left temporal lobe was not sufficient to support normal memory. Therefore, this study demonstrates the importance of the hippocampus and the temporal medial lobe area for memory.

Evaluation:

There is not much to criticise with this study. Corkin had interviewed H.M. extensively over the years, and took care to ensure that the MRI caused no trouble to H.M., who had three non-magnetic clips inserted in his brain by Scoville in 1953, and which had they been magnetic would have meant an MRI was not advised. However, ethically there are some questions. It was Brenda Milner, the psychologist associated long-term with H.M. who gave

the permission for Corkin to scan H.M.'s brain. It is not clear if she was the appointed responsible adult legally able to do this. H.M., even if he gave permission himself, would not have remembered it, so there are issues with informed consent and right to withdraw, although anonymity was maintained until after his death.