The Legacy of Patient H.M. for Neuroscience, Squire (2009)

Abstract Summary

H.M. is probably the best known single patient in the history of neuroscience. His severe memory impairment, which resulted from experimental neurosurgery to control seizures, was the subject of study for five decades until his death in December 2008. Work with H.M. established fundamental principles about how memory functions are organised in the brain.

H.M. had been knocked down by a bicycle at the age of 7, began to have minor seizures at age 10, and had major seizures after age 16. He worked for a time on an assembly line but, finally, in 1953 at the age of 27 he had become so incapacitated by his seizures, despite high doses of anticonvulsant medication, that he could not work or lead a normal life. William Scoville, a neurosurgeon in Hartford, Connecticut offered H.M. an experimental procedure that he had carried out previously in psychotic patients, and the surgery was then performed with the approval of the patient and his family.

In 1952, Brenda Milner, a memory researcher at McGill University was invited to travel to Hartford to study H.M. When Milner first visited H.M., she saw that the epilepsy was now controlled but that his memory impairment was even more severe than had previously been seen two other similar patients, P.B. and F.C. What she observed was someone who forgot daily events nearly as fast as they occurred, apparently in the absence of any general intellectual loss or perceptual disorder. He underestimated his own age, apologised for forgetting the names of persons to whom he had just been introduced, and described his state as “like waking from a dream ... every day is alone in itself...” **(Milner et al., 1968).**

The first observations of H.M., and the results of formal testing, were reported a few years later by **Scoville & Milner, 1957.** This publication became one of the most cited papers in neuroscience and is still cited with high frequency. H.M. continued to be studied for five decades, principally by Brenda Milner, her former student Suzanne Corkin, and their colleagues. He died on December 2, 2008, at the age of 82. It can be said that the early descriptions of H.M. inaugurated the modern era of memory research.

It was found that H.M struggled to process new information and had difficulty pushing this into long-term memory. In contrast, his recollection of information prior to his surgery was very good. He could recall historical facts and personal events easily. **Corkin (1984)** found that H.M. produced well-formed autobiographical memories, from age 16 years or younger. It was concluded that H.M’s remote memory impairment now extended back to 11 years before his surgery.

H.M.’s intact intellectual and perceptual functions, and similar findings in other patients with large medial temporal lesions, have been well documented. A key additional finding was that H.M. had a remarkable capacity for sustained attention, including the ability to retain information for a period of time after it was presented. Thus, he could carry on a conversation, and he exhibited an intact digit span. Indeed, information remained available so long as it could be actively maintained by rehearsal. For example, H.M. could retain a three-digit number for as

long as 15 min by continuous rehearsal, organising the digits according to an elaborate mnemonic scheme. Yet when his attention was diverted to a new topic, he forgot the whole event. In contrast, when the material was not easy to rehearse (in the case of nonverbal stimuli like faces or designs), information slipped away in less than a minute. These findings supported a fundamental distinction between immediate memory and long-term memory. This case study showed that STM and LTM were separate stores.

Before H.M., due particularly to the influence of Karl Lashley, memory functions were thought to be widely distributed in the cortex and to be integrated with intellectual and perceptual functions. The findings from H.M. established the fundamental principle that memory is a distinct cerebral function, separable from other perceptual and cognitive abilities, and identified the medial aspect of the temporal lobe as important for memory. The implication was that the brain has to some extent separated its perceptual and intellectual functions from its capacity to lay down in memory the records that ordinarily result from engaging in perceptual and intellectual work.

H.M. was the first well-studied patient with amnesia and became the yardstick against which other patients with memory impairment would be compared.