

Patient H. M.

On 23 August 1953, William Scoville performed a bilateral medial temporal lobe resection on patient H. M. in an attempt to stop his epileptic seizures. The result was a surprise to everyone. After the operation, H. M. experienced a severe anterograde memory impairment that persisted to this day. Having been studied for more than 40 years, H. M. can be considered the single patient that has provided the largest collection of data to the students of memory [Corkin, 1984] [Milner, 1968].

H. M.'s syndrome is surprisingly isolated. His impairment is mostly limited to his inability to register new facts in his long term memory. His IQ is above average. His perceptual abilities are normal except his odor discrimination. This is normal, because the operation might have damaged the orbitofrontal cortex, olfactory bulb, or olfactory tracts. Some of his spatial abilities are compromised, and some are preserved. His performance efficiency might reflect the specialization of the temporal neocortex versus the medial temporal-lobe structures. He does not have any attentional disorder. His immediate memory is preserved in both verbal and non-verbal tasks. Although his operation was performed when he was 27, his memories are intact until age 16, with an 11 year retrograde amnesia. His language production and comprehension are mostly normal, he can understand and produce complex verbal material. He is impaired on tests of semantic and symbolic verbal fluency. This might be due to premature aging produced by his multiple neural abnormalities.

There have been dozens of experiments on H. M.'s memory impairment. In his post-operative years since 1953, his symptoms have been very stable. The major findings show that he is impaired at virtually any kind of learning task in which there is a delay between presentation and recall, particularly if interfering material is presented in between. The learning materials used in tests include photographs of people, verbal material, sequences of digits, complex geometric designs or nonsense patterns. He is severely impaired with his memory of daily life. He does not know, for example, where he lives, who cares for him, what he ate at his last meal, what year it is, who the president is, or how old he is. In 1982, he failed to recognize a picture of himself that had been taken on his 40th birthday in 1966. He has some islands of remembering from his post-operative years, however. For example he knows what an astronaut is, a public figure named Kennedy was assassinated and what rock music is. Although H. M.'s general knowledge is meager, it is not completely void.

H. M. has been tested on different maze learning tasks [Milner, 1970]. These are typically tasks in which the subjects tries to learn a path on a board with his fingers. He failed to acquire to correct route even after extensive testing. He was able to learn the solution on a radically shortened version of the test, although after many repetitions.

The attempts of testing classical conditioning on H. M. have failed because of a peculiar reason. The tests by Kimura in 1962 had to be abandoned because H. M. was extremely tolerant to electric shock, even at the levels normal people find painful. This extreme tolerance was later understood to be a manifestation of a more general lack of sensitivity to internal signals such as hunger, pain and fatigue. The structural damage responsible for this is uncertain.

More interesting results are the ones that show the tasks that H. M. can perform. For example the fact that H. M. only has problems with long term memory but has an intact short term memory clearly demonstrate that these two phenomena are supported by different hardware. Furthermore, the fact that H. M. has intact memories from his childhood, but cannot remember anything new shows that the structures that store memories are separate from the mechanisms that encode them, and hippocampus probably plays a role in the latter. There are other dissociations discovered on H. M., most notably the experiments on motor and skill learning. In a 1962 experiment Milner trained H. M. on a mirror-drawing task. This task involves tracing some figure on the paper by only seeing the mirror image of the drawing. Normal people are

initially pretty bad at this task, but they can get better with training. H. M. had a normal learning curve for this task. On later days, even though he denied having performed the task previously, he retained his skill. Corkin trained H. M. on various other manual tracking and coordination tasks [Corkin, 1968]. He showed nearly normal improvement from session to session. He could be trained to acquire perceptual skills, such as reading of briefly presented words, or mirror reading. Cohen and Corkin showed a similar result on the Tower of Hanoi puzzle in 1981 [Cohen and Corkin, 1981]. This is a qualitatively different result, since the puzzle involves mental operations beyond just motor coordination or simple perception. H. M. was able to learn the procedures necessary to perform this cognitive skill, even though he did not have any declarative memory of performing the task. Also, biasing effects with words is quite normal. After having been shown a word, although he fails dramatically on subsequent recall and recognition testing, he becomes biased in subsequent word stem completion tasks. The distinction between procedural and declarative learning may be one dichotomy to explain these findings.

Deniz Yuret

Wed Sep 20 17:47:02 EDT 1995