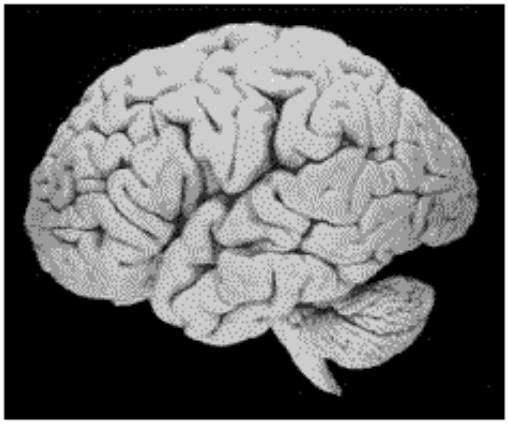
While You Were Sleeping: Recent Discoveries About Amnesia

Peter, who had just awakened from a coma, looked at the blurred faces of his family gathered around his hospital bed. Suddenly his gaze encountered an unfamiliar face. "Who the hell are you?" he blurted. His family looked at each other in consternation. "Amnesia." Someone voiced their fear. Peter proceeded to recite various trivia of his life--such as his college GPA. (He is a lawyer, after all.) But only amnesia could explain his inability to recognize his fiancee Lucy -- and his doctor agreed. "Selective amnesia is a case where the patient forgets selected events or people," he ponderously told the stricken family.

Of course, if you have seen the romantic comedy While You Were Sleeping, you could have told the doctor that he was dead wrong. Peter really had never seen Lucy in his life--except as the token collector he hardly noticed on his way to work. With a vivid imagination and her infatuation for the handsome stranger, Lucy had dreamt of getting married to Peter. After all, the fact that they had never even spoken to one another is only a minor obstacle.

When she saved his life by pulling him out of an oncoming train's way, her dream came true unexpectedly. His large, determined family took her to be Peter's fiancee--and Peter was in a coma and unable to speak for himself. No wonder he didn't recognize Lucy when he woke up. And what does the doctor's false diagnosis say about our understanding of memory and amnesia?



Scientific American, Sept. 1992.

How does the wiring in the human brain give rise to memory?

In fact, we do know a little more about memory than the scene from the movie seemed to indicate, although most of this knowledge has been gained only recently. For example, researchers have now identified many regions of the brain associated with memory. These advances are inextricably linked to clinical studies of amnesia and began because of the rather peculiar case of patient H.M., possibly the most researched individual in scientific history (6).

H.M. was an epileptic patient who had brain surgery to relieve his seizures, which were occurring at a rate that incapacitated the patient (3). The surgery involved the removal of both sides of the medial temporal lobe and succeeded in its original aim of relieving the patient's epileptic seizures. Unfortunately, it also impaired his ability to remember anything which occurred after the surgery for more than a short period of time (3). Since H.M. was normal in all other aspects, neurologists concluded that memory is a process separate from other functions (6).

The case of H.M. also substantiated the division of memory into distinct components of "declarative" and "non-declarative" memory, mediated by different parts of the brain (6). For example, when researchers taught H.M. to draw the mirror image of an object, he would not remember that he had learned the task before, but he would become better at the task after each trial (5).

Remember the old saying that you never forget how to ride a bicycle? Well, there is actually a sound

neurological basis for the claim. Remembering how to ride a bicycle, like knowing how to tie your shoelaces or how to draw mirror images, belongs to the non-declarative memory of skills and habits and cannot be "explicitly" recalled; these memories go through a different path in the brain from the declarative memory of facts and figures (6).

Since the case of H.M. and our increased understanding of memory, researchers have also been able to delve into many of the causes of amnesia. One major advance is the development of animal models that mimic the symptoms of human amnesia (6). By creating a lesion (which would impair neuronal functions) in a particular region of the brain on monkeys, researchers have been able to create monkeys with H.M.'s symptoms.

By making lesions on other parts of the brain, they can determine the importance of those regions of the brain in the function of memory (6). These evidences are supported by clinical studies of diseases in which amnesia is a symptom. For example, Alzheimer's disease, which often begins with amnesia, is found to affect the medial temporal lobe, the same area of the brain which is removed in patient H.M. (1).

But can memory be explained solely on the basis of neuroanatomy? Elizabeth Loftus's article "The Reality of Repressed Memories" shows clearly that amnesia becomes muddier when we consider it from the psychological perspective. Loftus cites the controversial case in which George Franklin was convicted of murder on the strength of his daughter's recollection of his killing her best friend--a memory which had been repressed for twenty years. She also cites the increasing number of cases in which children are accusing their parents of sexual abuse decades after the events had supposedly happened (4).

Whether these memories are real is still a hotly debated question. Thus the premise of While You Were Sleeping was not in fact too far-fetched--Peter could theoretically have blocked or repressed the memories of Lucy if he had associated her with a traumatic event!

Another interesting and controversial aspect of amnesia and memory is the human ability to create and retain "false memories" as the result of the cliché "the power of suggestion." For example, if Peter's family had insisted long enough that Lucy was really his fiancee, and if they had given him suggestive details of how they had met, would Peter really come to "remember" Lucy as his fiancee? This is of course the major question in the cases of repressed memories, and Loftus cites in her article several cases in which a therapist had, while the subject was under hypnosis, suggested events which the subject later claimed as "real" memories (4).

Two recent studies have attempted to integrate molecular and psychological aspects of memory. In a letter to Nature published last year, several researchers proposed a molecular explanation for the stronger memory we have of emotional events. The mechanism involves the recruitment of a stress hormone system during the storage of emotional memories (2). When investigators blocked the reception of this hormone in cells, only the memory of the emotional events was affected (2). Other researchers have linked a brain structure called the amygdala to the conditioning of fear. Rats were trained to fear light by electric shock to the foot whenever a light appeared. Their results showed that rats who had been "fear" conditioned by light lose this response when their amygdala was removed.

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pathways of memory research, molecular and psychological, are in fact convergent. At the end of these converging paths lies an integrated understanding of human memory and part of the solution to the ultimate mystery that is human mind and consciousness. More practically, this research demonstrates the vitality in the field of neuroscience. One day, perhaps, I might even learn that there is actually an amnesia that selectively blocks a patient's memory of organic chemistry reactions, and that it really wasn't my fault that I flunked that orgo exam...

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-- Tawen Chang