

THE MYSTERIES OF MEMORY

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“Where are my keys?” Such begins a conversation in our house. “Do you **remember** where you left them? Well if I **remembered**, I would not be asking you to help me find them.”

It is a different conversation today when the phone is missing, and of course I am talking about the cell phone. In the old days, no one had trouble finding what we now call a land line—it is attached to the wall, and we normally did not have a problem **remembering** where the wire came out of the wall.

For our cell phones, modern technology comes to the rescue. As long as we **remember** our cell phone number (or more accurately, the number that is programmed into the phone of our significant other who we are asking for help), a simple call to our cell phone tells us the location. If the ring tone does not reveal the location, and we still do not **remember** where we put the phone, of course there is an “app for that”: The “Find My Phone” app, using that magic satellite known as GPS, will tell us where we left the phone.

The mysteries of memory---how is that we remember, or maybe more interesting, why do we forget where we put our keys or phone?

How about if we are called upon to **remember** the description of a person—to give an eyewitness account? Not an everyday occurrence, but what if we are asked to describe a perpetrator of a crime?

Bloomington Indiana. It was an early class at the business school and I was late-Business Law. Although a liberal arts major, I was thinking about going to law school. It was a large class and the professor lectured from a stage. Being late for class meant I was forced to sit in the front row.

Suddenly someone ran onto the stage holding something and there was a loud bang. I was in the line of fire. I ducked. Then this John Wilkes Booth “wannabe” quickly disappeared. The professor was now assuring his students that he was alive and well. This was some kind of bizarre experiment and he was asking questions and having students respond by raising their hands to answer. What do the students remember about the assailant? I remembered nothing because I was in the line of fire. Was the assailant a man or woman? 80-20 in favor of a man. What was the color of the assailant’s hair? What was he or she wearing? How tall? What about the color of his or her skin? The students could not agree as to the most basic questions as to identifying the characteristics of the would be assailant.

Before beginning my research, I doubted if a professor would try a similar experiment today. My professor did prove his point that eyewitness testimony, based on what an individual remembers seeing or hearing, can be unreliable. Having ducked out

of fear, I could not answer any of his questions, but most of the students had an unobstructed view, and my recollection is that a significant portion of the students could not accurately **remember** what they saw.

As Milton Meltzer said in his very readable book The Landscape of Memory, “memory is treacherous.”

The science of memory, with words and concepts such as neurons, neuroscientists, synapses, encoding, storage, and retrieval—is quite mysterious to this student of political science, history and the law. I will explore and discuss memory, and the science of what we do and do not remember, through the lives of 4 individuals, three of whom had either extraordinary memory loss or memory ability, and a fourth individual who was a victim of an eyewitness’s bad memory.

Henry Molaison

I will begin with Henry Molaison, known before his death in 2008 only by his initials “H.M.”

Henry, as a child and a young adult in the 1940s and early 1950s, suffered from severe epilepsy. Drugs available at the time did not provide any meaningful relief from severe epileptic seizures. Henry was under the care of Dr. William Scoville, a leading neurosurgeon and a proponent of what was known at the time as psychosurgery. Dr. Scoville had performed experimental brain surgery on psychiatric patients that involved removing parts of the brain—a form of lobotomy.

In the course of operating on a schizophrenic patient who also had epilepsy, and consistent with the law of unintended consequences, the surgery was marginally helpful in relieving the patient's psychiatric problems, but Dr. Scoville observed the surgery did alleviate the patient's epileptic seizures. Dr. Scoville theorized that removal of what is known as the hippocampal complex, along with some other parts of the brain, may alleviate if not eliminate Henry's epileptic seizures.

In 1953, when Henry was twenty-seven and while he was awake, Dr. Scoville performed brain surgery. The surgery did in fact accomplish the goal of dramatically curtailing Henry's seizures, but unfortunately, also had a serious side effect: The surgery left Henry in what has been described as the "permanent present tense".

In the recovery room, Henry made what seemed to be a normal physical recovery from a serious brain operation. While the seizures stopped, it quickly became obvious that something was wrong: Henry did not recognize the caregivers who were present daily nor could he remember how to find the bathroom despite repeated visits.

Henry retained the ability to form short term memories, but he lost the ability to convert such short term memories into long term memories—he suffered from what is known as anterograde amnesia. Henry did remember and could recognize the faces and names of family and celebrities that he knew before the operation, and he "recalled historical facts that he learned in school, had a good vocabulary, and could perform routine daily tasks such as brushing his teeth, shaving, and eating", but Henry could not

create new memories for faces he saw or events that occurred for the first time after his operation.

Henry's life is told by Professor Suzanne Corkin, an MIT scientist, in her book Permanent Present Tense, The Unforgettable Life of Amnesic Patient H.M. With the initial cooperation of Henry's parents and later his guardian, and the enthusiastic cooperation of Henry, Corkin and other scientists were allowed to perform memory tests and experiments on and with Henry and perform x-ray and similar scans of his brain. The work by Corkin and her fellow scientists has been described as forming the basis of modern memory research.

Short term memory does not refer to recalling what we did yesterday, this morning, or even 30 minutes ago. Short term memory is the immediate present and it expires within about 30 seconds or less depending on the task. For example, when hearing the phone number of an acquaintance, the digits will remain in our short term memory briefly, but will quickly be forgotten unless the telephone number is written down. Henry could remember telephone numbers, but if a scientist meeting with Henry left the room for a minute or more, when returning, Henry had no memory of the scientist and had to be reintroduced.

Henry's long term memory of events prior to his surgery and his inability to convert new memories into long term memories may be illustrated by a car ride and a cup of coffee from McDonald's. A researcher had picked up Henry at his home in

Connecticut to bring him to MIT for some tests. On the way, the researcher stopped at McDonald's and returned with a cup of coffee. After a few minutes on the road, Henry noticed the cup of coffee in the cup-holder and said to the researcher that as a boy growing up, he had a friend by the name of John McDonald. Henry proceeded to tell stories about his friend and the researcher was impressed by Henry's ability to describe this childhood memory. The conversation ended, and after a few more minutes, Henry looked again at the coffee cup and remarked to the researcher that he had a friend by the name of John McDonald and proceeded to re-tell virtually the identical story. The conversation ended, and a few minutes later Henry again looked at the coffee cup and told to the researcher about his friend named John McDonald.

Scientists use different and not necessarily consistent terms to define different types of memory. Corkin uses the terms declarative memory and non-declarative memory. Examples of declarative memory are the ability to remember what we need to buy at the grocery store without a list, while an example of non-declarative memory is our ability to ride a bicycle after not having been on a bike for years, which scientists refer to as a motor skill.

In some elaborate experiments, scientists challenged Henry to trace a 5 pointed star that was hidden from his direct view and could be viewed only indirectly through a mirror. Most people find the task difficult and frustrating, but over time and with practice, learn to trace the star. The ability to trace the star involves mastering and

remembering a new motor skill, and after practice Henry was able to trace the star cleanly—thus he acquired and remembered a new motor skill.

Three days later, the scientist again gave the tracing test to Henry. Henry was able to replicate his ability to trace the star cleanly. While Henry had acquired and remembered a new motor skill, he had no memory of having done the task before nor did he remember the scientists who had given him the test three days before. When successfully tracing the star, Henry proudly observed “Well, this is strange. I thought that this would be difficult, but it seems as though I have done it quite well”. The parts of the brain removed by Dr. Scoville did not prevent Henry from learning and remembering how to trace the star, a new motor skill, but their removal did prevent Henry from remembering how he learned the new skill and who taught him how to trace the star.

As a result of the X-rays and CT and MRI scans, Corkin was able to confirm that Dr. Scoville removed, among other parts of Henry’s brain, the hippocampal complex. Scientist now know that the hippocampus is necessary for forming new long term memories, but is not necessary for short term memory or to learn and remember motor skills.

Henry’s parents took care of him for the next thirty years. He enjoyed reading magazines and doing jig-saw puzzles, without knowing that he had already read the magazine and completed the puzzles on numerous occasions.

Memory can help us in mourning the loss of a loved one. Without memory, Henry had a difficult time mourning and processing the loss of family members who died after the surgery. Henry did not remember the death of his favorite uncle and his father. Every time he learned or became aware of their death, it was new to him and he became upset. Henry would also occasionally ask when his uncle and his father would be visiting.

If time can bring some comfort to those mourning a death, lacking the ability to remember did not help Henry mourn and process his father's death. As Corkin noted: "Henry could not hold onto the fact that his father had died long enough to come to terms with his death. He had no memory of saying goodbye to his father, attending his funeral, visiting his grave, or being comforted by the love and sympathy of his family and friends".

Henry's mother developed dementia and moved to a nursing home. Scientists later discovered that Henry had written two notes to himself that he kept in his wallet: "dad's gone" and "mom's in nursing home".

On December 2, 2008 Henry died.

Research by memory scientists did not stop when Henry died. After his death, Henry donated his brain to science and research continues on what has been described as the most studied brain in the world.

Memory gives us the ability to develop relationships with each other and to know each other well. Although Henry had many acquaintances and friends that he acquired after the surgery, he was unable to develop any close relationships. After many years of working together, Henry developed a vague sense of familiarity with Corkin, and identified her as a friend from high school.

Although no one would want to have the memory loss of Henry, we all likely have some specific memories of events or circumstances that we wish that we could forget. Henry, although generally even tempered and rarely a behavior problem, sometimes suffered from anxiety. One time in the nursing home he became upset about noise from some residents, and he began to swing his fist at staff members. The police were called. The next day, Henry was asked if he remembered what happened the day before and he answered “I don’t remember – that’s my problem”. When asked further whether he remembered the policeman, Henry responded “sometimes it’s better not to remember”.

In her eulogy at Henry’s funeral. Corkin noted that Henry’s “tragedy became a gift to humanity. Ironically, he will never be forgotten”. In his obituary, the New York Times noted that while Henry left no survivors, “he left a legacy in science that cannot be erased”.

Su Meck

For those of us seeking to retain our ability to remember, in addition to avoiding a lobotomy, we may also want to avoid falling ceiling fans.

“I don’t remember any of what I’m about to tell you” is how Su Meck begins her 2014 book, I Forgot to Remember: A Memoir of Amnesia. In 1988, Su and her husband Jim had 2 young children, including 8 month old Patrick. As many young parents do, on a Sunday afternoon at her home in Fort Worth, the young 22 year old mother picked up Patrick and raised him high toward the ceiling exclaiming “weee”. Suddenly Patrick came in contact with a low hanging ceiling fan which inexplicably came crashing down on Su and her son. Patrick was unscathed but Su suffered a traumatic brain injury.

When Su awoke at the hospital, she had acquired a big headache but lost her ability to remember events and facts from prior to the time of the injury---complete retrograde amnesia. Su describes her loss of memory as follows:

“I didn’t know who I was and couldn’t recall that I had a husband or children or the identities of my parents or siblings. I didn’t know what a house was or that I lived in one. I didn’t know the purpose of school, or that I had ever attended. I didn’t know what a city was; the name Fort Worth did not register nor did the terms Texas, United States, and Earth. ...I could speak, but my vocabulary extended to only to maybe one hundred words....I didn’t know what a utensil was, or how to use one.”

For months after coming home from the hospital, Su would ask her husband the same question: “Who are you?”

While Henry Molaison generally retained memory of facts and events that occurred prior to his surgery, but could not form new memories, Su Meck lost all memory of her life prior to the fateful contact with the fan, but after a period of time, she was generally able to regain the ability to form new memories.

Like Professor Corkin, whose work focused on providing a physiological explanation for Henry’s loss of memory, doctors treating Su attempted to identify what parts of her brain were damaged and may be responsible for her memory loss. For months after the injury, Su had multiple appointments with doctors and had a battery of medical tests and procedures, but the doctors were unable to identify the parts of her brain that were damaged and were the cause of her memory loss. Some doctors even suggested Su’s problems were psychological—that her memory loss was not caused by the brain injury.

Frustrated by the lack of meaningful help from the medical community, Su and Jim simply stopped seeking medical attention. Instead, Su and Jim focused their attention on how Su, released from the hospital only 3 weeks after the fateful fall of the ceiling fan, could regain her ability to raise 2 small children she did not remember and in an unfamiliar house and live with and be a wife to a stranger named Jim.

Upon arriving at home, Sue noticed family photographs hanging on the wall that included images of her parents, brother, husband, and children. She recognized only one person in the photographs – herself. All others were all strangers.

When Christmas arrived, Su had no idea why so many family members wanted to be together, why anyone would go to church at night, why there were so many cookies, and most mysterious of all, why anyone would have a tree in their house.

While visiting the home of her parents, Su was terrified of the pool in the backyard, even though prior to her injury she had been a good swimmer. Also as a child, Su learned how to play the piano, and in contrast to her lost ability to swim, Su went immediately to the family piano and sat down and played Scott Joplin’s “The Entertainer”, in her words, “by memory”. She also did not forget how to ride a bike. Professor Corkin would likely call this non-declarative memory, and whatever brain injury occurred when the fan fell, the part of the brain responsible for Su’s non-declarative memory remained in place.

Su’s memoir is a fascinating and a very personal story of survival and accomplishment, including rather intimate details of the relationship with her husband, and her story ends with her graduation from college.

As to the physical causes of her loss of memory, it remains a mystery. In contrast to Corkin’s book, which focused on the science behind how we form memories, Su’s memoir contains little discussion of the science of memory loss.

Su says she is often asked if she would now like to consult with brain specialists to find out why she lost her memory. In response, she writes she would welcome an explanation, but she has no interest in being a “human guinea pig”. Corkin and her fellow scientists were fortunate that Henry and his parents did not have the same attitude.

When asked if she hopes that someday modern science would allow her to regain all her memories, Su says she is not sure: “I would have to figure out exactly who I am all over again”. I am not sure that Henry Molaison could answer this question, because he did not fully understand the memory loss he suffered.

Jill Price

Jill Price’s extraordinary memory is not the result of a misguided surgeon or a falling ceiling fan and does not involve memory loss, but rather extraordinary autobiographical memory, what scientists have recently named Highly Superior Autobiographical Memory. Unlike Henry Molaison, who after his surgery was unable to form new autobiographical memories, Jill, along with others who possess such superior memory, can remember (i) virtually everything they have done, where they did it, and with whom, and (ii) all important public events that occurred during their lifetime of which they had knowledge at the time the event occurred.

Jill first began to realize her great memory ability in 1978 when she was in the 7th grade studying for a test. Like many 7th graders, she was not enjoying middle school. It was May 30th and her mind drifted to what she was doing one year before and she

realized that she could remember in great detail everything that happened on May 30th of the year before, including the fact she was sitting on the beach with family near lifeguard station #4.

Two months later, Jill was sitting on the beach with her friend Kathy when Jill remembered that she and Kathy had been together on the beach exactly one year before. When Jill told Kathy that they had been together at the same beach the prior year, Kathy looked at Jill and said that she vaguely remembered being with Jill, but had no recollection of the date.

As Jill grew up, her inability to forget caused her, as she describes in her aptly named book The Woman Who Can't Forget, to become a “prisoner to my memory”, which she described as “tyrannical”. Many of us have had middle school experiences that over the years we have been successful in forgetting or have been able to edit to remember only the good times. We also may be able to forget about family fights and hurtful words said or received from family and friends, but Jill has no delete button; such memories are as fresh as the day the fight took place or the words were exchanged. Recall Henry’s answer, when asked if he remembered the police officers: “Sometimes it’s better not to remember”.

Jill began seeing a therapist to help her cope with her unforgiving memory, but the therapist, like her mother, offered little help other than telling her to stop dwelling so much on the past.

In the year 2000 and at the age of thirty four, Jill's concerns about her memory caused her to do what we all do today if we have a question: She began a search on-line by typing the word "memory". Her search did not reveal any obvious information about individuals with her extraordinary memory, but the first entry was a man named Dr. James McGaugh, a memory scientist at the University of California.

Jill sent an email to Dr. McGaugh, which included the following:

"I just hope somehow you can help me. I am thirty-four years old and since I was eleven I have had this unbelievable ability to recall my past. I can take a date, between 1974 and today, and tell you what day it falls on, what I was doing that day and if anything of great importance occurred that day.... It is non-stop uncontrollable and totally exhausting..."

The email evaded Dr. McGaugh's spam filter and Jill received a response within ninety minutes after she hit the send button.

Dr. McGaugh was skeptical, but went ahead and invited Jill to come to the university for a meeting. Dr. McGaugh had with him a book entitled **The 20th Century Day By Day**. From the book, Dr. McGaugh prepared two lists, one a list of dates when important events occurred and a second list of events that had taken place and the date the event occurred. Dr. McGaugh soon learned that Jill's memory was more accurate than the book.

The first date on Dr. McGaugh's list was November 5, 1979. He asked Jill what day of the week did it fall upon and what happened on that day. She correctly responded that it was a Monday, but she could not recall any important event that occurred on that day, although she did say that on November 4th the Iranian students invaded the U.S. Embassy. Dr. McGaugh shook his head and said no, the Embassy was taken over on November 5th. Jill was adamant the correct date was November 4th and Dr. McGaugh checked another source and found out that the book was incorrect and Jill had the right date. Jill went on to correctly answer questions such as what happened on August 16, 1977 (Elvis Presley died), June 6, 1978 (California Proposition 13 passed), May 25, 1979 (plane crash in Chicago). She also remembered the date Bing Crosby died on a golf course in Spain (October 14, 1977), because she heard the news from a car radio while travelling with her mother.

While Jill has great autobiographical memory, she has no unusual ability to remember long list of numbers like the number of digits in pi nor does she have the ability of a savant like the Dustin Hoffman character in the movie **Rain Man**, who memorized phone books and baseball statistics.

While Jill was the first person that Dr. McGaugh and his fellow scientists identified as having Highly Superior Autobiographical Memory, up to 50 more individuals have been subsequently identified who share with Jill this extraordinary memory of personal experiences and important public events. Recently *60 Minutes* profiled several of these individuals, including actress Marilu Henner.

Like Professor Corkin, Dr. McGaugh and his fellow scientists who have studied Highly Superior Autobiographical Memory are interested in whether there are physiological differences in the brains of individuals with this superior memory. While no individual has donated their brain to science, scientists have taken MRI scans of individuals with highly superior memory and have observed that their brains do appear to differ from those of us who forget the location of our car keys. According to a February 2014 article in *Scientific American* written by Dr. McGaugh, scientists have discovered that the gray matter and the white matter in the brains of these individuals varied in size and shape from similar matter in the brains of individuals who forget to buy their spouse a birthday present. Like most scientists, Dr. McGaugh raises the chicken and the egg question: he cannot be sure whether the brain differences cause the extraordinary memory ability or whether the brain differences are a consequence of extensive use of that ability.

In an interview with ABC Television, after Jill noted that her extraordinary memory sometimes can be a burden because she remembers so many events or decisions that she now may regret, Jill was asked if science can do anything to help her. She responded no, absent a lobotomy. I suspect Henry Molaison would agree that she should avoid such drastic a remedy.

Ronald Cotton

Ronald Cotton did not suffer any brain injury and he had a normal memory, but he was the victim of the faulty memory of an eyewitness who mistakenly identified him as a perpetrator of a crime.

A recent study by a professor and a student of the University of Michigan Law School focused on 873 cases where individuals had been convicted of a crime and were subsequently exonerated—found innocent. Many of the exonerations were by DNA evidence, as was the case of Ronald Cotton. The study found that an astounding 43% of the cases involved mistaken eyewitness identification. Where defendants were wrongfully convicted of sexual assault, like Ronald Cotton, 80% involved mistaken eyewitness identification.

In July of 1984, Jennifer Thompson was a 4.0 college student in Burlington, North Carolina living in an off campus apartment. Late one night, a man broke in and brutally raped her. During the attack, Jennifer later said she stayed calm because she wanted to survive and to be able to later identify her attacker to the police. She was successful in distracting her attacker by feigning the need to go to the bathroom and offering him a drink of water in the kitchen. This allowed her to turn on lights to have a better look at him, and ultimately to escape out the back door.

Jennifer later recounted that during the attack she paid very careful attention to her attacker's face, eyes, weight, height, and what he was wearing. She was determined to remember all these identifying features.

A police detective, Mike Gauldin, asked Jennifer to help in the preparation of a composite sketch of her attacker---a black man with a thin mustache. The newspapers published the sketch and a man named Ronald Cotton, who resembled the face in the paper, became a suspect.

In a subsequent photo lineup, Jennifer was asked by detective Gauldin to look at the pictures of 6 men and asked if she could identify her attacker. Jennifer said later she assumed her attacker must be one of the men in the photos. She approached the task like she was taking a multiple choice exam question ---take her time, read all the choices first, eliminate the obvious wrong answers, and then pick the correct answer. She did take her time, and she picked one of the photos---it was Ronald Cotton. She asked if she "did OK", and detective Gauldin responded by saying "you did great".

The next step was a physical line up. With detective Gauldin again present and responsible for the lineup, Jennifer was asked to identify her attacker from a group of 7 men--- identified by number. Ronald Cotton was number 5. Jennifer took her time, and then identified number #5 as the one. Again, she asked how she had done, and the police congratulated her for being able to identify her assailant.

There was a second rape the same night that Jennifer was attacked. The police were convinced the same man was responsible for both crimes. Mary Reynolds, the second victim, could not identify her assailant, and because Mary could not identify Ronald, the prosecution decided to charge him only in Jennifer's case.

In January of 1985, Ronald was convicted of the crime, largely based on the eyewitness testimony of Jennifer, who was absolutely confident and convincing to the jury in her identification of Ronald.

While in prison, Ronald met a fellow inmate named Bobby Poole, who also lived in Burlington at the time of the attacks. Bobby closely resembled Ronald and bore an amazing resemblance to the original composite sketch of the attacker. One day a fellow inmate told Ronald that Bobby had confessed to him that Bobby had in fact committed the attacks on Jennifer and Mary.

Ronald appealed his conviction and in 1987 the appellate court ordered a new trial. This time, Ronald was charged with the attack on Jennifer and Mary. What happened at the second trial could have been straight from a John Grisham novel. Jennifer again testified and identified Ronald, and although Mary could not identify her attacker at the time it occurred, at the second trial she testified and identified Ronald as the man who raped her. For reasons only lawyers could understand, the judge did not allow the jury to hear evidence offered by the defense that Bobby Poole was responsible

for both crimes. Bobby was in the courtroom yet neither Jennifer nor Mary recognized him. Ronald was convicted of both crimes and sentenced to life plus 50 years.

In 1995, 10 years after Ronald's original conviction, the criminal justice system learned about the science of DNA in the O. J. Simpson trial. DNA testing proved that Ronald was innocent and Bobby Poole was guilty of both crimes. After 11 years in prison, Ronald was released from prison and was a free man.

Two years later, at Jennifer's request, she met with Ronald to express her sorrow and ask for forgiveness for her mistaken testimony. At a forum on criminal justice taped on C-Span, Jennifer remarked that when she met Ronald, she realized immediately he was too tall to have ever been her attacker, and she asked rhetorically "how did my memory fail me?" Indeed, memory is treacherous.

Criminal psychologists have now recognized that memory of what we see is not like a video recorder. Our memory is susceptible to suggestion, if not manipulation. In a lineup, if the real perpetrator is not included, a witness tends to choose the individual who most closely resembles the perpetrator. Once an individual is identified, the police may inadvertently reinforce the memory and the choice –Jennifer was told "good job". The police official in charge of the lineup should not know who in the lineup is the suspect, thus avoiding the power of suggestion.

As a footnote, Thompson and Cotton co-wrote a book, **Picking Cotton- Our Memoir of Injustice and Redemption**, and also appeared on *60 Minutes* and told their story.

Conclusion

I do not remember the name of my business law professor nor do I know if he ever published or wrote about the experiment in his class that morning. I initially concluded that he was ahead of his time, but upon further research, at least according to the internet, in 1908 a professor in Berlin conducted a similar experiment with similar results of inconsistent recollections from his students. I also saw a reference that a college professor in Maine conducts a similar experiment with his students, but this time the crime is only the theft of some chalk, and the students are not questioned as to what they saw until after signing a written consent to participate in the experiment. Bloomington in the early 1970s was not so politically correct.

I may have identified some of the mysteries of memory, but as is usually the case, it is easy to raise a question but more difficult to provide an answer, or in this case, to solve a mystery.

Indeed, memory is treacherous.

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