



McGaugh: Memory a long, remarkable process

(CNN) -- Memory is a universal, if often misunderstood, process central to people's sense of identity -- who they are, what they know and how they envision their future.

James L. McGaugh, a neurobiology professor at the University of California, Irvine, talked with CNN's Dr. Sanjay Gupta about the complex process of memory.

DR. SANJAY GUPTA: How do movies get memory wrong?

JAMES MCGAUGH: The screenplay writers seem not to understand the nature of memory loss. Let's take a person who has amnesia, for example. A person with amnesia is unable to record and store new information. Among the new information that we store is our plan to do things. So that means, if we have amnesia, we've lost the ability to store new information -- to make a plan.

So people with dense amnesia live in the present and in the long past. And the longer they have amnesia, the older the past is because there will be a growing gap between the last thing they remember and the time of the present.

Anyone who writes about amnesia for a screen production or a play has to understand that their characters can't have plans or intentions. Because plans are nothing but our memories of what we intend to do.

GUPTA: What about specific movies?

MCGAUGH: In "Memento," for example, the lead actor is always dealing with a plan ... Well, densely amnesic people don't have plans to discover something; they have to be reminded that it's time to eat.

Another example -- and there are several of these -- are movies and plays in which it's alleged that specific memories can be eliminated. So that you have some awful memory that's driving you to distraction, and you decide that you'd like to get rid of that particular memory. Let's say it's the memory of a former wife or the memory of someone who has mistreated you.

The idea is that one could, by some magic of neuroscience or technology, reach into the brain and pull out selectively that particular memory, leaving everything else OK. Well, that's not going to happen.

GUPTA: What's wrong with the assumption of memory being attached to only one part of the brain?

MCGAUGH: What we have learned during the course of this research is not places in the brain where specific memories are stored, but what different regions of the brain do in the processing of memories. We know that parts of the brain are not equal with respect to the creation, the maintaining and the retrieving of our memories. But they all have functional roles to play.

The most famous clinical case in memory is H.M., well known to everybody who has ever taken a psychology or neuroscience course. The young man had brain seizures and, as a consequence, had surgery on the temporal region on the brain, the hippocampus. After the surgery, the seizures were reduced, but he was left with a very specific disorder. He

was -- and he is still alive today -- after that unable to acquire any new specific information about the world. He couldn't learn anything.

Yet his functional intelligence remained very good. He could remember very recent events at a normal level, and he could remember things he had learned prior to the surgery. So old memories are intact, very recent memories are intact, [as] was his ability to acquire new motor skills.

Now, why was this important? It told us that this region [hippocampus] is important for making new memories, but it's not the permanent home of them. That's because he had that region removed, and his memories were not lost. His sunshine was not removed.

GUPTA: Where in the brain would we go to find the different parts of a memory? Your wedding, for example.

MCGAUGH: The dominant view is that the neurocircuitry underlying my memory of that day is widely distributed throughout the brain that would handle each part of the information. So the visual memory of what things look like might be stored much closer to the visual association area of the cortex. The memory of the sounds, because every wedding has a sound and music, those would be located in the parts of the brain more closely associated with the auditory cortex. And so on ...

If memories were like a book in a library, then we could always go to that spot and pull it out. And it would always be like the book -- maybe a just little worn from being used, but the words would still be there in the same order. But that's not the way our memories ordinarily are, with the possible exceptions of things we memorize extremely well [like a social security number, phone number or spouse's name].

Remembering is a constructive process, in which the brain is very active in pulling out information in an attempt to integrate that information to create what we then record and recall as the memory.

GUPTA: Is a memory made in trauma biologically different than one made under normal circumstances?

MCGAUGH: Our memories of events that are slightly or somewhat exciting are just like all our other memories, they just last longer. They are just a little stronger.

So if we ask someone if they remember your graduation from high school, that would be better remembered than the day before your graduation. If you move up a bit, and say you remembered where you were and what you were doing, if you are old enough, when [President Kennedy] was shot. Most people will claim they do, in fact, remember, in a general way (not all the details).

People have been asked where they were and what they were doing when the last big earthquake near San Francisco, California, hit [in 1989]. People who lived near San Francisco gave very strong and clear reports on what they were doing and they remembered it a year later, with very few errors made. People in Georgia also remembered initially where they were, but a year later didn't remember so well. They weren't threatened very much by the earthquake; people in the San Francisco area were.

So if something is highly significant to you personally, you are going to be emotionally excited about it and you are going to remember it better. Not necessarily perfect: This is not making perfect memories, this is making stronger and longer lasting memories.

We have all these degrees of excitement and remembrance, and then we can move onto severe trauma. If you're on the [battlefield] and your friend's head gets shot off, that's a little more exciting than your high school graduation. There will be a very strong memory of that and that can lead to post-traumatic stress disorder at the extreme.

GUPTA: How quickly are memories made?

MCGAUGH: Memories are not made instantly. They start to form at the time of the experience, and then it takes a while to become fixed. So a learning experience initiates consolidation, which lasts for a period of time. Think of it as the setting of Jell-O. You make Jell-O by pouring it into a bowl, [then] you put it into a refrigerator. But it's not Jell-O for a while. The brain makes memories in a slow fashion, so anything done after learning can either disrupt it or enhance it.

GUPTA: How important is memory to the human experience?

MCGAUGH: Memory is by far the most important capacity that we have. Nothing comes close. If you don't have a memory, you don't care if you had heart disease or cancer because you wouldn't know, simple as that.

Everything that we do as human beings is based on our memories -- all our experiences in the past, our ability to communicate, our language. We make our plans, our aspirations ... based on our memories. Without it, we are like vegetables.

In order to see the importance of this, all you have to do is see a friend or loved one when they have a disease that robs them of memories or the capacity to make new ones. They become different people, they are the people that we no longer know. So memories are essential to our life. They define us. They are who each of us happens to be.

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