published in Reader's Digest,
25 April 2015

link to Reader's Digest article [1]

brain [2] wonder [3] exercise [4]

No other human system works in such absolute robustness and weakness simultaneously. Whilst frustrating, this design is essential to ensure that our brains are not overloaded with memories. But what determines which memories stay?

“Precious memories, how they linger, how they ever flood my soul!” sang Jim Reeves, Dolly Parton, Bob Dylan and countless others over the years. It is true that special memories seem to stay with us into old age; reminiscence afternoons are steadfastly popular in nursing homes and the nation delights to stir up memories of bygone eras. Yet despite the remarkable capacity of the human memory, we all know how it feels to have forgotten what we went upstairs for, or where we parked the car.

The Science of Memory

Scientists have wondered whether easily forgotten and long-term memories are perhaps stored differently in the brain. Lending support to this hypothesis is the brain of a patient called Henry Molaison, who underwent removal of large parts of his brain to treat epilepsy in the 1950s. After surgery, his short-term memory was intact, but he could no longer form long-term memories, suggesting that different areas of the brain may hold memories for different lengths of time.

Even more intriguingly, individual brain cells (neurons) might hold some memories more tightly than others. In animal studies, some types of learning cause a temporary increase in the amount of brain chemical released from neurons, whereas at other times of learning neurons grow permanent new connections: could this underlie permanent memories?

The Importance Of Sleep

Away from the microscope, simple everyday activities seem to have a lasting effect on memory. It is heartening to know that sleep, an activity that occupies about a third of our lives, is essential in consolidating memories. Dr Kate

Porcheret, of Oxford University, has shown that sleep deprivation greatly reduced patients' recall of a video they had seen; Professor Wen-Biao Gan in China has observed new neuronal connections forming in mice brains, when they slept after learning a new motor task.

Memories need Exercise!

Physical exercise also strengthens memory formation. In 2011, Erickson and colleagues in Illinois showed that increased levels of walking enlarged the volume of the hippocampus, a deep brain structure essential for memory formation.

Repetition of a task also helps form long-term memories; just consider the way you can remember your times-tables having chanted them throughout childhood, or how popular wartime songs remain on the lips of elderly people. And why do smells of grandma's house bring memories of her flooding back? It is known that the olfactory bulb, the part of the brain for processing smells, lies right next to the hippocampus.

Making Connections

Perhaps then, in a small way, we can actually help our brains form long-term memories. Unlocking the deep secrets of the memory so as to really sharpen it may be a tall order however; Neuroscientist David Eagleman summed up the scale of the challenge when he said, "there are as many connections in a single cubic centimetre of brain tissue as there are stars in the Milky Way". Memory is indeed a marvel.

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