Brain overload explains missing childhood memories

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Scientists believe they've learned why toddlers don't retain early memories.

Scientists – and parents – have long wondered why we don’t remember anything that happened before age 3. As all parents know, no matter how momentous an event is in a toddler’s life, the memory soon drifts away and within months there isn’t even a wisp of it left.

Now a new study shows that “infantile amnesia” may be due to the rapid growth of nerve cells in the hippocampus, the brain region responsible for filing new experiences into long-term memory. The study was presented Friday at the annual meeting of the Canadian Association for Neuroscience.

While youngsters do seem to remember important events for a short time after they occur, they lose these memories as time goes by, says study co-author Paul Frankland, a senior scientist at the Hospital for Sick Children in Toronto.

“They can’t form stable memories of what happens in the first few years,” Frankland says. “I have a daughter who is 4 years old and because we were working on this study, I would always ask her questions about her memories of places we visited 2, 3 months ago. It’s clear that she can form memories with quite some detail. But four years from now she won’t remember anything.”

There’s always been a suspicion that the hippocampus had something to do with the puzzle, says Dr. Eric Kandel, Kavli professor and director of the Kavli Institute for Brain Science at Columbia University and senior investigator at the Howard Hughes Medical Institute.

“The hippocampus matures slowly and probably doesn’t reach any reasonable maturity until we’re 3 or 4,” Kandel says. “While 2- and 3-year-olds can remember things for a short time, the hippocampus is required for long-term storage of those memories.”

But nobody really knew the details of what happens in a toddler’s brain.

Frankland suspected that memories actually got filed away into long-term storage, but that the hippocampus lost track of where they’d been stacked during the rapid growth phase that takes place in the first few years of life.

As the hippocampus matures, huge numbers of new neurons come on line and need to be hooked into existing circuits, he says. The most likely scenario is that in all that restructuring, the brain “forgets” where it stored the memories.

As the expansion slows down, the brain can better keep track of where everything is filed away – so long-term memory gets better as youngsters get older.

To test his theory, Frankland gathered up some baby mice and slowed down the rate at which new neurons were formed in the hippocampus. Normally baby mice have the same problem with long-term memory that human toddlers do – if you teach them to navigate a maze, after a few days they’ll forget how to find their way around. But with neurons being produced more slowly, the mice now were able to form long-term memories and remember how to get through the maze.

Frankland’s approach appears to be “sensible and correct,” says Kandel.

Dr. Liana Apostolova of the UCLA Brain Research Institute was delighted to have an answer to why her 6-year-old doesn’t seem to remember things that she recollects as very important. "This is a very interesting finding,” she says, “and it ties in greatly with what's in the literature."

It seems like a case of overload, she says. The hippocampus has two jobs: to make a sort of tape recording of each event and then to file that tape recording away in long-term storage, with flags that allow the person to retrieve it. With all the energy spent making new neurons, the filing never gets done.

Interestingly, Frankland says he may actually get a chance to check out his theory on humans soon. He sees many children with brain cancer who receive drugs that, as a side effect, slow down the generation of new neurons. “We can check to see if the treatment preserves memories of things that happened just before the chemotherapy, just as it did in the mice,” he says.

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