The New York Times | http://nyti.ms/1uttZTy

HEALTH

How the Brain Stores Trivial Memories, Just in Case

By **BENEDICT CAREY** JAN. 21, 2015

The surge of emotion that makes memories of embarrassment, triumph and disappointment so vivid can also reach back in time, strengthening recall of seemingly mundane things that happened just beforehand and that, in retrospect, are relevant, a new study has found.

The report, published Wednesday in the journal Nature, suggests that the television detective's standard query — "Do you remember any unusual behavior in the days before the murder?" — is based on solid brain science, at least in some circumstances.

The findings fit into the predominant theory of memory: that it is an adaptive process, continually updating itself according to what knowledge may be important in the future.

The new study suggests that human memory has, in effect, a just-in-case file, keeping seemingly trivial sights, sounds and observations in cold storage for a time in case they become useful later on.

But the experiment said nothing about the effect of trauma, which shapes memory in unpredictable ways. Rather, it aimed to mimic the arousals of daily life: The study used mild electric shocks to create apprehension and measured how the emotion affected memory of previously seen photographs.

In earlier work, researchers had found plenty of evidence in animals and humans of this memory effect, called retroactive consolidation. The new study shows that the effect applies selectively to related, relevant information.

“The study provides strong evidence for a specific kind of retroactive enhancement,” said Daniel L. Schacter, a professor of psychology at Harvard who was not involved in the research. “The findings go beyond what we’ve found previously in humans.”

He and other experts cautioned that the details of retroactive consolidation were still far from clear. No one knows which past memories an emotional experience flags, how far back in time it reaches or, indeed, whether it also suppresses some details. Memories are not fixed when encoded, experts said, and can be weakened by later events, as well as strengthened.

The study, done at New York University, had several stages. In the first one, the 119 participants sat in front of a computer watching photographs scroll by, and categorized each one as a tool (hammer, saw, ladder) or an animal (horse, eagle, kangaroo). They saw 30 tools and 30 animals, in no particular order.

Five minutes later, the men and women again sat in front of the computer, only this time with electrode wires attached to one wrist. The research team, led by Joseph Dunsmoor, a postdoctoral fellow in cognitive neuroscience, calibrated a shock level for each person that was uncomfortable but not painful. The participants then categorized a new set of 60 photographs, 30 tools and 30 animals, in random order. Half of the group received a shock most times they saw an animal, and half received one most times they saw a tool.

The research team then gave the participants a surprise test, measuring how well they remembered all the photographs, particularly the first set. The results varied depending on when people took the test.

Those who took it right away remembered as many tools as they did animals; the shocks had no apparent effect. But those who took the test six hours or a day later recalled about 7 percent more items from the "shocked" category. For example, they remembered more tools if they had been zapped seeing tools.

"The emotional experience of the shocks strengthened or preserved the memories of things that, at the time they were encoded, seemed mundane," Dr. Dunsmoor said in an interview. "At least when it's tested hours or a day later."

Dr. Dunsmoor's co-authors on the study were Vishnu Murty, Lila Davachi and Elizabeth Phelps.

The fact that the retroactive strengthening took time to happen — none was evident in people tested immediately — leaves the timing unclear.

"That's the most surprising finding to me, that the enhancement depends on some consolidation process we don't yet understand," Dr. Schacter said.

This finding raises at least as many questions as it answers. How long are items stored in the "just in case" mode? Are some too weak to be consolidated? Are others, which are not very relevant, also somewhat strengthened — or weakened? And do rewarding experiences enhance past details in the same way?

The TV detective would want to know, and so do the scientists. "All questions for further research," Dr. Dunsmoor said.

A version of this article appears in print on January 22, 2015, on page A14 of the New York edition with the headline: How the Brain Stores Trivial Memories, Just in Case.
