Limits of memory retrieval allow us to live in the present

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Renowned violinist Louise Owen is sitting across from CBS News correspondent Lesley Stahl when Stahl asks Owen to recall what she did two decades ago, on April 21, 1991.

"Okay. 1991, [it was] a Sunday. I was in Los Angeles and had a concert with the American Youth Symphony," says Owen. "I don't remember what I had for lunch but I remember what I had for dinner the night before."

Stahl is wide-eyed and speechless. Owen is matter-of-fact.

"It's almost as automatic," she tells Stahl, "as if you were to say, 'What is your name, and where do you live?'"

Owen is one of a handful of people in the United States who have hyperthymesia, also known as superior autobiographical memory, or the rare ability to remember and relive their entire lives.

Luckily, most people can and do forget events and tasks— a blessing in disguise, especially when appointments are missed or items are forgotten at the grocery store. The ability to forget and change memories, says Almut Hupbach, enables humans to keep their memories up to date.

Hupbach, an assistant professor of psychology, says these episodic memories, which she refers to as "mental time travel," are stored in different parts of the brain and bound together by the hippocampus.

Reopening the memory trace

Her interest in episodic memories was piqued by a 2000 study of rats by psychology professor Karim Nader of McGill University and his colleagues, which found that through invasive pharmacological manipulation, memories can be almost wholly erased.

"You can take a fear-conditioned memory, and you can reactivate it, which supposedly reopens that memory for modification," Hupbach says. "If at that point you inject a protein synthesis inhibitor into the amygdala, the brain's center for fear, the fear memory will be lost or erased. That was the most critical finding of the study by Nader et al."

Hupbach's fascination with Nader's results led her to develop a human paradigm that seeks to change episodic memories without administering pharmaceuticals.

"In our paradigm, participants learned a set of everyday objects," she says. "After a delay, we brought them back and reminded them of the first learning episode, potentially reopening the memory trace for the first set of objects to modification.

"We then showed these participants a new set of objects with the idea that this new set might influence memory for the old set of objects. To assess this, we asked them, after another delay, to recall only the first set of objects."

Hupbach's results were compatible with, but different from, the results obtained in the animal world: While rats' fear memories were erased, the human participants' memories of the original event remained intact. By opening up the memory trace for the original event during the second session, however, Hupbach was able to "update" the memory of her participants—when recalling the objects from the original set,

participants interspersed them with objects from the newer set.

"It is as if reminding someone of something from the past opens up the memory for modification so that new details can be added," she says.

The vulnerability of memories is more of a blessing than a curse, says Hupbach. Indeed, people like Owens tell of their inability to live in the present because they are constantly reminded of events from their past, no matter how trivial and inconsequential those past events may have been.

Another hyperthymesia patient, AJ, has described her superior memory as a running movie that never stops and is split between two screens, the past and the present. She says her memory is a burden.

For people like this, forgetting something—anything—may be advantageous and desirable. Trying to get someone, even a person without a superior autobiographical memory, to forget something from the past is no easy task, however. This is the focus of another area of Hupbach's research—intentional directive forgetting, or telling someone to forget a past event.

Hupbach has found that telling someone to forget a past event is often a futile exercise although it is possible under some conditions: In her studies, people could forget a learned set of objects, such as pictures, if the instruction to forget was immediately followed by the learning of a new set of pictures. However, such forgetting seems to be limited to information learned recently, and does not apply to memories from the more distant past. So intentionally forgetting a troublesome memory, especially one that occurred some time ago, might be difficult without the use of pharmaceuticals, she says.

Some animal researchers have been working on developing a drug that

blocks PKMzeta, a kinase crucial to memory recall. After targeting a specific memory to erase, the PKMzeta blocker would be administered and patients could continue living without being dogged by a troublesome memory.

This sounds a lot like the not-so-distant future of the 2006 film Eternal Sunshine of the Spotless Mind, in which patients go to a clinic to have their most painful memories erased.

Thankfully, Hupbach says, our memories, even the most unpleasant ones, are important to us.

"At first, people say, 'Sure. It would be great if I could forget my last breakup or something unpleasant,' she says. "If you ask them a little bit more in detail, however, most people say that they wouldn't want to completely forget anything because it's part of their identity."

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