

Memory – The Ultimate Guide

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Here are two of the seven articles which made up the Memory Guide in *New Scientist* #2885. If you want to see the others, try your local library.

Memory: Remembrance of things to come

by David Robson

The discovery that memory evolved to allow us to predict the future rather than recall the past has some very strange implications.

WHEN thinking about the workings of the mind, it is easy to imagine memory as a kind of mental autobiography - the private book of you. To relive the trepidation of your first day at school, say, you simply dust off the cover and turn to the relevant pages. But there is a problem with this idea. Why are the contents of that book so unreliable? It is not simply our tendency to forget key details. We are also prone to "remember" events that never actually took place, almost as if a chapter from another book has somehow slipped into our autobiography. Such flaws are puzzling if you believe that the purpose of memory is to record your past – but they begin to make sense if it is for something else entirely.

That is exactly what memory researchers are now starting to realise. They believe that human memory didn't evolve so that we could remember but to allow us to imagine what might be. This idea began with the work of Endel Tulving, now at the Rotman Research Institute in Toronto, Canada, who discovered a person with amnesia who could remember facts but not episodic memories relating to past events in his life. Crucially, whenever Tulving asked him about his plans for that evening, the next day or the summer, his mind went blank - leading Tulving to suspect that foresight was the flipside of episodic memory.

Subsequent brain scans supported the idea, suggesting that every time we think about a possible future, we tear up the pages of our autobiographies and stitch together the fragments into a montage that represents the new scenario. This process is the key to foresight and ingenuity, but it comes at the cost of accuracy, as our recollections become frayed and shuffled along the way. "It's not surprising that we confuse memories and imagination, considering that they share so many processes," says Daniel Schacter, a psychologist at Harvard University.

Over the next 10 pages, we will show how this theory has brought about a revolution in our understanding of memory. Given the many survival benefits of being able to imagine the future, for instance, it is not surprising that other creatures show a rudimentary ability to think in this way ("Do animals ever forget?"). Memory's role in planning and problem solving, meanwhile, suggests that problems accessing the past may lie behind mental illnesses like depression and post-traumatic stress disorder, offering a new approach to treating these conditions ("Boosting your mental fortress"). Equally, a growing understanding of our sense of self can explain why we are so selective in the events that we weave into our life story - again showing definite parallels with the way we imagine the future ("How the brain spins your life story"). The work might even suggest some dieting tips ("Lost in the here and now").

It is still early days, but what's clear is that we are at the beginning of a long and exciting journey. "The one thing that we really have learned is that memory is extraordinarily more complicated than anyone would have thought 10 or 20 years ago," says Tulving

Memory: How the brain spins your life story

By Kirsten Weir

GRADUATION day. The first concert you attended. Your first kiss. These personal recollections stand apart from memories of shopping lists or the world's capital cities. Autobiographical memories define us; they are who we are.

Yet they are far from complete, with some periods of our lives producing heaps of recollections while others receive relatively patchy coverage. What forces lead us to remember one event but forget another? Until recently, the subject had largely been a black box to researchers, but they have now begun to make huge strides towards an understanding of the way our minds write our life story.

Our brains certainly start remembering at a young age, learning simple associations before we are born. One small study even found that newborns tend to stop crying when they hear the theme tune of a TV show their mother often watched while pregnant, perhaps because it reminds them of the comfort of the womb. But we cannot consciously remember specific events from before the age of 2 or 3, when our autobiographical memory begins to develop. Even then, we are hard-pressed to remember much from before our sixth birthday.

So far, three different factors have emerged that might explain this hazy recall. One possibility is that the neural pathways are not mature enough between the hippocampus - where memories are consolidated - and the rest of the brain, so our experiences from this period may never be cemented into long-term storage. Our burgeoning language skills also play a key role, says Martin Conway at City University London, because words provide a kind of scaffold on which we hang our memories for future retrieval. His experiments have shown that children don't tend to remember an event until they have learned the words to describe it.

A sense of our own identity is also crucial for our memory of particular experiences. In a series of experiments, Mark Howe at Lancaster University in the UK showed toddlers a toy lion, which he then placed in a drawer. A week later, those who could recognise themselves in a mirror - a sign that they had developed a sense of self - were able to recall where he had placed the stuffed toy, while toddlers who failed the mirror test drew a blank.

As we get older, our identities and recollections develop together in an intimate dance. While the events in your life shape your opinion of yourself, your personality also determines what you remember; someone who thinks they are courageous might fail to remember a time when they acted cowardly, for example. "Your sense of who you are and how you enact your personality traits is very tied up in autobiographical memory," says Robyn Fivush at Emory University in Atlanta, Georgia.

Guiding all of this are our parents, who form our identities and cement our memories with their storytelling. When families discuss personal events in an elaborate way, children develop more detailed narratives of their own by the time they reach school age than those whose parents weave less intricate stories. Psychologist Qi Wang at Cornell University in Ithaca, New York, believes this may explain the influence of culture on the way we reminisce. Chinese parents tend to focus less on individual experiences and emotions when discussing the past, with fewer details, than Americans, for instance. As a result, Wang has found that Chinese people's memories, even during adulthood, tend to be less personal, focusing instead on events of social or historical significance.

As we venture further from the safety of our parents' embrace, our autobiographical memories continue to mature. The difference is quite noticeable, says Conway; a 10-year-old cannot relay a coherent life story, but a 20-year-old can go on for hours. "Something happens over that adolescent period." But what? So far, studies to tackle that question are lacking. "There's a big lacuna between about age 7 to late adolescence where we don't really know what's going on," he says.

The cultural script

We do know, however, that we are more likely to remember events from the end of this period, in young adulthood, than from any other period in our lives. This "reminiscence bump" may be the result of anatomical changes to the still developing brain. Alternatively, it may be that our brains feel emotions more keenly during adolescence and early adulthood - and memories linked to intense feelings stick in the mind for longer.

Or perhaps it is simply down to the fact that many important landmarks in our lives - learning to drive, graduating and falling in love for the first time - tend to fall within this period. "Those distinct events are more likely to be remembered, because they're culturally marked," Fivush says.

Recent work in Denmark supports this idea. Annette Bohn and Dorthe Berntsen at Aarhus University found that when young children were asked to write their future life stories, most of the events they imagined took place in young adulthood, mirroring the reminiscence bump. So it seems that we are aware of the "cultural life script" from a young age, which may mould our recollections of events as they occur.

The finding dovetails with the idea that memory and foresight share the same machinery in the brain. A child's ability to imagine the future seems to develop in tandem with his or her autobiographical memory, for instance. Wang, meanwhile, has found that the cultural differences that shape our personal narratives can also influence our planning abilities, showing that Chinese people are less likely to give specific, personal details than Americans when they talk about events to come.

Our autobiographical memories aren't perfect, to be sure. But whether we are looking forward or gazing back into the past, our personal narratives are central to understanding our place in the world. That's a point worth remembering.

Shared recall

Autobiographical memories are, by definition, personal. But that doesn't mean they are all our own, says Amanda Barnier, a cognitive scientist at Macquarie University in Sydney, Australia. She and her colleagues interviewed couples that had been married for decades. Not surprisingly, couples who remembered together, rather than independently, were able to recall significantly more than those who took a solo approach.

Much research focuses on the downsides of this process, including the risk of false memories: it is not uncommon for people to absorb their siblings' or spouses' recollections into their own life stories, for example.

But Barnier argues that collaborative recall's benefits have long been overlooked. Understanding the cues that couples use to prompt one another could offer new ways to shore up memory in elderly people facing dementia, for instance.

"We often hear about this idea of someone losing their long-term partner, and all of a sudden they experience a rapid decline," she says. "It must be like they've lost a part of their mind."