Ongoing inquiry into how human memory works

Shreds of Memory

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What is memory? Why do we remember one thing well but forget another? Modern psychology is shedding more and more light into these corners of our minds

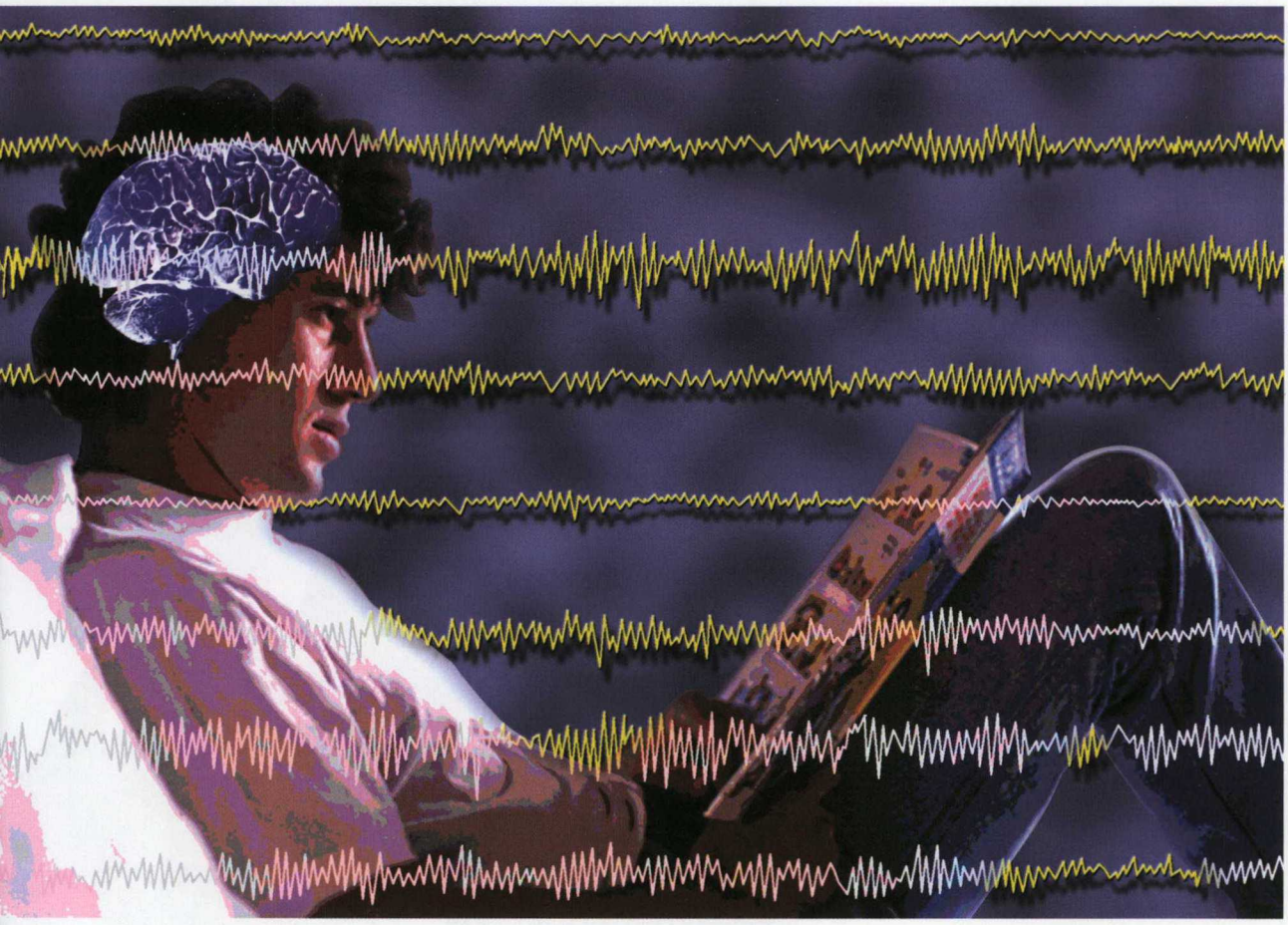
The modern psychology of memory springs from two sources and cultivates two traditions. The first was initiated by the work of Herman Ebbinghaus, particularly his *Memory: A Contribution to Experimental Psychology* (1885), while the other dates back to work by Galton in a similar period, concentrating on memory under everyday conditions. Both of these traditions remain very vibrant today.

Ebbinghaus developed a method for studying memory which showed that the memory trace of events disappears along a continuous "forgetting curve," by measuring the "savings" evidenced in re-learning. Here the subject (Ebbinghaus in fact served as his own sole subject; subsequent researchers were not as devoted and patient) memorizes a series of nonsense syllables until a certain criterion is achieved, e.g. until they produce the first correct full recall, and the time required for such memorization is recorded. After an interval, the researcher checks how well the previously memorized list is still retained. Of course, it is never remembered in full. Then the subject rememorizes the same list until meeting the same proficiency condition. This round takes less time than the previous one, and the degree of time saved in repeat learning is treated as an indicator of the strength of the trace left behind in the memory. The stronger the memory trace, the greater the "savings." Ebbinghaus claimed that memory retention showed an initial sharp drop, followed by a more gradual decrease. We might say in jest that we initially forget things very quickly but then more and more slowly, since there is not much left to be forgotten anyway.

Ebbinghaus's research indicated that time was chiefly at fault for the deterioration of memory records, but nowadays we know that forgetting depends on many other factors as well. Ebbinghaus tried to study memory in pure form, e.g. without various techniques to improve memorization speed or prolong retention time. That decision had a great impact on the study of memory, and it would only meet with critique decades later.

Breakfast schema

The second current of memory research was initiated by Francis Galton. His approach lacked the laboratory purity of Ebbinghaus's experiments, but was significantly closer to what we colloquially describe as "memory" and characterized by significantly greater ecological validity. In one of his studies, Galton asked his subjects to describe what their breakfast table looked like one or two days before. All of us can perform a similar task, convinced we remember everything correctly, and indeed we do recall things better than the "forgetting curve" would seem to indicate. According to Ebbinghaus's findings, after 24 hours we should be able to recall 34% of information, yet we recall significantly more. We can in fact remember what we had for breakfast, who sat at the table, in which seat, etc., although we might of course not remember whether the napkins on the table were white or dark yellow, whether the butter sat to the left or right. Such recollections are facilitated by the fact that we have in our minds a certain breakfast schema, a kind of summary of many breakfasts, containing information about recurring elements. Galton himself was not familiar with that explanation, but



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It is quite rare for information to be reconstructed as it was initially recorded. This may occur when the storage time is very short or when an individual knows that the information must be recalled in literal form, such as when learning poetry by rote

the importance of such schemata began to become clear with the work of Frederick Bartlett in the 1930s.

Declarative and non-declarative

The modern psychology of memory is a very active and buoyant field. The plethora of the diverse work now underway on memory becomes readily apparent when one takes even a quick look at the leading periodicals devoted to the subject: *Memory and Cognition* (published since 1972), *Memory* (since 1992) and the series *Journal of Experimental Psychology: Learning, Memory and Cognition* (since 1975).

The most important advances in the psychology of memory can be summed up in several points. There are two types of memory: declarative and non-declarative. The former is reminiscent of what is colloquially known as "memory," i.e. content that is consciously available and may be brought to mind in various situations. Declarative memory is invoked by an individual when recalling, for instance, the date of an important historical event or the atomic number of calcium. Non-declarative memory, on the other hand, does not have to be consciously accessible and it manifests itself in distinctive situations, such as ice-skating: one may know how to skate but be unable to articulate how it is done.

Lately a great deal of attention has been paid to implicit memory, defined as the impact which previous experiences may exert on behavior without the individual realizing it. For example, one can show patients suffering from amnesia a list of words such as "kayak, feather, beam." When asked to recall same words some time later, they may encounter difficulty. Yet when asked to give the first word beginning with k, f, or b that comes to mind, they will name the words from the previous list.

One new line of research on declarative memory involves studying episodic memory. The distinction between our memory of facts (semantic memory) and our memory of events (episodic memory) goes back to the work of Tulving. Episodic

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memory pertains to events characterized by continuity over time and is of a clearly more personalized nature than our memory of facts. Tulving posited the principle of asymmetry in the coding and retrieval of episodic memory, whereby the left prefrontal cortex is responsible for recording episodic information, the right prefrontal cortex for retrieving it.

Memory is as a rule not a process of a reproductive nature, although it is considered to be such a process in many cases. It is exceptionally rare for information to be reconstructed in the same form it was initially recorded in. This may occur when the storage time is very short or when an individual knows that the information must be recalled in literal form. That shows that the old metaphor of memory as a mechanism akin to a tape recorder, video recorder, or computer has long ceased to be valid. It may seem tempting to claim that our brains have working (RAM) and permanent memory stores, like those of computers, but the capacity of our working memory does not compare very well at all to that of modern computers, reckoned in gigabytes. Yet on the other hand, despite its obvious limitations, we are able to use our working memory in a more creative and flexible way. The contradictions outlined here suggest it may be very misleading to seek similarities between human and computer memory.

Since the appearance of the concept of recoding (how the content of memory becomes modified as new information is stored, studied by Tulving in the 1970s) researchers have adopted the notion that we very rarely encode anything "from scratch." Recall that coding of this type was involved in the studies of Ebbinghaus, who used nonsense syllables. The "natural" method of assimilating memories in everyday situations involves the elaboration principle postulated by Kihlstrom in 1996. It maintains that information is preserved better when it is incorporated into previously extant knowledge structures at the moment of storage. That principle enables us to understand that memory depends not only on biologically defined mechanisms, but also on educational training and the influence of culture. A good example of this can be found in the storage of information about oneself. Researchers Wang and Conway recently analyzed the crosscultural differences in memory content. They discovered, for instance, that women in Western culture evidence autobiographical recollections that are better-developed and stretch further back in time than those of men, as demonstrated by the study of MacDonald, Uesiliana, Hayne in 2000. But in Chinese culture, an analogous phenomenon occurs in boys, who enjoy a privileged position.

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Certain information may be inscribed into our memory against our will, such as when it is constantly reiterated by the media

False photographs

Memory processes are now known to be of a generative nature. After a certain time passes, people remember information in fragmentary fashion and on the basis of those shreds of information they strive to rebuild the most likely image of some

event or to reconstruct a fact as it seems most likely to them. Sometimes that leads to the reconstruction of information about events that never actually took place. Such information may appear in memory under the influence of suggestion (cases of this sort were notably analyzed by Loftus with respect to false memories instilled during therapy, for instance). It may also be the outcome of imagining to ourselves events which we never in fact experienced. Such research was initiated by Loftus and Garry in 1996. Recently, purposefully fabricated photographs have been used to instill false memories, a technique that has proven more effective than older methods. Moreover, false stories have proven just as effective in suggesting information to subjects - some time later they may begin to consider such stories real. We may surmise that phenomena of this sort stem from errors in monitoring the source of information. People cast to memory not only information about a given event, but also information about the source of that information. But source information gets forgotten quite quickly, and when it does some information from an uncertain or untrustworthy source may be treated as if it were true.

Flashbulb effect

The role of image elements in memory is currently a point of much discussion, related to what is known as the "flashbulb effect" (which I have discussed elsewhere). Research on this effect has shown that people create a nearly photographic record of moments when they first found out about a particular event of great import for their society or nation. Such events that have interested many researchers include the assassination of Swedish Prime Minister Olof Palme, the death of Princess Diana, and the attack on the World Trade Center. People who experience this phenomenon are convinced of the accuracy of their recollections, yet careful analysis of the flashbulb phenomenon has shown that the salience of recollections provides no guarantee of their being faithful. Analyses by Neisser in the early 1980s likewise demonstrated that such salience may be illusory and that individuals may frequently invoke schemata, referring to what may have and should have happened in a given situation.

One topic currently of much controversy is the link between memory and emotion. That link is frequently analyzed with respect to the memory of traumatic events. The debated issues include whether the memory of such events is better than that of emotionally neutral events, and if so whether the phenomenon of suppression occurs, as indicated by a review by Brewin last year. Many researchers, including Schacter, question the usefulness of suppression as an explanation for post-traumatic phenomena, while on the other than the psychology community has recently been intrigued by the findings of Anderson and Green, who claim they have managed to substantiate the suppression effect in the laboratory.

People create a nearly photographic record of moments when they first found out about some sort of event of great social impact

The psychology of memory is nowadays a problem of increasing social import. On the one hand people have greater memory-support means at their disposal (cell phones, palmtops) and broader access to large sets of information (the Internet), but on the other the reliability of such information highly varies and some information is even inscribed in people's memories against their will - the media, by incessantly repeating certain messages, gives people false impressions that they personally took part in a given event and cause them to feel related emotions (the average Pole has watched the flaming World Trade Center towers collapse dozens if not hundreds of times). Memory content is thus shaped not only by personal experience, but also by fabricated cultural messages. ■

Further reading:

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Wang Q., Conway M. (2005). *Autobiographical memory, self and culture*. [In:] Nilsson L-G., Ohta N. (Eds.). *Memory and society: Psychological perspectives*. Hove: Psychology Press.