
Gone But Not Forgotten

Scientists uncover pervasive, unconscious influences on memory

By BRUCE BOWER

Donald M. Thomson, an Australian psychologist and lawyer, undoubtedly will never forget the day 15 years ago when he walked into a Sydney police station on routine court-related business and was arrested for assault and rape in a weird turn of events worthy of an Alfred Hitchcock movie.

The evening before his arrest, Thomson appeared on a local television program, where he discussed psychological research on eyewitness testimony and how people might best remember the faces of criminals observed during a robbery. As he spoke, a Sydney woman watching the show was attacked, raped and left unconscious in her apartment. When she awoke several hours later, she called the police and named Thomson as her assailant.

The following day, after Thomson's arrest, the woman confidently selected him as the perpetrator from a lineup of possible rapists at the police station.

Thomson, of course, professed his innocence. "The police didn't believe me at first," he recalls, "but I had appeared on a live television show when the crime occurred, so I had a good alibi."

Officials quickly dropped the charges when they realized the woman had unwittingly substituted Thomson's televised face for that of her attacker. "She had apparently watched my television appearance very closely, but it's not clear if she ever actually saw her assailant's face," says Thomson, now at Monash University in Clayton, Australia.

The real rapist was never apprehended.

Memory researchers from Los Angeles to London still talk about Thomson's bizarre brush with the law (with inevitable embellishments and distortions, according to Thomson), and many cite it as a dramatic demonstration of how no-doubt-about-it recollections can march to the misleading beat of an unconscious drummer. Over the last decade, in fact, laboratory investigations of "implicit memory" — the unintentional retrieval of

previously studied information on tests that do not ask for that information — have surged faster than Thomson's blood pressure on the day he was wrongly accused.

"Most researchers now agree that implicit memory is more influential than explicit, conscious memory," says psychologist Robert G. Crowder of Yale University.

But opinions differ concerning the implications of implicit memory findings for an overall understanding of how memory works. One school of thought, endorsed mainly by those who study brain-damaged and amnesic patients, holds that several memory systems in the brain handle different types of implicit and explicit knowledge. Another camp, populated primarily by researchers who study healthy volunteers, regards memory as a single entity. These investigators theorize that successful performance on any memory test reflects a match between the mental processes or operations used in the initial learning of an item and those used in remembering it.

For much of the past century such a dispute was unthinkable, as psychologists focused almost exclusively on explicit, conscious memories of previous experiences. Study participants typically were asked either to recall what they had already seen — say, a list of five common nouns — or to pick out previously studied items from among two or more choices on "recollection tests."

But current memory investigations often delve into what psychologists call the "cognitive unconscious" — mental processes that operate outside of awareness but nevertheless influence conscious thoughts and actions. Considerable inspiration for this approach comes from the work of psychologist William James, who in 1890 contrasted the automatic nature of numerous habitual behaviors — driving a car, to use a modern example — with the consciously controlled use of reason.

Sigmund Freud's notion that our conscious mental lives reflect unconscious conflicts and emotions pitted against

psychological defense mechanisms rarely accommodates controlled laboratory experiments, and thus gets little attention from explorers of the cognitive unconscious.

A series of ground-breaking studies with amnesic patients, conducted in England during the 1970s, paved the way for implicit memory research. One investigation found that brain-damaged men with no conscious memory of words they had just read showed a marked preference for the same words on implicit tests. For instance, the amnesics had no idea they had read a list of five-letter words including "table," but when told to complete the word stem "tab-" with whatever came to mind, they responded with "table" as often as healthy study participants did. Amnesics also mentioned previously studied but consciously forgotten words after viewing fragmented versions of the words, in which segments of each letter were omitted and the word's identity was ambiguous.

Other researchers went on to probe the unconscious memories of amnesics with different implicit tasks. For instance, amnesics shown a list of common idioms, including the item SOUR-GRAPES, were asked to write down the first word that came to mind upon seeing a cue such as SOUR-?. In most cases, they wrote down previously studied idiomatic completions. In a test of explicit memory, however, the amnesics were at a loss to remember previously studied words when instructed to use SOUR-? and other half-completed items as cues.

As research proceeded through the 1980s, the subtle staying power of implicit memory and the relative fragility of explicit memory grew more evident. Among the findings:

- Some brain-damaged patients who have no conscious memory for faces nonetheless show preferences for previously viewed faces on implicit tests.

- Although children and the elderly display poor recognition memory com-

pared with young adults, the effects of prior study on word-stem completion and other implicit memory tasks remain stable from the wonder years through the golden years.

• While drugs such as alcohol dampen conscious recall and recognition, implicit memory remains largely impervious to these substances.

Implicit memory resists even the numbing effects of surgical anesthesia, according to a report in the September *PSYCHOLOGICAL SCIENCE*. Researchers led by John F. Kihlstrom of the University of Arizona in Tucson played tape recordings of pairs of related words (such as "house-chair") to 25 anesthetized hospital patients during surgery. Two weeks later, the patients could not recall having heard the words. When told the first word from each pair, they still had no recollection of the matching word. But when asked to report the first word that came to mind upon hearing half of each word pair, most participants responded with the other half heard under anesthesia.

Some scientists say such results indicate that implicit and explicit tests tap into distinct memory systems housed in different brain regions. In his influential book *Memory and Brain* (1987, New York, Oxford University Press), psychologist Larry R. Squire of the Veterans Administration Medical Center in San Diego draws a line between "declarative" and "procedural" memory systems. In Squire's view, declarative memory—thought to reside mainly in the brain's outer layer—holds the consciously remembered, factual and personal knowledge plumbed by explicit tests. He suggests the procedural system—with a home base in deeper brain structures—underlies the fluid, automatic performance of skilled behaviors, forms of learning such as classical conditioning, and unconscious preferences displayed on many implicit memory tasks.

In classical conditioning, an automatic response comes under the control of a formerly neutral stimulus. Pavlov's dogs provide the classic example: After several instances of hearing a bell just before receiving food, they salivated at the mere sound of the bell.

However, emerging evidence suggests that a large category of implicit memory operates independently of Squire's declarative and procedural systems, asserts psychologist Daniel L. Schacter of the University of Arizona.

In the Jan. 19 *SCIENCE*, he and Endel Tulving of the University of Toronto propose that a "perceptual representation system" directs a common type of im-

PLICIT memory known as priming. As in the British studies of amnesics, tests of priming involve the presentation of reduced perceptual information about previously observed words, pictures of objects or other items. Study participants then attempt to name or categorize incomplete items with whatever comes to mind. Priming occurs when responses predominantly refer to items already seen.

Whereas memories for motor skills, personal events or factual information lodge in specific brain regions, the perceptual representation system distributes different perceptual versions of particular words and objects throughout the brain, Schacter contends. Moreover, each

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of the multiple perceptual forms assumed by an item apparently responds to its own memory cues.

For example, in an unpublished study directed by Tulving, volunteers saw a list of words, such as AARDVARK and UMBRELLA. They later filled in three-letter fragments (say, -A-D-R- and U-R-L-), and then five-letter fragments that included the three letters already seen (-ARD-AR- and U-BR-LA). Tulving found that individuals completing a three-letter fragment with a previously studied word did not show priming for the five-letter fragment of the same word, and vice versa.

Schacter says studies of brain-damaged patients by his group and others

suggest that the perceptual representation system contains a subsystem that promotes priming by granting mental access to a word's visual form, not its meaning. Some patients with brain injuries can read aloud but have little or no understanding of written words, he notes. They correctly pronounce printed words that cannot be sounded out, such as "cough" or "blood," although they haven't the faintest idea what the words signify.

Schacter theorizes that another subsystem handles structural knowledge about objects and shapes that can exist in three-dimensional form. In studies he and his colleagues describe in an upcoming *JOURNAL OF EXPERIMENTAL PSYCHOLOGY: LEARNING, MEMORY AND COGNITION*, college students were shown line drawings of physically possible and impossible three-dimensional objects on a computer screen for 5 seconds. Participants then viewed for 0.1 second each previously seen object—as well as a new series of possible and impossible 3-D objects—and were asked to decide whether each drawing was structurally feasible. The 0.1-second flashes allowed no time for conscious mental manipulations of the drawings.

Volunteers accurately categorized only the possible objects presented previously. This, says Schacter, suggests that priming through the perceptual representation system depends on perceiving objects as "structured wholes."

Other pursuers of the cognitive unconscious perceive memory itself as a structured whole, lacking separate brain systems but obeying a few general principles.

According to these researchers, one such maxim holds that performance on any type of memory test improves when initial learning and later testing involve the same mental operations or forms of information. Most explicit tests engage the learning and memory of word meanings and semantic concepts, whereas implicit tests usually begin and end with perceptual information, observes Henry L. Roediger of Rice University in Houston. Thus, test design—rather than separate memory systems in the brain—guarantees striking differences between an individual's performance on most implicit and explicit tasks, he argues.

Roediger buttresses his point by noting that two implicit tests focusing on different types of information also produce contrasting results. In a 1987 study published in *MEMORY & COGNITION*, he and a colleague had subjects study a list of words and pictures of common objects before taking one of two implicit memory tests. One was a word-stem completion

test with stems corresponding to previously studied words, the names of already studied pictures and new items. The other test required identification of incomplete pictures corresponding to previously studied pictures, already studied words and new objects.

Prior study of pictures produced substantial unintentional memory only for corresponding picture fragments, not for picture fragments based on words in the original list. Likewise, previously seen words were generated mainly by corresponding word stems rather than by stems based on pictures. In other words, memory improved when the study and test conditions tweaked a common mental operation, such as verbal or perceptual processing, Roediger maintains.

Differences between conscious recall and recognition provide further ammunition for Roediger's argument, which he outlines in the September *AMERICAN PSYCHOLOGIST*. For instance, while healthy volunteers recall commonly used words more often than rarely used words, they identify rarely used words more accurately than common words on multiple-choice recognition tests. Roediger concludes that when individuals attempt to recall words in the absence of memory cues, automatic mental operations engaged by reading familiar words apparently kick into gear; when several choices consciously prod memory, the more deliberate mental manipulations used with unusual words take precedence.

Conscious judgments may also reflect often-deceptive unconscious inferences, contends Larry L. Jacoby of McMaster University in Hamilton, Ontario.

Jacoby regards data from implicit and explicit memory experiments as potentially misleading. Conscious recollection partially pumps up performance on some implicit tasks, including word-stem completions, Jacoby maintains. Unconscious memories sometimes influence responses on explicit tests or spark the spontaneous conscious recall of prior events, he adds.

Yet researchers can exploit a natural opposition between unconscious and conscious memories, Jacoby says.

In a series of studies, Jacoby and his colleagues found that unconscious exposure to a word quickened the conscious perception of the same word on an ensuing memory test and created an illusion of familiarity with the word. Conscious exposure to the word produced no such effect.

For example, college students in one experiment prepared for a recognition test by studying a word list. Then, just before the test, they viewed new words

flashed for a fraction of a second on a computer screen — just long enough for unconscious perception. New words also showed up on the recognition test, and students often mislabeled them as previously studied words, Jacoby and Kevin Whitehouse of McMaster report in the March 1989 *JOURNAL OF EXPERIMENTAL PSYCHOLOGY: GENERAL*.

"The flashed word produced more fluent perceptual processing of the new test word, which was interpreted as familiarity," Jacoby says.

When flashed words were shown long enough for conscious perception, students correctly labeled them as "new" on the subsequent recognition test.

In a related study described in the same issue, Jacoby and several associates made up nonfamous names and presented them on a computer screen, asking students to read the names aloud. They told all the students in advance that the names (such as Sebastian Weisdorf and Valerie Marsh) were not well known. Some volunteers devoted their full attention to the task; others were asked to read the names while listening for runs of three odd-numbered digits in a continuous string of numbers announced through a loudspeaker.

All students then rated whether or not names on a test list were famous. The new list included previously read names, new nonfamous names, and famous names (such as Satchel Paige and Minnie Pearl).

Volunteers who had been distracted by the loudspeaker during the initial name-reading task showed poor conscious recollection of the names they had read, but they often judged those names as famous when rating the test list. Students who had given full attention to reading the first list remembered most of the names later on and judged them as nonfamous.

"False fame" judgments also occurred when students gave full attention to the initial list of nonfamous names and then responded to the test list while listening for odd-numbered digits.

In both instances, divided attention blocked conscious recognition of nonfamous names, while an unconscious familiarity with each moniker bred mistaken fame judgments, Jacoby says.

Even something as basic as the perception of sound can become skewed by unconscious influences, he adds. In one study, Jacoby's research team presented previously heard and new sentences against an unchanging background of noise and asked students to judge the loudness of the noise. Students judged loudness as substantially lower upon hearing the old sentences. Jacoby asserts that previous exposure made these sentences easier to perceive through the din of the test situation, and that participants

misattributed this to a lower noise level.

This phenomenon often occurs outside the lab, he adds, citing the experience of learning a foreign language as a case in point. At first, native speakers seem to speak so rapidly that one cannot make out separate words. As facility with the language increases, the speech rate of native speakers seems to slow and distinct words pop out of the verbal stream. Thus, Jacoby says, a typical language student automatically perceives the accumulation of fluency as a slowing of native speakers' speech rates.

Jacoby draws a lesson from the pranks played by unconscious influences: "Mundane, rather than traumatic, experiences exert the most unconscious effects on perception and behavior," he suggests.

And those mundane influences can have traumatic consequences, as in cases of unconscious plagiarism. Consider the respected psychiatrist who resigned last year as head of a major psychiatric hospital amid accusations that one of his published papers contained paragraphs with wording identical to that in another researcher's previously published report on the same subject. The psychiatrist said he had seen the other paper, but he maintained that any resemblance between the two works was unintentional.

Jacoby says his studies of the cognitive unconscious suggest that, unbeknownst to some plagiarizers, previously read material may automatically bubble to the surface during an attempt to write about a similar topic.

Subtle, unconscious influences also play tricks on eyewitness accounts of crimes, as starkly illustrated by the false rape accusation levied at Donald Thomson, says psychologist Robert A. Bjork of the University of California, Los Angeles.

"Misleading unconscious inferences create serious questions about the accuracy of much eyewitness testimony, even when the witnesses are confident and sincere," remarks Bjork, who frequently testifies in court on the fallibility of eyewitness memories.

No single theory neatly pulls together all the data on unconscious or implicit memory, Bjork adds. But in his view, the new generation of studies shoots down the intuitive and widespread belief that memory works like a tape recorder, storing pristine bits of information for playback later on.

"People misunderstand their own memories to a great degree," he argues. "They think memories etch themselves into the brain, when memory actually involves unconscious interpretations of previous experiences." □