

## Brain region linked to conscious memories

New findings from brain scans indicate that the hippocampus, a seahorse-shaped structure, located beneath the cerebral cortex, and nearby tissue spring into action when a person remembers a previously studied word. Other areas, at the front of the brain, orchestrate attempts to retrieve the memory of the word prior to its conscious return, according to a report in the Jan. 9 PROCEEDINGS OF THE NATIONAL ACADEMY OF SCIENCES.

"Our results suggest that hippocampal activation is more closely associated with the actual recollection of a past event than with the effort involved in attempting to remember the event," contend Daniel L. Schacter, a psychologist at Harvard University, and his colleagues.

Implicit memory, the unintentional retrieval of previously studied information without any reported awareness of the material, relies on brain systems that direct the perception of words and objects. These systems lie outside the hippocampus and the related tissue that wraps around it—known collectively as the hippocampal formation—the scientists maintain.

They administered memory tests to 16 physically and mentally healthy adults. Half of them completed conscious, or explicit, recall tests; the rest performed implicit memory tasks.

Explicit testing included both "high recall" and "low recall" tasks. In the former task, participants thought about the meanings associated with each word in a list and then later were asked to remember those words. In the latter task, volunteers tried to remember words they had monitored for the letter t. Only the high recall test resulted in largely accurate word memories.

On the implicit trials, volunteers saw a series of words and paid attention only to the number of times the letter t appeared in them. They then completed strings of three letters with the first word that came to mind, such as saying "garnish" for "gar\_\_\_." Some letter strings represented the first parts of words from the previously presented list.

As in many studies of implicit memory, participants usually produced an already viewed word when presented with a letter string from that word (SN: 11/17/90, p. 312).

Positron emission tomography (PET) scans of blood flow in the brain were taken for each person during the memory tests.

Activity in the hippocampal formation showed a substantial increase only when the researchers subtracted PET data for volunteers on low recall trials from the data for high recall trials. This procedure isolated brain activity uniquely linked to the conscious recollection of words, the researchers argue.

In contrast, areas at the front of the brain showed activity boosts only during volunteers' low recall efforts to retrieve words they could not remember.

Regions at the back of the brain involved in vision displayed increased blood flow when participants retrieved implicit memories.

Several earlier PET studies have reported heightened activity in the hippocampal formation for implicit as well as explicit memories. But in those instances, individuals may have had unintentional conscious recollections of some words presented in implicit trials, Schacter's team suggests.

The act of consciously retrieving a

## Crows rely on tools to get their work done

Next time you need to borrow a tool, your thoughts may turn to the crows flying overhead.

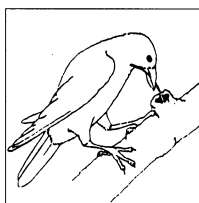
Crows on the Pacific island of New Caledonia make tools out of sticks and leaves, says ecologist Gavin R. Hunt. The birds differ from other tool-making wild animals, including other birds, in several respects, he contends: The crows make two types of tools, the implements show "a high degree of standardization," and the tools have hooks and barbs.

Humans' stone and bone tools lacked these features until about the time *Homo erectus* appeared, reports Hunt of Massey University in Palmerston North, New Zealand. Tools used by chimpanzees also lack these features, he says.

"It's very interesting to see that crows can make different tools for different purposes," says Christophe Boesch of the University of Basel in Switzerland. "But Hunt went a bit far when he claimed these tools represent standardization and abilities that haven't been observed in [other wild] animals."

Hunt watched the New Caledonia crows, *Corvus moneduloides*, using twigs or leaves as tools on 52 occasions between November 1992 and March 1995, he reports in the Jan. 18 NATURE. The birds usually employ the tools' hooked or narrow ends to find bugs in wood or under leaves, he reports. They carry the tools as they fly between trees or foraging locales and leave the tools at their feet or "in a secure position on their perch" when not using them.

The birds make one class of tools, which Hunt calls stepped-cut tools, from the barbed leaves of pandanus trees. He has never seen a bird making these



Hunt/Nature

Tools help crows dig out food from holes.

word from memory may stimulate the hippocampal formation much more than simply recognizing a previously studied word, they add.

However, other studies have found relatively weak responses of the hippocampal formation on memory tests similar to Schacter's high recall, explicit condition, according to Steven E. Petersen, a neuroscientist at Washington University School of Medicine in St. Louis.

"I suspect that the hippocampal formation plays a key role in the reorganization of one's knowledge about the world, but the extent to which consciousness enters into that process remains unclear," Petersen holds. "We're slowly approaching a good explanation of what the hippocampal formation does."

—B. Bower

devices, but he has collected many samples of them. They look like tapered saw blades, are slightly rigid, and range in length from 10.6 centimeters to 40 cm.

On four occasions, Hunt watched the crows make the other class of tools, which he calls hooked-twig tools. A bird pulls a twig off one of a variety of trees. Using its beak, it forms a point at the hooked end of the twig. It also strips off the leaves and usually the bark.

The hooked-twig tools Hunt collected at a site on Mount Cindoa averaged 15.9 cm in length; those from a site on the mountain Pic Ningua averaged 13.3 cm.

Scientists have described tool use by 36 other species of birds, but only two wild birds employ tools regularly to find their prey in trees, Hunt says.

The woodpecker finch from the Galápagos Islands uses modified twigs and cactus spines. The brown-headed nuthatch in the United States detaches pieces of bark and uses them to pry off other bark. These tools require much less technical sophistication to manufacture than the devices used by the crows in New Caledonia, he says.

Crows in Scotland, Kenya, and the United States use found tools in various fashions, Hunt says. For example, in the United States, crows use "cars as nut-crackers" by dropping walnuts on the road and waiting for cars to run over them. Another member of the crow family, the raven, throws stones at intruders.

Boesch, who wrote an accompanying commentary, challenges Hunt's statement that crows make standardized tools rather than modifying them during use. He says that Hunt didn't observe enough birds making tools to know whether or not they changed their tools after trying them out.

In addition, Boesch says that chimpanzees' tools have features that Hunt claims are unique to crows' tools.

—T. Adler