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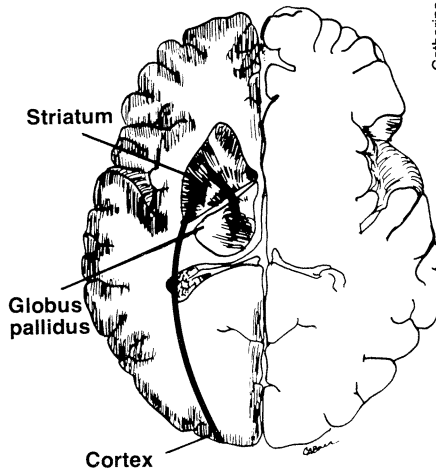
Mishkin that they have gradually acquired a long list of stimulus-response bonds. Where memorizing seems to be quick and effortful, habitual learning is automatic, building up slowly as the result of continuous reinforcement.

This distinction might help explain the finding of another NIMH psychologist, Herbert Weingartner, that normal human subjects learn in two ways — with and without effort. With work, people can store a long list of words, but even while doing so they are also noticing and storing the wallpaper design, the furniture, faces of strangers. And Weingartner has found that when effortful memory is impaired — in patients with Parkinsonism, for example — automatic memory is spared. In addition, Weingartner notes, effortful memory can be enhanced with certain drugs; automatic memory cannot.

The distinction between habits and memories may also help explain another phenomenon that has long puzzled memory researchers — so-called childhood amnesia. Human infants are obviously learning, yet adults rarely have memories from early childhood. Freud suggested that, for emotional reasons, childhood memories were repressed; indeed, the practice of psychoanalysis is founded on the belief that the memories are there, just difficult to get at. But Mishkin believes that the answer is simpler: The memory system of the brain develops later than the habit system.

In order to test this theory, Mishkin tested monkeys of different ages on both a memory task and habit acquisition task.

Habit System



Clinical studies suggest that some kinds of learning — specifically skill learning — may not involve memory at all. One theory is that the cortex signals a brain region called the striatum, completely bypassing the memory system. The striatum might then stimulate the adjacent globus pallidus, a sub-cortical motor area, thus forming a bond between a perceived stimulus and a motor response.

The memory task is a very simple association task that adult monkeys mastered very quickly, Mishkin notes, but the young monkeys were unable to succeed until they were close to six months old; and they did not reach adult proficiency until they were close to two years old. In contrast, even the three-month-old monkeys were as proficient as adults on the conditioning task.

Just where the habit system is located in the brain remains unclear, but Mishkin speculates that it is another sub-cortical region known as the striatal complex. From an evolutionary perspective, the striatal area is older than the limbic system and the cortex, and so is present in the brains of lower animals that are capable of rudimentary learning; and there is some evidence, Mishkin says, that it precedes the limbic system in normal development. In addition, it is positioned in such a way that it can easily receive sensory information from the cortex and, in turn, signal the motor areas of the brain — thus creating the stimulus-response bonds that show up as habits.

What does all this mean to those suffering from amnesia? Storybook amnesia is cured as simply as it is caused — with a blow to the head — but unfortunately science is far from providing any such solution. Indeed, the lives of H.M. and N.A. stand as dramatic testimony to the importance of memory in every aspect of human behavior. Neither can work, and both live lives of isolation. N.A., less impaired, can find his way home sometimes, although as Squire describes it, it is like he is finding his way around a town he hasn't been to in 20 years. H.M. spends his days watching TV and doing crossword puzzles — with the vocabulary he had at age 27. Although he is 55 now, he is the same good-natured and polite young man who entered the operating room in 1953 seeking a cure for epilepsy. He has described his perspective to Corkin: Every minute, he says, is like waking from a dream. □

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Electronic Life: How to Think About Computers — Michael Crichton. For the first-time user of a home computer or the person thinking about buying one, a book that discusses something not covered in most computer books or manuals — how to think about computers, not just how to use them. Talks about how computers are transforming our world. The theme — you are "in charge." Knopf, 1983, 209 p. \$12.95.

Enjoy Old Age: A Program of Self-Management — B.F. Skinner and M.E. Vaughan. This book is based on a paper delivered at the American Psychological Association meeting in August 1982 (SN: 8/28/82, p. 141). Skinner, at 79, shares what he has learned about aging from experience, training and research. Vaughan, an expert in the field, has distilled information and practical suggestions from the literature on aging. Norton, 1983, 157 p., \$11.95.

A Field Guide to Butterflies Coloring Book — Roger Tory Peterson and Robert Michael Pyle. A coloring book designed especially to teach butterfly identification. A short description is included for each illustrated butterfly. HM, 1983, 64 p., color/b&w illus. by Sarah Anne Hughes, paper, \$3.95.

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The Guinness Book of Astronomy: Facts & Feats — Patrick Moore. Completely updated, this second edition includes new sections on Venus and Mars and new information about Jupiter and Saturn. The star catalogue has been amended to the year 2000. Guinness (Sterling), 2nd ed., 1983, 289 p., color/b&w illus., \$19.95, paper, \$12.95.

Hypothermia: The Facts — K.J. Collins. Describes the problem of hypothermia in old people; shows how it arises; and how it can be recognized, prevented and treated. Hypothermia in newborns, accidental hypothermia and drug-induced hypothermia are discussed with suggestions for prevention. Oxford U Pr, 1983, 136 p., illus., \$13.95.

The Illustrated Dinosaur Dictionary — Helen Roney Sattler, foreword by John H. Ostrom. Dinosaurs have been known to the world for only a little more than a century and a half. Of the approximately 300 kinds included here almost 100 were discovered and named in the last 20 years. This book is an alphabetical guide to dinosaurs and some other prehistoric animals with descriptions of the animals in simple language together with line drawings of many of these fascinating creatures. Lothrop, 1983, 315 p., color/b&w illus., \$17.50.

Recombinant DNA: A Short Course — James D. Watson, John Tooze and David T. Kurtz. Three outstanding researchers in the field of molecular biology summarize the history of recombinant DNA, survey the recent techniques in recombinant molecular genetics and explain the experimental methods now in use, their results and applications for human beings. Scientific American Bks (WH Freeman), 1983, 260 p., illus., \$27.95, paper, \$17.95.

The Tangled Wing: Biological Constraints on the Human Spirit — Melvin Konner. A well-written, well-balanced synthesis of human nature that includes the latest research findings. Originally published in hardback by Holt, Rinehart & Winston in 1982. Har-Row, 1983, 543 p., paper \$8.95.