Mental Skills in the Elderly: Lost and Found

It is a common assumption that aging often impairs the ability to think and reason. But declines in two important types of intellectual function among the elderly are largely avoidable and, in many cases, quickly counteracted by supervised training, according to psychologists at Pennsylvania State University in University Park. Furthermore, report K. Warner Schaie and Sherry L. Willis in the March DEVELOPMENTAL PSYCHOLOGY, the same training boosts the performance of a substantial number of older adults whose intellectual abilities have remained stable.

"There are different types of decline in thinking ability with age, some of which are associated with neurologic loss," says Willis, "but for many older adults we think our data indicate that decline occurs because they don't use acquired skills as much as they used to."

Not all investigators are confident that training can pump up fundamental thinking skills, but Willis points out that this is the first study to chart intellectual decline over time and then examine training effects. A number of studies have shown that training techniques improve the performance of elderly subjects on tests of memory, reasoning and problem solving, she notes, but researchers do not know whether these approaches remedy a loss of function or bolster the skills of people suffering no decline.

Schaie and Willis addressed this problem by comparing measures of the same thinking skills — inductive reasoning and spatial orientation — obtained from 229 healthy adult volunteers in 1970 and in 1984. Subjects, recruited from a health maintenance organization near Seattle, were screened for neurologic and mental disorders and ranged in age from 64 to 95 years by the end of the study. A significant decline on one or both of the measures occurred among 122 subjects; the rest remained stable.

Inductive reasoning was assessed by showing subjects several series of letters, numbers and words. They were asked to find the pattern in a series and select the next element from among five choices. Spatial orientation involved the ability to mentally rotate two- and three-dimensional objects.

Subjects then were assigned to five-hour training sessions in reasoning or spatial orientation. Those declining in one area took training in that ability; subjects who declined in both areas or who remained stable were randomly assigned to a training program. Training concentrated on practice problems and strategies to improve performance, such as underlining repeated letters in a series or focusing on two or more features of a figure during rotation.

More than 60 percent of subjects whose performance had declined in one or both areas since 1970 achieved markedly higher scores after training; 40 percent scored as high as their 1970 performance levels. More than half of the subjects whose scores remained stable over the 14 years also showed significant improvement after training on either ability. Training effects, say the researchers, were unrelated to differences in age, education and income.

In other words, says Willis, relatively simple training techniques reversed declines in two primary intellectual abilities and improved performance among the considerable proportion of subjects — almost 47 percent — whose scores remained stable. The training has practical consequences, she adds. Reasoning skills relate to everyday tasks such as understanding instructions on medicine bottles and food labels, and spatial ability aids in navigating neighborhoods and buildings and in reading road maps.

Other investigators of adult development are impressed with the study but caution that its meaning is not yet clear. "I'd put [Schaie and Willis's] interpretations on hold until there's more data on health and history of heart disease among their subjects," says psychologist James E. Birren of the University of Southern California in Los Angeles. Physical ailments, particularly coronary disease, have been linked to intellectual decline.

"The study was meticulous," adds Birren, "but the researchers may be measuring something other than basic intellectual capacities. I wouldn't expect fundamental abilities to change so much after only five hours of training."

Psychologist John L. Horn of the University of Denver agrees that "this is a very important study if it's replicable, but it's really not known if reasoning or spatial orientation tests apply to general types of thinking."

Further long-term studies are needed, says Horn, to examine whether training specifically helps the elderly or has comparable effects on subjects followed from youth to middle age. "I don't want to set up false hopes for people," he notes.

In their report, however, Schaie and Willis stress that the improvement and reversal of decline they demonstrated "may be a rather conservative estimate of what could be achieved by more extensive programs of this kind." The "$64,000 question," adds Willis, is: What distinguishes the older adults who responded to training from those who were not helped? — *B. Bower*

Microsketching an underwater surface

Surface details on the scale of typical atoms are notoriously difficult to detect, especially when the sample is immersed in water. Now a team of researchers reports the design and construction of a special "scanning tunneling" microscope that can pick out the atomic-scale bumps and hollows on a water-covered graphite surface.

This effort represents the first successful attempt to resolve such fine details on a wet surface. At best, an optical microscope is restricted to features 1,000 or more times larger. An electron microscope operates only when the sample is in a vacuum.

In the April 11 SCIENCE, Richard Sonnenfeld and Paul K. Hansma of the University of California at Santa Barbara also report that the new instrument can be operated in salt solutions. This opens up the possibility of imaging proteins and other biological materials in their active states. The microscope may also be useful in electrochemistry for detecting surface changes that occur at electrodes.

In a tunneling microscope, an extremely sharp metal needle is brought within a few angstroms of the sample's surface. This distance is small enough for electrons to leak or tunnel across the gap and generate a minute current. As the gap between the tip and the sample increases, the current decreases. A scanning mechanism pulls the needle across the sample's surface, constantly adjusting the tip's height to keep the current constant. The result is a microscopic sketch of the surface's contours (SN: 4/6/85, p. 215).

Getting such a microscope to work in water was a challenge because water conducts electricity. The resulting electrical current could swamp the tunneling current. The answer was to minimize the area of the needle that could conduct current through water and into the sample surface. The researchers did this by coating a platinum-iridium needle with glass insulation, leaving only its tip bare.

Says Sonnenfeld, "Because the electrical current through the water remains constant, we could pretty much ignore it. It didn't have any effect on the images."

The microscope took 20 seconds to produce an image of a clean graphite surface immersed in deionized water. The image revealed rounded peaks and val-