

## Religious schools inspire math reasoning

In Israel, as in other technological societies, public elementary and high schools expose students to a range of mathematics and science classes. Yet ironically, ultraorthodox Jewish schools—which focus on learning to interpret holy texts, along with a smattering of basic arithmetic—provide a better training ground for solving tricky geometry problems than the mainstream facilities do, according to a new study.

Orthodox education's emphasis on examining texts from different perspectives, achieving insights through independent learning, and using strict problem-solving procedures may nurture reasoning skills that apply to novel realms of knowledge, such as geometry, propose Yoram Dembo and Iris Levin, both of Tel Aviv University, and Robert S. Siegler of Carnegie Mellon University in Pittsburgh.

The early years of mainstream education in Israel may actually harm students' geometric reasoning skills, the psychologists argue. Classes typically stress solving geometry problems quickly and accurately without delving into the underlying logic of those operations, a pattern also found in many U.S. schools. Geometric understanding in mainstream students blooms only for those who take advanced math instruction in high school, the scientists say.

"These findings will displease Israel's mainstream education system, which sees itself as enlightened compared to the ultraorthodox approach," remarks psychologist Nathan A. Fox of the University of Maryland at College Park.

Levin's husband used his ultraorthodox education to prepare for and pass Israel's medical school entrance tests, thus inspiring the study.

The researchers examined geometric reasoning in 240 students: 60 12- to 14-year-olds and 60 16- to 18-year-olds in mainstream schools and equal numbers of students in the same age groups in ultraorthodox schools.

Only boys took part, since ultraorthodox girls receive less intensive instruction.

Volunteers first viewed demonstrations in which a flexible, three-dimensional shape was changed from one form to another—say, from a circle to an ellipse. Students judged whether a shape's total volume increased, decreased, or stayed the same after each transformation.

A majority of students in each group then received training to clarify how shapes with the same circumference can have different volumes. They either observed whether beads that filled an initial shape also filled its transformed shape, or they imagined what would happen to a shape's volume if the actions that transformed it were taken to their

extreme—approaching a straight line.

Finally, students attempted to solve new questions about the relation between the volume and the circumference of shapes.

Most strikingly, 12- to 14-year-old ultraorthodox students performed better on all geometric reasoning tasks than their mainstream peers, the researchers report in the January *DEVELOPMENTAL PSYCHOLOGY*. Among 16- to 18-year-olds, only mainstream students taking advanced math courses scored higher than ultraorthodox students. Moreover, ultraorthodox and mainstream students ben-

## Novel antioxidants may slow brain's aging

Many of the degenerative changes that can accompany aging—from atherosclerosis and muscle tremors to memory loss and cancer—have been linked to the cumulative effects of free radicals in the body. These highly reactive molecular fragments can alter proteins, including the enzymes responsible for tissue repair. Moreover, such damage can accelerate with age.

Last year, researchers in Texas showed that the vulnerability of brain proteins to free radicals determines where and how quickly many age-related neurodegenerative changes occur (*SN*: 5/18/96, p. 311). Now, other researchers have shown that nitrones—novel antioxidants designed to trap free radicals—can prevent the protein damage that seems to underlie such brain impairment.

The new findings "are really supportive of the concept that [free] radicals are involved in aging," says Earl R. Stadtman of the National Heart, Lung, and Blood Institute in Bethesda, Md. Together with a host of related studies, he says, these data suggest the possibility of developing a drug "to reverse some of the age-related changes" that can debilitate the elderly.

Until leaving to form Centaur Pharmaceuticals in Sunnyvale, Calif., last year, pharmacologist John M. Carney was part of a research team at the University of Kentucky in Lexington that worked with two strains of specially bred mice. One strain ages at a faster than normal pace and can serve as a model for memory and learning impairments in the elderly. A longer-lived, genetically related strain shows normal resistance to the oxidative changes underlying those impairments.

The Kentucky team injected a nitron known as PBN into 10-month-old mice of both strains daily for 2 weeks. After the last injection, the researchers compared the brains of these animals to those of untreated mice.

In the quickly aging strain, PBN protected brain proteins from the free-radi-

cal-induced oxidation that would otherwise have occurred. However, PBN had no apparent effect on the normally aging strain, the team reports in the Jan. 21 *PROCEEDINGS OF THE NATIONAL ACADEMY OF SCIENCES*.

This is significant, Carney says, because it suggests that PBN is "selectively controlling only those pathological [free radical] modifications that give rise to dysfunction or disease."

Indeed, the body normally harnesses free radicals not only to eliminate invaders and unwanted tissues but also to synthesize many important compounds, including hormones. The PBN treatment did not appear to depress these healthy, free-radical-based processes, he explains.

The new study also shows for the first time that PBN's protection extends to the proteins that make up a cell's cytoskeleton, or framework. These structural proteins "are fundamentally important," he says, to controlling a cell's shape. Other proteins that were protected contribute to a cell's ability to communicate with other brain cells.

Stadtman notes that at least one study has found that PBN can extend the life of mice. In another, old rodents treated with PBN suddenly performed maze tests as well as young animals. Carney reports that test-tube experiments show that PBN treatment "can prevent [Alzheimer's disease] plaque formation" and will probably improve the removal of this plaque.

Though PBN appears safe in animals, Carney says it has the drawback of sedating them. However, he notes, at Centaur "we've already made something better" and have just launched safety trials with that related chemical in 30 people.

Are nitrones the proverbial Fountain of Youth? "Maybe they won't really extend life," Stadtman says, but that's not so bad if they improve the quality of life in old age. "They ought to be able to do that," he adds.

— J. Raloff