Our aging bodies need good food and exercise to flourish--and so do our brains. The brain craves positive training, education and experience throughout the life span, according to science writer Ronald Kotulak. His book *Inside the Brain: Revolutionary Discoveries of How the Mind Works* is based on his Pulitzer Prize-winning series for the *Chicago Tribune.*

Kotulak summarized recent scientific discoveries about the brain at the 45th Annual Meeting of the American Society on Aging (ASA). His talk kicked off "The Power of Education," a one-day conference intensive organized by ASA's newly renamed Lifetime Education and Renewal Network (formerly the Older Adult Education Network).

THE PLASTICITY FACTOR

According to Kotulak, scientists now realize that the brain actually organizes and constructs itself, something no other organ does. Rather than being hard-wired for growth, the brain wires and even rewires itself--for example, to enable it to continue operating in the wake of a stroke or spinal injury. "At the core of this new knowledge is the plasticity factor, a term used to describe the brain's amazing capacity to constantly change its structure and function in response to experiences coming from the outside," said Kotulak.

The brain's plasticity means that new learning and relearning can take place at any age. Still, the first three years are life are by far the most critical, according to Kotulak."There's a growing recognition today that the kind of experiences that the brain is exposed to in the first three years dramatically influence how it operates for the rest of its life," he said.

He said that University of Chicago researcher Peter Huttenlocher found that after birth, the brain constructs more than a thousand-trillion connections, or synapses--twice as many as the brain will eventually need. "The surplus of connections is there to guarantee that a newborn will be able to receive input from any environment it is born into, whether it's Chicago, Florida or Calcutta," Kotulak said.

Huttenlocher's studies show that this explosion of synaptic connections halts around the age of six, and the brain begins to eliminate unused connections. By age 14, the idle connections have been pruned away, and the brain's circuitry is more or less complete. "The brain is like a block of marble, and we have to use outside experiences to shape it into a working organ. Experience sculpts neural networks for language, vision, thinking and other capacities. Synaptic connections not used are eliminated, like the chips of marble that must be chiseled away to reveal a beautiful work of art," Kotulak explained.

STIMULATION

Much recent neurological research has focused on the effects of very early education and experiences on later-life abilities and predispositions. "For the first time we are gathering the biological evidence showing that lack of proper mental stimulation could actually harm the brain," Kotulak said.

Researchers are finding that the nascent brain is extremely fertile for the seeds of good or evil. A lack of stimulation--or the wrong kind of stimulation--can predispose an individual to learning disabilities, violence, alcoholism, depression and even mental retardation, Kotulak warned.

On a brighter note, Kotulak reports in his book that mental training in old age can boost intellectual power, help maintain mental functions like problem solving, and reverse memory decline. Even if they haven't received the benefits of good early education and experience, older adults can still do much to keep their brains in shape.

"There isn't much difference between a 25-year-old brain and a 75-year-old brain," Monte Buchsbaum, Mount Sinai School of Medicine in New York City, told Kotulak. Buchsbaum is director of the school's Neuroscience pet Laboratory. His lab did positron emission tomography (pet) scans on the brains of aging volunteers and young volunteers, and found no significant differences between their frontal lobes. This is the region where we "think about thinking" and use memories to provide new insights and creativity, he noted.

When severe declines in memory and mental functioning do occur, they're generally caused by a disease such as Alzheimer's, which affects about 20% of elders. The research again links predisposition back to education. The more connections, or synapses, one has between brain cells, the more resistant they are to the effects of Alzheimer's, Kotulak writes in *Inside the Brain.*

Yaakov Stern, a clinical psychologist at Columbia University, New York City, reported in studies published in 1994 and 1995 that people with less than an eighth-grade education had twice as much risk of developing Alzheimer's as those with a greater amount of formal education. When those with lower educational levels also worked at mentally unstimulating occupations, the risk was three times higher.

CONVENTIONAL WISDOM

Most other types of mental decline, however, are now believed to be caused mainly by a lack of mental exercise, according to Kotulak. People do not lose massive numbers of brain cells as they age, contrary to conventional wisdom. Rather, the brain's functions get rusty with disuse.

The Seattle Longitudinal Study, started by K. Warner Schaie, has involved 5,000-plus people ages 20 to more than 90 to see what happens to the intellectual abilities of aging people. Schaie, now director of the Gerontology Center at Pennsylvania State University, found that intellectual decline varies widely, mainly depending on how much the mental fire is kept ablaze.

Seven factors stood out in the findings regarding elders who maintain their mental acumen: a high standard of living marked by above-average education and income; lack of chronic diseases; active engagement in reading, travel, cultural events, educational clubs and professional associations; willingness to change; having a smart spouse; an ability to grasp new ideas quickly; and satisfaction with accomplishments. Schaie and his colleague Sherry Willis found more good news in another study: Even if mental activity is lost through inactivity, it can easily be reclaimed through retraining.

In a similar vein, Marilyn Albert, a Harvard University neurologist and director of gerontology research at Massachusetts General Hospital, studied more than 1,000 people ages 70 to 80. She found that both physical and mental factors seem to determine which elders hold on to their intellects. Key elements revealed in the study were education, which appears to increase the number and strength of synaptic connections; strenuous activity, which improves blood flow to the brain; lung function, which ensures that the blood is adequately oxygenated; and the feeling that what people do makes a difference in their lives.

Kotulak quoted Albert, "Is mental exercise important for the brain? People used to ask me that years ago, and I would say we don't have enough data one way or another. I don't say that anymore. I tell them that's what the data look like: Use it or lose it."