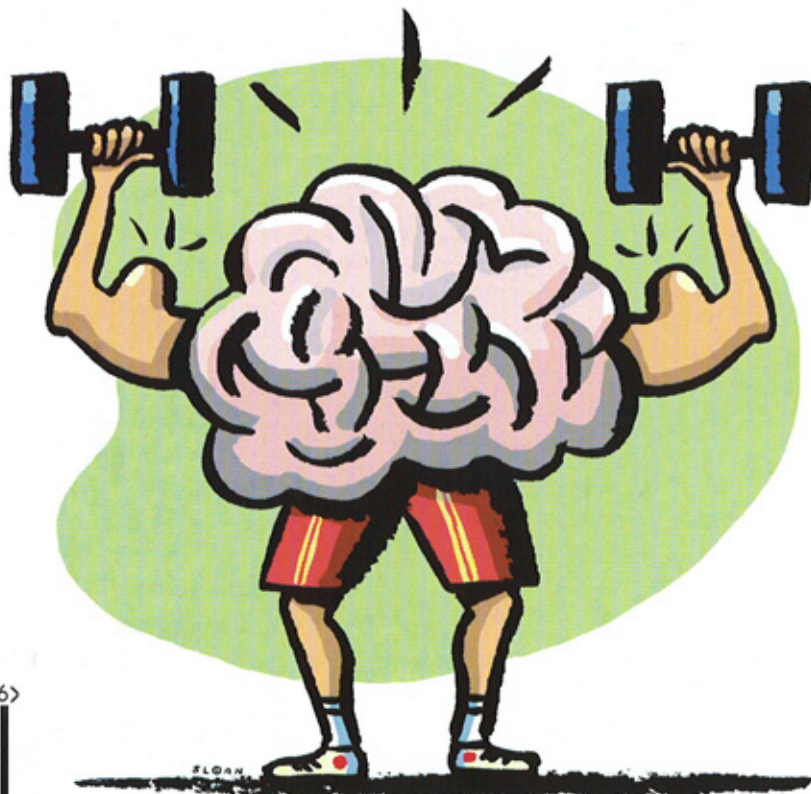


Pakistan's Most Wanted • Economic Angst

& WORLD REPORT
U.S. News
FEBRUARY 11, 2008

Keeping Your **Brain** Fit

The Latest Science on Boosting Your
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COVER STORY

Keeping Your Brain Fit

Think of your brain as a muscle. As with your other muscles, you can make it stronger. Or at least keep it from aging so rapidly. We look at the ways brain science has discovered to improve the cognitive performance of adults of all ages. By Christine Larson

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KEEPING YOUR BRAIN FIT



THERE'S PLENTY YOU CAN DO TO SLOW THE EFFECTS OF AGING. HERE'S HOW TO KEEP YOUR THINKING AND MEMORY SHARP

By Christine Larson

Marian Conte's brain weighs 1,100 grams, according to Nintendo. "That's up from 800 grams when I started playing," jokes Conte, 52, a real-estate agent from Hamilton, N.J., who recently added the video game *Big Brain Academy* to her fitness regimen. The better she scores on brainteasers, the larger her fictional brain. Since Conte's moth-

er died of complications from Alzheimer's disease in 2003, she's trying to guard herself any way she can, embracing crossword puzzles, fruits and vegetables, and a new genre of high-tech workouts that aim to slow cognitive loss. This particular game makes no such claim. But regular play certainly can't hurt, Conte figures: "I want to do any little thing I can to protect my brain."

If her Nintendo score isn't solid evidence, science increasingly suggests Conte's efforts may pay

off. Just within the past few months, several groups of researchers have added support for the growing consensus that plenty can be done to slow the age-related declines in memory, mental speed, and decision making that affect most people. In November, a team from the Mayo Clinic and the University of Southern California announced that one computer-based mental training program appeared to improve older people's cognitive performance by as much as 10 years. That same month, a Harvard researcher found that long-term use of beta carotene supplements delayed cognitive decline by up to a year and a half.

And a new book out last month puts forth evidence that "exercise is the single best thing you can do for your brain," says author John Ratey, a clinical associate professor of psychiatry at Harvard Medical School. The book is *Spark: The Revolutionary New Science of Exercise and the Brain*.

"Some of the myths about the brain—that it was not changeable, that there was nothing you could do about cognitive decline—have really been dispelled in the past 10 years," says Lynda Anderson, director of the Healthy Aging Program at the federal Centers for Disease Control and Prevention, whose bold goal is "to maintain or improve the cognitive performance of all adults." The potential



Marian Conte, 52
Her mother died of Alzheimer's, and Conte follows a regimen aimed at avoiding that fate: a healthful diet, crossword puzzles, and high-tech brain games.

with Alzheimer's shrink about twice as fast. The effects are greatest in the prefrontal cortex, the seat of executive function (which includes working memory—responsible for remembering a telephone number while you're dialing, say—and planning, focus, and behavior choices), and sometimes in the hip-

after about age 60 or so. Gradually, the brain shrinks, losing around 0.5 percent to 1 percent of its volume each year after that age threshold; brains

Not every mental skill suffers equally. Vocabulary, for instance, tends to remain, as do skills practiced for a long time, like playing the piano or using a spreadsheet. You might even improve at some things: In tests of experienced crossword puzzlers of all ages, the best were in their 60s and 70s.

Potential. The more scientists learn about the brain's decay, the more curious they've become about how well people function anyway. Even among people 85 and older, only 18.2 percent live in nursing homes. "In the past, much of

People with five social ties were less likely to suffer cognitive decline than those with no ties.

payoff is enormous. Alzheimer's now afflicts 4.5 million people in the United States—double the number in 1980—and is expected to reach 16 million by 2050. "Statistics show if we could delay the onset of Alzheimer's by five years, the number of people with the disease would be cut in half," says Yaakov Stern, a cognitive neuroscientist at Columbia University.

What are you up against? The inevitable physical changes start in early adulthood but become especially marked

the research has focused on disease and decline," says Gene Cohen, director of the Center on Aging, Health and Humanities at George Washington University. "Now we're looking at the concept of potential and how older people often continue to thrive and grow even in the face of the most serious illness." Recent studies of both animal and human subjects have found that several factors go hand in hand with better mental performance, including education, professional success, and intellectual, social,

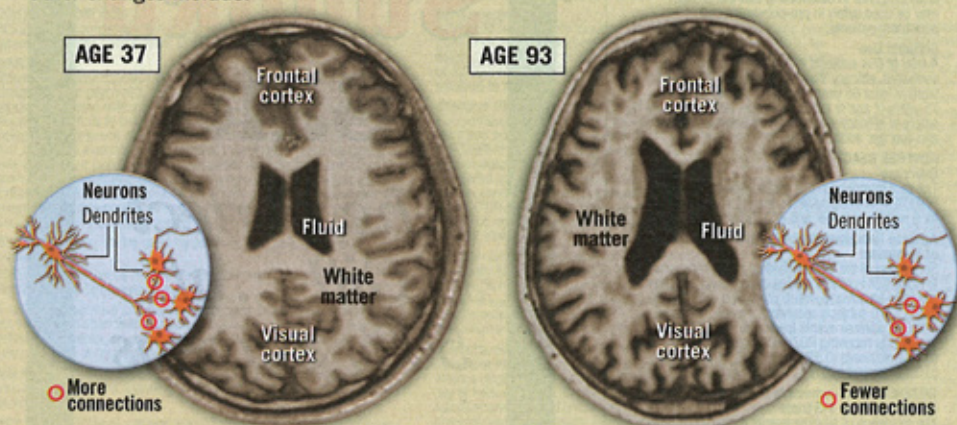
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More on the brain, including video and information on Alzheimer's disease, is at usnews.com/agingbrain

The Incredible Shrinking Brain

Brain volume starts diminishing in the 20s and accelerates over time. After age 60, it shrinks by around .5 to 1 percent a year. Not all brain regions shrink uniformly: The hippocampus tends to shrink faster than the frontal cortex; some areas, like the primary visual cortex, don't shrink at all. Other changes include:



CEREBRAL BLOOD FLOW

The brain's blood supply (important for healthy brain cell function) decreases over time.

CAN YOU HEAR ME NOW? Connections between brain cells decline, as dendrites retract in several brain regions including the prefrontal cortex and hippocampus.

A FAILURE TO COMMUNICATE? White matter, which connects various brain regions, becomes less dense in the 50s. As it deteriorates, regions become less coordinated with each other.

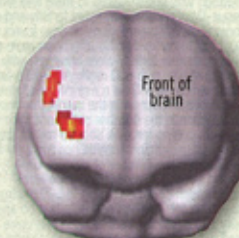
GOOD NEWS. The hippocampus and olfactory bulb, which processes smell, continue to produce new neurons. Not all survive to become part of the working brain—but in animal studies, physical exercise and mental stimulation increased brain cell survival rates.

Sources: Brain scans: Randy Buckner—HHMI at Harvard University. Inset images: Cabeza R, Anderson ND, Locantore JK, McIntosh AR (2002) Aging Gracefully: Compensatory Brain Activity in High-Performing Older Adults. *Neuroimage* 17:1394-1402

RECRUITING HELP?

Older brains use different areas than younger brains to perform some tasks. One study involving a memory task showed:

Younger people used only one side of the brain.



Older people often used both sides. This shift may be the brain's response to slower processing speed and less efficient neural networks.



STEPHEN ROUNTREE AND JILL BEVIER—USNEWS

and physical activities. A 2003 study reported in the *New England Journal of Medicine*, for example, found that people over 75 who danced, read, or played board games or musical instruments also had a lower rate of dementia.

Much of the work has focused on finding ways to bulletproof people against Alzheimer's. In mice, an Alzheimer's vaccine seemed to work, but it proved toxic in humans and trials were suspended (although research on vaccines continues). Beta carotene supplements may delay cognitive decline if taken for many years—but only by a year and a half. Education seems to lower your odds of Alzheimer's—but even some Nobel laureates develop it.

Cholesterol-lowering drugs seemed to offer some promise in fending off Alzheimer's, but a 12-year-long study published in January showed they had no effect. For now, experts think the best approach is to take the sorts of steps that Conte is taking to delay normal cognitive decline.

Stretch the plastic. For decades, scientists assumed that humans were born with all the brain cells they'd ever have. Then, in the 1970s, researchers showed that new brain cells and neural pathways form through the end of life. "This was the beginning of the brain plasticity movement," says Cohen, "the understanding that when we challenge our

brains, the brain cells sprout new dendrites, which results in increased synapses, or contact points." More recent research has shown that there isn't an age limit: Training older adults in certain memory tasks, like remembering faces and names, seems to boost those specific abilities—though it won't remind you to bring your shopping list to the store. And the newest evidence suggests that intensive practice in reasoning skills or in distinguishing sounds appears to lead to more generalized improvements in brain function.

In 2006, for example, a controlled clinical study of more than 2,000 older people by researchers at Pennsylvania



Exercise is good for both the brain and the body.

A Much Younger Body, Too

Vigorous exercise can really roll back the years

Researchers focused on fighting the ravages of time can tell you how to keep your body young longer as well: Eat less and move more. "Even elite athletes who keep up their regular training routine will lose about 1 percent of muscle mass per year," says

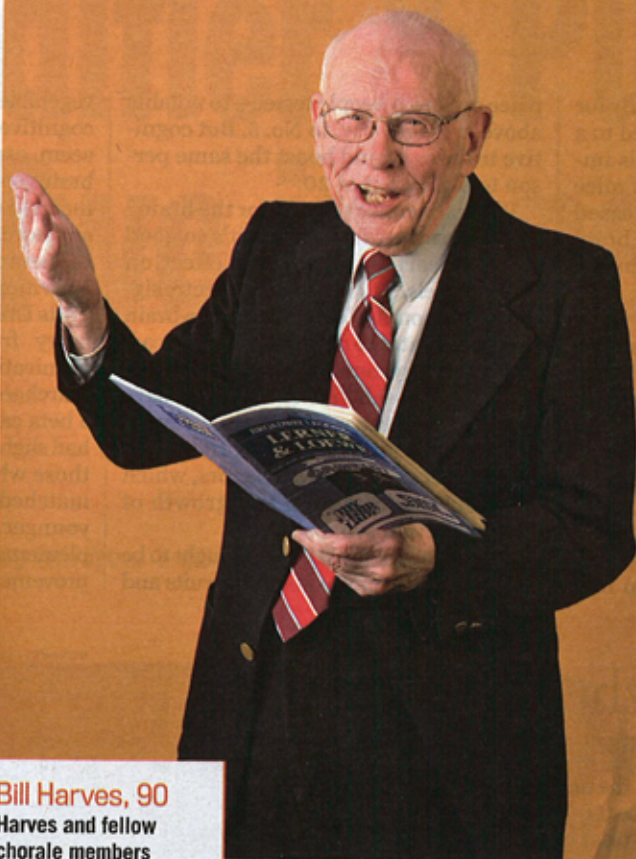
physician Steven Masley, author of *Ten Years Younger*, a book on how diet and exercise battle aging. Since body fat increases at the same rate, he notes, "basically, you turn from free range to prime cut."

A sedentary lifestyle and poor eating habits acceler-

State University, Indiana University, Johns Hopkins University, and elsewhere found that those who received 10 60-to-75-minute training sessions in reasoning—specifically, in recognizing word, number, and letter patterns and filling in the next item in a series—reported less difficulty with such activities of daily living as understanding instructions on a medication label. The effects still were apparent five years later. This past November, scientists from the University of Southern California and the Mayo Clinic announced that study subjects who spent an hour a day for eight to 10 weeks using a program that asked them to recognize subtle differences in sounds performed better than the control group on memory and speed tests, too. Designers of the Brain Fitness Program (made by Posit Science, which funded the study) claim that such ear training causes the brain to convey information more precisely from one region to another—which, in turn, improves other types of thinking.

"The amount of memory improvement was equivalent to going back 10 years in your ability," says Elizabeth Zelinski, professor of gerontology and psychology at USC and a principal investigator on the study, which has not yet been published.

Experts caution that most brain-training products (box, Page 49) haven't been tested and that what data do exist are



Bill Harves, 90

Harves and fellow chorale members rehearse weekly and perform several concerts a year. It's fun and offers brain-saving social ties.

JEFFREY MACMILLAN FOR USNEWS

still shaky. If improvement of daily living tasks is the goal, "we don't yet have the data to suggest they accomplish that," says Arthur Kramer, a neuroscientist at

the University of Illinois. "Yes, we have data that says you can get better at certain things with practice. But does it translate to the real world? We don't know yet." Still, many doctors who work with older people feel they don't have time to wait for the research, and nursing homes and senior centers across the country are adding "brain gyms" and other programs to help older people stay mentally active.

activity that will keep you curious and learning: reading and writing, attending lectures, taking classes, even gardening.

Sound body, sound mind. Still, the best workout for your brain may be the old-fashioned kind.

As far back as 1999, researchers at the University of Illinois found that older people who started exercising showed faster reaction times and better ability to focus after just six months than did a control group. Now, it's becoming clearer why. In a second study reported in 2006, the same team found that the aerobic exercisers actually increased their brain size by about 3 percent. Last year, researchers at Columbia University found

"I've learned more about China than you can imagine," says Hortense Gutmann, 100, who started using E-mail just over a year ago through a new computer-education program for residents of Sarah Neuman Center for Healthcare and Rehabilitation, a nursing home in Mamaroneck, N.Y. She now keeps in touch with relatives there, as well as in Minnesota and Israel, and takes great pleasure in having mastered a new skill.

Consumers aren't waiting for more research, either. The market for products like Brain Fitness Program, Nintendo's Brain Age, and MindFit soared to an estimated \$80 million in 2007, up from just \$2 million to \$4 million in 2005, according to SharpBrains.com, a San Francisco-based group that follows the industry. Meanwhile, the Alzheimer's Association recommends any ac-

ate that shift, putting the average person "10 years farther along the graph" than he or she should be, as Masley puts it. Sedentary bodies produce a slow drip of cytokines—proteins that circulate in the bloodstream and cause inflammation, among other things, says Henry Lodge, an assistant professor at Columbia University Medical Center and coauthor of *Younger Next*

Year: A Guide to Living Like 50 Until You're 80 and Beyond. While inflammation is important to healing, too much is linked to arthritis, heart disease, and a growing number of other diseases. Vigorous exercise activates cytokines that promote cell repair and growth.

"When you exercise, you change the chemical makeup of your blood for eight to 12 hours," says Lodge. "So

for a large majority of that day, you're regenerating cells and building a better body and brain." Just last week, British scientists reported that people who exercised about 200 minutes per week had telomeres—repeated sequences at the ends of chromosomes that shorten with age—as long as those of sedentary people up to 10 years younger.

The recommended dose:

45 minutes to an hour of aerobics most days and two or three weekly sessions of strength training. A low-to-moderate-fat diet high in fruits and veggies and omega-3 fatty acids is in order, too. "If people followed this plan, they would markedly decrease their chance of premature or accelerated aging," says Masley, "and stay vital until the end." —C.L.

that when people exercised regularly for three months, blood flow increased to a part of the hippocampus, which is important for memory. In studies of mice who exercised on treadmills, increased blood flow to the same part of the brain corresponded with an increase in the production of new brain cells.

The power of exercise seems far more impressive than that of brain-training software, says Sandra Aamodt, editor in chief of *Nature Neuroscience*, a scientific journal on brain research, and coauthor of the forthcoming book *Welcome to Your Brain*. A recent meta-analysis of numerous exercise studies found that, on average, faithful aerobic exercise might boost someone's cognitive performance from average—say, from 10th

place out of 20 people tested—to notably above average—say, to No. 5. But cognitive training would boost the same person to eighth out of 20.

Why is exercise so good for the brain? Maybe for the same reason it's so good for the heart: its beneficial effect on blood vessels. "It may be that a pretty significant amount of deterioration in brain function relates to disruptions of the cardiovascular system by microstrokes," in the tiny vessels in the brain, says Aamodt. Exercise may help prevent them. It also stimulates the production of proteins called growth factors, which promote the formation and growth of brain cells and synapses.

Certain nutrients, too, are thought to be protective. The antioxidants in fruits and

vegetables have been linked to improved cognitive function; berries, for instance, seem especially beneficial in keeping brains spry. "Old neurons, like a lot of old married couples, don't talk to each other anymore," says James Joseph, director of the neuroscience lab at the USDA Human Nutrition Research Center on Aging at Tufts University. "We have found that the berry fruits improve neuronal communication." In November, Harvard researchers announced that men who took a beta carotene supplement for 18 years had slightly better cognitive function than those who didn't—their memory scores matched those of people about one year younger. However, men who took supplements for only one year showed no improvement, and several other studies have

Attacking Alzheimer's

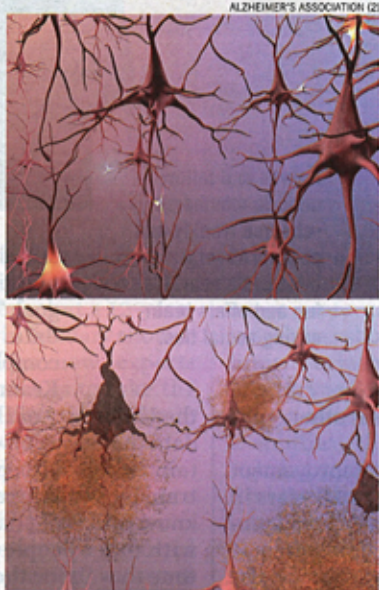
The latest news on treatment and diagnosis

Though they may live in dread of it, most people will never develop it. "There's a 10 to 15 percent chance, if you live a normal life [span], you'll develop Alzheimer's disease," says Norman Relkin, associate professor of clinical neurology and neuroscience at New York Presbyterian Hospital and Weill Cornell Medical College. (To be sure, the prevalence in people over age 90 rises to nearly 1 in 2.) Relkin suspects the body has natural defenses—and several years ago, he and his colleagues set about finding them.

They looked for signs of antibodies that target beta-amyloid, a protein fragment that clumps in the brain plaques of Alzheimer's patients, to block the signaling pathways and eventually tunnel in to kill the cells. By comparing the blood of Alzheimer's patients with that of normal older people, the team discovered that the patients did indeed have lower-than-normal levels of a particular antibody. The researchers administered

the antibody—already present in a therapy used to treat immune deficiencies—to a handful of people with Alzheimer's in 2004. A few months later, they were shocked by the improvements in the patients' cognitive function. "The mental scores were increasing by an amount that was equivalent to setting the disease back by a year and a half," Relkin says. Last June, he discovered that the antibodies were ignoring single amyloid molecules and kicking in only to destroy the toxic clumps. Relkin hopes to launch larger trials in patients this year after the Food and Drug Administration reviews his proposal.

New directions. Immunotherapy for Alzheimer's patients is just one of several new directions promising to transform the treatment of Alzheimer's, Relkin says. "We're at a juncture now where we're trying to make the transition from treating symptoms to disease-modifying treatments" that hit at the cause of Alzheimer's, he says. "A whole new window



The nerve cells in a healthy brain (top) form a dense "neuron forest." The brain below shows Alzheimer's disease.

is opening in terms of the approach to the disease." Other researchers, for example, are looking at drugs that target enzymes involved in the clumping of beta-amyloid proteins. Strides are being made on the diagnostic front, too. Until recently, doctors weren't able to say for sure whether someone had Alzheimer's until an autopsy. But the closer science comes to a treatment for Alzheimer's, the more im-

portant early detection becomes. The National Institute on Aging is currently sponsoring a study of 800 older people—some cognitively normal, some with Alzheimer's, some with mild cognitive impairment—to uncover early warning signs. Promising techniques include MRIs used to show abnormal shrinking of the brain; PET scans to detect amyloid plaques in the brain or to spot patterns of glucose use associated with Alzheimer's; or

spinal taps to look for abnormal concentrations of certain proteins in the cerebrospinal fluid during the early stages of Alzheimer's. Of course, until scientists find a treatment, early diagnosis may be more disturbing than enlightening. "The push for early diagnosis," says Columbia University's Yaakov Stern, "is predicated on the idea that we'll have something to do about [the disease] when we find it." —C.L.



Hortense Gutmann, 100

After taking a computer program offered at her nursing home, Gutmann keeps in E-mail touch with relatives in China, Minnesota, and Israel.

found no link between antioxidants and mental performance. The Alzheimer's Association (www.alz.org) recommends a diet high in dark-colored veggies, like kale, spinach, beets, and eggplant; colorful fruits like berries, raisins, prunes, oranges, and red grapes; plus fish like salmon or trout high in heart-healthy omega-3 fatty acids.

Making connections. It has been more than two decades since Bill Harves, 90, quit singing in his church choir. Four years ago, he joined the professionally led chorale that rehearses once a week at his Bailey's Crossroads, Va., continuing care retirement community. The chorale gives several concerts a year, including one at Washington, D.C.'s Kennedy Center. He's gained in breathing technique, enunciation, and music reading skills. "There's no doubt I've improved as a singer," he says.

Besides having fun, Harves, who also serves as chairman of his community's computer club and is active on a residents' committee, is very likely protecting his cognitive function. In a study of more than 2,800 people ages 65 or older, Harvard researchers found that those with at least five social ties—church groups, social groups, regular visits, or phone calls with family and friends—were less likely to suffer cognitive decline than those with no social ties.

"The working hypothesis is that it has something to do with stress manage-

ment," says Marilyn Albert, a neuroscientist at Johns Hopkins and codirector of the Alzheimer's research center there. In animal studies, a prolonged elevation in stress hormones damages the hippocampus. Social engagement appears to boost people's sense of control, which affects their stress level. Creative arts seem to be a highly promising way to increase social engagement. George Washington University's Cohen has found that elderly people who joined choirs also stepped up their other activities during a 12-month period, while a nonsinging control group dropped out of some activities. The singers also reported fewer health problems, while the control group reported an increase.

All the new research has senior programs rethinking their offerings. In Chicago, for example, Mather LifeWays, a not-for-profit that promotes healthful aging, has opened three neighborhood cafes that serve coffee and sandwiches to people of all ages and offer fitness classes, computer courses, lifelong-learning opportunities, and volunteer activities for older adults. "I've met lots of friends here," says Jill Wonsil, 66, who drops in at the cafe near her home several times a week to socialize, check E-mail, and take exercise and other classes. If living life to the fullest is the best way to stay sharp, it's not such a tough prescription to swallow. ●

FOR MENTAL MUSCLE

Consumers have been snapping up software and high-tech games that challenge their synapses. If you want to invest in some workout equipment, here are a few popular choices:

BRAIN FITNESS PROGRAM

(www.positscience.com): The only commercial software backed up by published research suggesting it enhances brain function. Users wear headphones and use a computer to perform audio exercises: identifying whether a tone is ascending or descending in pitch and distinguishing between two similar syllables, say. Such fine-tuning, developers claim, "repairs the machinery" of the brain, so it conveys information more precisely from one region to another and improves overall brain performance. **Cost:** \$395 for one user; \$495 for two

MINDFIT (www.mindfit.com): PC software offering exercises to improve short-term memory, reaction time, eye-hand coordination, and more. Tracks performance over time. **Cost:** \$139 (download) or \$149 (CD) for one user; additional users, \$99 each

BRAIN AGE (www.brainage.com): Inspired by the research of a Japanese neuroscientist, this game for Nintendo's hand-held DS system includes 15 different puzzles and exercises, plus 100 Sudoku puzzles. **Cost** (for the game): \$19.99

BIG BRAIN ACADEMY (www.bigbrainacademy.com): For Nintendo's Wii or DS hand-held systems. Up to eight players compete in a myriad of activities, from memorization to math problems to matching shapes to pictures. **Cost** (for the game): \$49.99 (Wii); \$19.99 (DS)

MYBRAINTRAINER (www.mybraintrainer.com): A website offering 39 exercises. **Cost:** \$29.95 for one year

RADICA BRAIN GAMES AND BRAIN GAMES 2 (www.radicagames.com): Mattel's hand-held games feature exercises that ask you to complete sequences, find hidden words, solve math problems, and more. **Cost** (for game and unit): \$19.99