Staying Sharp

current advances in brain research

Successful Aging and Your Brain

The Dana Alliance for Brain Initiatives

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AARP's Educator Community

NRTA: *AARP's Educator Community*

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The Dana Alliance for Brain Initiatives

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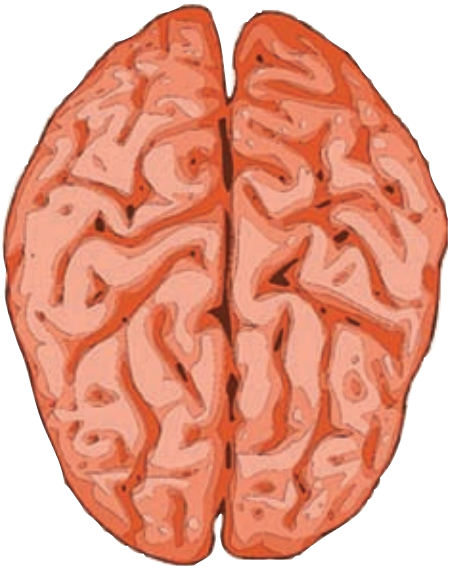

Learn what neuroscience tells us about successful aging, and what you can do to take charge of your brain health.

We all know people who seem to blossom after 50, and others who have stayed sharp well into old age. How do they do it? What can we learn from their experience? What are the secrets to maintaining our mental edge?

Brain researchers are working hard to find the answers—and there is good news: how we live our lives each and every day can make a difference in how our brain ages. The lifestyle choices we make, the activities we pursue, the friendships we maintain, even the foods we eat.

In this booklet, part of the *Staying Sharp* series of booklets on the brain, you'll learn what brain research is revealing about successful aging and your brain. Find out what steps you can take now to improve your brain fitness, whether you are just reaching the "new middle age" of 50 or passed that milestone long ago.

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Getting to Know Your Brain

Every aspect of brain function, whether it's solving a mathematical problem, hitting a ball with a club, or feeling the warmth of the sun, is represented in the brain as patterns of electrical and chemical signals traveling between nerve cells. Each thought, action or sensory perception stimulates distinct sets of nerve cells and brain chemicals. The cells are like musicians in an elaborate symphony orchestra, each playing its individual notes in harmony with the other musicians. In the case of the brain, the result of this harmonic convergence is human behavior itself, in all its nuanced facets.

Nerve cells (neurons) are the workhorses of the brain. Their fibers, or axons, form connections called synapses with other neurons. When activated by a thought or a sensory perception, a neuron sends a tiny electrical current down its axon, releasing biochemicals (neurotransmitters) that diffuse across the gap where one neuron meets another (the synaptic gap) and latch onto receptors on the receiving neuron.

This sets off a cascade of changes inside the receiving nerve cell that ultimately passes the signal along, like runners in a relay race. Some neurons send signals that "excite" other cells, activating them to fire, while others transmit inhibitory signals, essentially telling other cells to pipe down.

Neurons communicate via synapses with other cells, creating a dense network of pathways and circuits that criss-cross the brain and underlie every aspect of human thought and behavior.

New in Neuroscience: Astrocytes Play More Than a Supporting Role

Emerging neuroscience research is contributing to an altered view of synaptic transmission between nerve cells, one that includes a type of cell called an astrocyte as a critical player. Astrocytes are a type of glia, the non-neuronal brain cells that outnumber neurons as much as 9 to 1 (the other types of glia are oligodendrocytes and microglia). Glial cells have long been thought of as mere support cells for neurons—their name derives from the Greek word for glue—but it is increasingly clear that these cells play more than a supporting role in brain function. Recent studies suggest that astrocytes are crucial regulators of synaptic communication, capable of both receiving and sending chemical

signals to neurons that affect the quality of nerve signal transmission at the synapse. The role of astrocytes in neuron function and death is an active area of brain research that promises to yield more surprises in the near future.

Making Memories

When we experience something repeatedly, such as practicing a musical score, we are re-activating the same circuit of synapses over and over again. After several repetitions, the synapses being used change ever so subtly. The change can be structural or functional. A structural change, for example, might involve the sprouting of new dendritic spines along a well-used synapse—a bigger burst of neurotransmitter might be emitted, for example. Either one can enhance the efficiency of the circuit, resulting in a stronger synapse that transmits nerve signals more robustly. These changes are examples of the brain's plasticity—its ability to change and adapt in accordance with experience.

Scientists call this process of synaptic strengthening "long-term potentiation," or LTP for short. LTP is the molecular mechanism by which the brain encodes an experience or behavior into a long-term memory. It occurs only when the synapse is repeatedly or persistently activated. On the other hand, if a particular synapse is not regularly activated, it withers and ultimately disappears from the neural pathway, hence the old adage "use it or lose it."

Synapses that fire together, wire together—but only if you use them!

Anatomy of A Memory

Scientists believe that long-term memories are encoded within specific patterns of synapses in the cortex, the irregular folds and ridges on the outer layer of the brain where advanced mental processing takes place. The frontal lobe of the cortex, especially the prefrontal cortex (the area behind the forehead), is essential to high-level mental functions such as reasoning, planning, and judgment. The hippocampus, the amygdala, and neighboring structures within the medial temporal lobe form the core of the brain's memory processing system and are critical to short-term or "working" memory as well as emotionally charged memories. These structures are connected to the cortex by elaborate systems of neural circuits that shuttle messages back and forth.

In a study, volunteers underwent functional MRI brain scans while recalling news events from a period spanning 1 to 30 years past. The scientists found that activity in the hippocampus gradually decreased as participants recalled events that were 1 to 12 years old and remained low for older events. The opposite pattern of activity was seen in three areas of the cortex (frontal, temporal and parietal lobes): the older the news event, the more these areas lit up.

The New View of Aging

True or False: As we age, our brains lose neurons.
The answer may surprise you: the statement is false, despite popular myths to the contrary. This is an example of how modern neuroscience research is overturning longstanding dogma of the past.

It was long assumed that, of course the brain loses neurons as we age, possibly even thousands of neurons a day. Now we know that that's just not so. In fact, the opposite is true: neurogenesis, the birth and development of new neurons, continues throughout life in certain discrete parts of the brain, though the numbers are probably not huge and the functional significance of the new cells is not at all clear.

So, if a loss of neurons is not behind brain aging, what is? It's a question being hotly pursued in neuroscience laboratories around the world, and some clues are beginning to emerge.

What's become clear is that two broad types of changes are associated with brain aging: a loss of synaptic connections and a decrease in synaptic plasticity, the ability of synapses to adapt and rewire in response to learning and life experience. It's not that older people lose all, or even most, synapses: in fact, most remain intact. Nor is plasticity completely arrested—older people surely can still learn, which requires synaptic adaptability. But decreased capacity for plasticity may mean it takes a bit longer for older people to really learn new information, a fact that has been well-documented.

This new view of aging may spell good news for the development of therapies to stave off age-related memory decline, for the simple reason that replacing lost neurons would be far more challenging than replacing lost connections or improving synaptic plasticity.

New in Neuroscience: White Matter Matters!

The term gray matter is sometimes used to describe the "thinking" part of the brain and has even been adopted into the vernacular as a synonym for our brain. But there's a lot more to the brain than gray matter.

While gray matter is composed of neuron bodies, white matter is made up largely of the axons that nerve cells use to transmit electrical signals. Axons are wrapped and insulated with a fatty white substance called myelin, which gives white matter its characteristic pale sheen. Myelin helps speed the transmission of nerve signals along axons, making it essential to optimal brain function.

> In multiple sclerosis, for example, the myelin sheath around nerve fibers degenerates, leading to a breakdown in nerve cell communication. Myelin can also be destroyed in spinal cord injuries, and a major focus of spinal cord repair research is aimed at regenerating this protective nerve coating.

Scientists are only beginning to explore what changes occur in white matter with age. Recent evidence suggests that as we age, the myelin surrounding nerve fibers decreases in thickness, leading to an overall "shrinkage" of white matter. Using new brain imaging techniques, scientists have also identified specific patterns of white matter loss that are linked to poorer performance on cognitive tasks.

If white matter degenerates to the degree that synaptic communication is slowed or interrupted, brain function could be compromised in any number of ways, depending on where in the brain the lines of communication break down. Ongoing research is aimed at understanding what causes white matter to shrink with age and what might be done to counteract it. For example, studies in animals suggest that exercise and dietary factors can improve or at least maintain the integrity of white matter, but such effects have not yet been shown in humans.

Pillars of Successful Aging

How the brain ages—and why some people's brains hold up better than others—is a complex puzzle involving an interplay of genetic, environmental, and lifestyle factors. Scientists have spent decades tracking

people's activities and habits as they age to determine what distinguishes people who retain good mental faculties from those who fare less well. Many of these studies are ongoing, so we can expect new clues to be revealed as researchers learn more.

"Successful aging" studies consistently point to a few fundamental qualities of a brain-healthy lifestyle. The overall message is to stay active, mentally, physically and socially.

Already, certain qualities seem to stand out as consistent characteristics of people who age successfully in terms of brain health and maintaining cognitive function. In their book, *Keep Your Brain Young*, Marilyn Albert, Ph.D., and Guy McKhann, M.D., neuroscientists at Johns Hopkins University, talk about three fundamental tenets of successful aging:

- Staying mentally active
- Staying physically active
- Maintaining "self-efficacy"

Staying mentally active doesn't mean we have to master 5-star Sudoku every day, but it does mean turning off the television, a notoriously passive activity. The key is to actively engage the brain in novel ways. This could mean breaking out of old routines and learning something new, or simply doing something old in a new way. Activities that stimulate and challenge us intellectually seem to be best. (For more on this, see page 15.)

In the same way, staying physically active doesn't mean we have to pump iron like a bodybuilder or run a marathon! **Simply walking, or engaging in active hobbies such as gardening, can help you meet a daily "exercise quota**." A minimum of 30 minutes a day most days of the week is a good starting goal, but it doesn't have to be done all at

once. The important thing is to do something active on a regular basis, to make it a part of your day-to-day life. (For more on physical activity, see page 9.)

Self-efficacy, Albert and McKhann say, entails an ability to adapt to life's challenges and to maintain a degree of independence in and control over one's life. **Sustaining social ties with friends and family seems to be critical**—the more people get out of their house and engage in social activities, the better they seem to do, experts say. **Managing stress and keeping a positive outlook on life is also important**.

The bottom line is that the things we do every day can and do make a difference in how well our memory and learning abilities hold up as we age. **Simple changes can make a big impact, and the more changes we make, the bigger the impact is likely to be**.

New in Neuroscience: Learning From the 'Oldest Old'

You might call it "extreme aging": people who live into their 90s and beyond and still enjoy a vital, independent lifestyle. What can we learn from the "oldest old"?

Neuroscientist Claudia H. Kawas, M.D., is trying to find the answers. She and colleagues at the University of California, Irvine, have been studying a group of 950 90-plus year-olds since 2003, looking for clues about the secrets to successful aging at the upper extreme of human lifespan. The researchers are examining lifestyle habits such as diet, physical activity levels, social interactions, and leisure pursuits, as well as taking DNA samples to search for genetic links to super-longevity. The landmark study, which was recently re-funded by the National Institutes of Health for at least another 10 years, has already produced a plethora of data on what it takes to age well.

For example, Kawas and colleagues have found that staying socially engaged and being involved in one's community are closely linked to well-being in old age. Exercise is vitally important; even 15 minutes a day had a measurable effect on longevity. Getting 30 minutes was even better, and 45 minutes of exercise daily showed the greatest impact—but beyond that, more was not necessarily better. In contrast, there was no leveling-off effect with less sedentary activities such as reading,

doing crossword puzzles, and interacting socially; for these, the message is: the more, the better. They have found that maintaining a normal weight or being slightly overweight is better than being underweight, and that moderate amounts of alcohol—on the order of 2-4 glasses of wine per week—can increase longevity.

More evidence shows that physical exercise, social interactions, mental stimulation and weight control are important to longevity.

Study participants also agree to donate their brains after they die, and autopsy examinations have revealed an intriguing dichotomy between brain changes linked to Alzheimer's disease and impairments in cognition that might be expected to go along with such changes. The researchers have found that a number of individuals who stayed mentally sharp right to the ends of their lives had brains that were filled with the kind of Alzheimer's-related damage often associated with severe cognitive dysfunction. Understanding why they had no overt symptoms may yield clues to the prevention or treatment of Alzheimer's and other dementing illnesses.

Taking Control of Brain Health

How can we put decades of brain research to work for us in our quest to maintain brain health as we age? In this section, we'll take a closer look at what brain scientists have discovered about certain lifestyle factors that can improve cognitive functioning.

Exercise and Physical Activity

It is increasingly clear that what's good for your body is also good for your brain, and regular exercise is no exception. Study after study supports this premise, consistently finding correlations between higher levels of physical activity and better brain aging. Exercise has also emerged as a factor that may prevent (or at least delay) the onset of Alzheimer's disease.

> The healthy brain needs and craves physical activity.

Exercise may in fact help offset one of the most common effects of aging on the brain—the sort of generalized slow-down in neural processing that manifests as slower reaction times and taking longer to learn new information. Recent brain imaging studies show that highly fit older adults have faster reaction times than their less-fit counterparts, an indication of better concentration. They also are better able to focus on relevant information and ignore irrelevant cues, indications of better attention. These effects are "robust and relatively immediate" once an exercise program has begun, according to Arthur Kramer, Ph.D., a neuroscientist at the University of Illinois at Urbana-Champaign, who is a leading expert in this area.

How Much? What Kind?

How much exercise is necessary? Experts suggest 30 minutes or more at least three times a week. Brisk walking or any type of aerobic activity that increases cardiovascular fitness is beneficial, as are leisure activities that get us out and moving, like gardening or golf. Even better, it seems, are physical activities that challenge the mind as well, such as learning a new dance, practicing Tai Chi, or taking up a new sport. This may be because learning a new skill activates new patterns of brain activity, and may literally build new synaptic connections in areas of the brain that correspond to the skill learned. Social activities such as dancing or group exercise classes may be especially beneficial because they

combine social interaction with physical activity. **The important thing is to do something; any amount or type of activity is better than being sedentary.**

How does exercise affect the brain?

Accumulating evidence from neuroscience research is shedding new light on the basic question of how exercise changes the brain in beneficial ways.

Exercise reduces gray matter loss: Highly fit people also show less of a decrease in gray matter in the cortex than is normally seen with aging, which may suggest a protective effect of exercise against nerve cell death. This effect is most pronounced in areas of the brain involved in executive aspects of cognition, which typically decline most with aging.

Exercise promotes neurogenesis: Laboratory animals that are allowed to run freely on an exercise wheel show increases in the generation and survival of new neurons ("neurogenesis") in the hippocampus, a brain structure involved in memory formation. The hippocampus is one of only a few distinct areas of the brain where neurogenesis has been proven to occur naturally. The animals who had increased rates of neurogenesis in the hippocampus learned how to find their way through a maze more quickly than animals with normal rates of neurogenesis, suggesting that the increase in new neurons may be related to improved learning. These types of findings are now being extended to humans, and at least one brain imaging study has found that people involved in a consistent, regular aerobic exercise program (roughly 40 minutes a day, five times a week) had larger hippocampal structures after six weeks.

Exercise strengthens neural connections: In laboratory animals, running increases the number and density of nerve connections (synapses), physically changing the structure of these nerve-signal pathways to make them more efficient at transmitting nerve signals. The animal evidence suggests that the act of running activates a specific gene to pump up production of a protein that seems to be crucial to the type of synaptic remodeling that has been observed. This same molecular mechanism, called long-term potentiation, is believed to underlie long-term memory formation.

Exercise changes gene activation patterns: Human DNA contains about 30,000 genes, each of which can be turned on or off to produce (or stop producing) a wide array of proteins and enzymes that our cells use to conduct their daily business of keeping us alive and healthy. To understand how exercise may be effecting this complex system of gene activation, or "gene expression," scientists have examined which genes are switched on or off in animals that exercise regularly. It turns out that exercise induces changes in the expression patterns of a slew of genes, some of which become more active ("up-regulated") and some of which become less active ("down-regulated"). Many of the genes that are up-regulated are known to play roles in the structure and adaptability of synapses, suggesting a possible mechanism by which exercise can increase the complexity and flexibility of the brain.

Exercise pumps up growth factors: Nerve growth factors (neurotrophins) play vital roles in nourishing and supporting brain cells. A growth factor, brain-derived neurotrophic factor (BDNF), increases significantly in the brains of animals that run voluntarily. BDNF is thought to be involved in gene regulation, neurogenesis, and synaptic adaptability, and there is evidence that BDNF stimulates new synapses in the hippocampus.

Exercise enhances blood flow: The brain is the most energy-hungry organ in the body. To function optimally, it needs lots of oxygen and glucose, which are provided by blood that circulates into the brain via arteries and capillaries. Exercise increases the density and size of brain capillaries, which in turn increases blood flow to the brain. This may in turn help support the survival of new neurons in brain areas such as the hippocampus, which is involved in memory formation, and may facilitate faster "firing" by neurons.

"Just by moving your feet, you're literally building the structure of the brain."

–Carl W. Cotman, Ph.D., University of California-Irvine

Mind Your Numbers

There is now overwhelming evidence that the same lifestyle and dietary factors that contribute to heart disease also increase the risk of Alzheimer's disease and age-related cognitive decline. Therefore, "managing your numbers"—cholesterol levels, blood pressure, blood sugar, and weight—has become a rallying cry for brain-health advocates.

"Many factors that are good for your heart turn out to be good for your brain as well," says Sam Gandy, a scientific advisor to the Alzheimer's Association. "There are multiple reasons why you should pay attention to these central medical problems you might have and get control of them."

Obesity may be the biggest threat to longevity in Americans, and scientists are beginning to sort out the reasons why body weight matters to the brain. Excess weight is associated with vascular diseases (e.g., heart disease and stroke) and diabetes, which together constitute the leading causes of death and disability in this country. Obesity joins diabetes, high blood pressure, high cholesterol, and smoking as primary "vascular risk factors"; that is, factors that decrease blood flow through the body. Each of these factors can lead to weakness or clogging in both the small and large arteries that serve as pipelines for blood flow. Moreover, the effects are additive: having more than one of these conditions increases one's risk for dementia, as it does for heart disease.

A study of 1,449 Finns found that a body-mass index of 30 or more, indicating obesity, was associated with double the risk of dementia. In people who also had high cholesterol or high blood pressure, the risk was six times higher. Scientists who have studied overweight animals in the laboratory have reported learning and memory impairments and a higher vulnerability to stress-induced cognitive dysfunction. Recent studies indicate that high cholesterol alone also increases the risk for Alzheimer's, and reducing cholesterol levels through dietary and lifestyle changes, weight loss, or cholesterol-reducing medications such as statins can decrease one's risk.

A Brain-Healthy Diet

Like regular exercise, eating a healthy, balanced diet is one of the pillars of good health—and of good brain health.

Eat Your Vegetables

The latest news from neuroscience confirms what Mom always said: eat your vegetables! For all the interest in individual vitamins and supplement formulas, the best advice is to eat a variety of colorful, cruciferous, and leafy green vegetables.

A recent federally funded study of 13,388 nurses that has tracked their eating patterns for 10 years found that women who ate more cruciferous and leafy vegetables (such as broccoli, cauliflower, green lettuces and spinach) in their 60s had a lower rate of decline on learning and memory tests. The more of these vegetables they ate, the better they performed.

A diet rich in fruits and vegetables has long been promoted for its heart-healthy and cancer-fighting potential, so it's not surprising that such a diet is also good for your brain. Vegetables and fruits are packed with antioxidants and other essential vitamins and minerals, are low in fat, and are generally low in calories.

Antioxidants

Of all the dietary factors that are being investigated for possible roles in staving off mental decline with aging, antioxidants have received the most attention. Antioxidants, which include vitamins C, E, and beta carotene (a form of vitamin A), reduce oxidative damage to cells from "free radicals," unstable molecular fragments. Oxidation, which can be thought of as the biological equivalent of rusting, seems to contribute to aging and cognitive decline, in addition to a number of diseases.

While there's little question that antioxidants consumed as part of a healthy, balanced diet are a good thing, popping antioxidant pills is another matter altogether.

Caution! Don't run out to the health food store and start loading up on vitamins. Too much of some vitamins or minerals can actually be harmful. The best way to get antioxidants (or any other nutrient) is not by popping supplements, but by eating a variety of whole foods, especially dark, leafy greens and berries.

There is, however, a growing recognition that as we age, our bodies are less efficient at absorbing dietary nutrients from food. This fact, combined with the observation that older adults' diets may be less than ideally balanced nutritionally, has led many experts to recommend supplements for older people. If you want to take vitamins, experts recommend taking a standard multivitamin, which typically provides the recommended daily allowances for each ingredient.

Animal studies have shown pretty consistent benefits for diets rich in antioxidants, but human studies of antioxidant use have yielded ambiguous results. In fact, most well-designed studies of antioxidants have failed to show a benefit. This is partly because our diets are generally quite varied, and it's very difficult to prove that health benefits are the result of any one dietary factor. In animals, however, it's much easier for researchers to carefully control dietary elements in order to tease out effects.

For example, a series of studies in beagles found that an antioxidant-rich diet prevented or slowed age-related declines in various learning tasks. The animals that were fed the special diet had improved performance on both simple and complex cognitive tests. In fact, aged dogs that could not perform one of the more difficult tests at all in the beginning of the study could do so after three years on the diet.

> "We actually resurrected function out of the aging brain," says Carl Cotman, who led the study. "That just blew us away."

A series of studies out of Tufts University has shown that animals fed diets high in blueberries had improved short-term memory and balance. The ingredient that gives blueberries their color appears to endow them with potent antioxidant properties.

Common Foods High in Antioxidants (listed from most to lesser amounts)	
Fruits	**Vegetables**
Prunes	Kale
Raisins	Spinach
Blueberries	Brussels sprouts
Blackberries	Alfalfa sprouts
Strawberries	Broccoli florets
Raspberries	Beets
Plums	Red Bell Peppers
Oranges	Onions
Red Grapes	Corn
Cherries	Eggplant
Source: USDA	

Omega-3 Fatty Acids

Omega-3s are a particular type of polyunsaturated fats that are found in fatty fish. A growing body of scientific literature indicates that omega-3s are important to maintaining brain function in early development and throughout life, and may help protect the brain from aging. They seem to work in part by counteracting free radicals that cause oxidative damage to brain cells. Some research suggests they also may benefit the non-neuronal brain cells called glia, which help improve the efficiency of nerve signal transmission at synapses. The best dietary sources of omega-3s are mackerel, herring, sardines, tuna, anchovies, whitefish, and sablefish.

The caveat: There is increasing concern about the levels of organic mercury in some of these same fish, leading some experts to caution against eating such fish more than three times a week. Pregnant women should eat such fish even more sparingly due to concerns about the toxicity of mercury to the developing fetus.

B Vitamins

B vitamins are of interest because of their effectiveness in lowering levels of homocysteine, a blood protein that is associated with increased risk for cardiovascular disease as well as Alzheimer's and other types of dementia. In particular, scientists are investigating whether folate, or folic acid, may have a role in preventing Alzheimer's disease; it and other B vitamins are currently being evaluated in a clinical trial for people with Alzheimer's.

Multivitamin Supplements

Most experts are comfortable recommending that older adults take a daily multivitamin as a supplement to a healthy diet. Claudia H. Kawas, M.D., says, "I'm not opposed to multivitamins at all. I don't think any of our diets are that good, and as people get older and are eating less, they may have diets that are lower in various nutrients." Still, the best advice, she says, "is to do what your mother told you to do: eat all those healthy fruits and vegetables."

A common misperception is that if taking some vitamins is good, taking more may be better. This is not always the case, and some vitamins can be dangerous in high doses. A recent study found that people taking moderately high doses of vitamin E, an antioxidant vitamin that is being studied for health-protective effects in a number of federally funded clinical trials, were slightly more likely to die than those not taking the pills. Vitamins and herbal supplements can also interact with prescription medications, lowering their effectiveness or causing adverse effects, so be sure your health care provider knows about any of these you may be taking.

Exercise Your Mind

A lifestyle that includes stimulating mental activity, especially in the context of social interaction, is clearly correlated with healthy brain aging. This has been a consistent finding from large, well-designed studies of older adults. The largest controlled clinical trial to date, which was funded by the National Institutes of Health (NIH) and reported in the prestigious *Journal of the American Medical Association*, found that cognitive training sessions improved the memory, concentration and problem-solving skills of healthy adults 65 and older.[1]

The effects were powerful and long-lasting, effectively erasing 7 to 14 years of normal cognitive decline and persisting for at least two years.

The NIH trial follows numerous smaller studies that have shown varying degrees of benefits from specific types of training. A common theme that has emerged is that cognitive training can improve older adults' ability to maintain day-to-day activities, and that the skills learned can enhance functioning on similar-minded tasks, but may not transfer to other aspects of cognition. For example, memory training might improve recall, but may not help with problem-solving.

Cognitive Training

In the largest clinical trial ever conducted to test the usefulness of cognitive training interventions (dubbed the "ACTIVE" trial), study subjects engaged in three types of training exercises:[2]

Memory training included strategies for remembering word lists and sequences of items, text material, and main ideas and details of stories.

Reasoning skills involved training in how to solve problems that follow patterns, strategies that can be used in tasks such as reading a bus schedule or filling out an order sheet.

Speed-of-processing training focused on the ability to identify and locate visual information quickly, which can be applied to tasks such as looking up a phone number, finding information on medicine bottles, and responding appropriately to traffic signs.

Immediately following the five-week training period, 87 percent of participants in speed training, 74 percent of participants in reasoning training, and 26 percent of participants in memory training demonstrated reliable improvement on the respective cognitive ability. The training effects continued through a two-year follow-up period, particularly for the participants who received "booster" training.

Engaging Your Brain

Though more research is needed on which types of activity are best, most brain experts are convinced that staying mentally active throughout life is good advice. "We can make the brain work better simply by accumulating more knowledge, which builds more networks

of connections in the brain," says James McGaugh, Ph.D., at University of California, Irvine. Acquiring more knowledge—and therefore building more nerve connections—may enable our brain to essentially compensate for, or at least forestall, any age-associated loss of synaptic connections that may occur. In other words, our brain would be better equipped to forge alternate pathways of nerve connections to accomplish mental tasks. There is evidence from brain imaging studies that older people who maintain mental sharpness do in fact harness alternate brain pathways to accomplish the same tasks as younger people.

The brain is a learning machine. It craves novelty and challenge. Acquiring new skills and seeking out new experiences–rather than simply repeating the same old routines–will help ensure the machine continues to perform at its best.

Social Interactions

Maintaining social ties is another factor that has been consistently correlated with healthy brain aging. For example, Claudia Kawas has been following a group of 1,100 adults age 90 and above since 1981. One clear finding, she says, is that "people seem to do better if they get out

of their houses and interact with other individuals, even if that interaction is not particularly sophisticated. You don't necessarily have to take French classes." The more contact people have with others, the better they seem to do cognitively, she says.

> "We are social individuals and isolation is very bad. I actively arrange my life in such a way that I have plans for the year ahead, so that I'm looking forward to trips I will be taking and activities I will be doing."
>
> –Marianne VonEckhardt, 95; participant in the 90+ Study at University of California, Irvine (quoted on UC Irvine website: www.uci.edu/aging)

Activities that not only use your senses but also have you engaging with other human beings can be a great form of brain exercise. Social activities such as dancing, attending wine-tastings or other social events, playing cards, traveling with friends, golfing or taking yoga classes are some examples experts give that could fit the bill here. A large study reported in the *New England Journal of Medicine* found that people who engaged in leisure activities such as learning to play a musical instrument or dancing were less likely to develop dementia. Dancing may be especially beneficial to the brain because it combines physical activity with social interaction, and often involves a cognitive challenge in learning dance steps.

Brain Blockers

With all the good news about how we can positively impact our brain health as we age, it's important to also recognize those things that can interfere with learning and memory.

Stress

Stress is a bit of a double-edged sword, when it comes to the brain. "Acute" stress—the kind we experience when we narrowly avoid an accident or face an impending deadline—can actually improve memory, because it activates a surge of powerful hormones that increase the staying power of a memory. Strong emotions can also trigger strong memories. This is why so many people retain vivid memories of what they were doing when they first heard of the assassination of John F. Kennedy, or of the terrorist strike at the World Trade Center. But these same hormones (called glucocorticoids) can damage the brain's memory center when they are overproduced, as when we are faced with chronic stress, or when the body fails to properly shut down their production, as can occur after a particularly traumatic event.

Managing stress is therefore an important facet of retaining a sense of control in our lives. Exercising and engaging in positive social interactions can help reduce stress, as can techniques such as biofeedback, meditation, relaxation therapy, or visual imagery. Recognizing your limitations and prioritizing your activities to ensure that you're spending your time on the things that bring you pleasure and that are truly important to you can go a long way to reducing day-to-day stress.

> "In the last 20-odd years I've made up my mind not to bother with stress anymore… I just roll with the punches."–Gordon Bern, 95; participant in the 90+ Study at University of California, Irvine (quoted on UC Irvine website: www.uci.edu/aging)

Inadequate Sleep

Not getting enough sleep can be a common problem as we age. Drowsiness impairs memory, and studies indicate that a good night's sleep is essential for the brain to consolidate newly acquired information into long-term learning. If you have consistent problems getting to sleep or staying asleep, and lack of sleep is interfering with your day on a regular basis, you should consider speaking with your doctor.

Practicing good "sleep hygiene" may help; here are some tips from the National Sleep Foundation:

- Consume less or no caffeine and avoid alcohol.
- Drink fewer fluids before going to sleep.
- Avoid heavy meals close to bedtime.
- Avoid nicotine.
- Exercise regularly, but do so in the daytime and not too close to bedtime.
- Try a relaxing routine, like soaking in hot water (a hot tub or bath) before bedtime.
- Establish a regular bedtime and wake-time schedule.

Medications and Supplements

Many common medications can negatively impact our brain, and older adults are more apt to be taking multiple pills that may have cross-reactions. Be sure all of your doctors know all of the drugs you're taking, as well as any vitamin or herbal supplements. If you notice a sudden change in mental status, especially if you've recently changed or added a medication, talk to your doctor about it. Prescription or over-the-counter drugs that more commonly cause adverse cognitive effects include anti-anxiety drugs (e.g., anxiolytics, anti-psychotics), antihistamines, sleeping aids, and anticholinergics (often used for asthma).

Alcohol and Illicit Drugs

Excessive alcohol consumption can interact negatively with prescription drugs, can cause sleep problems, and has been associated with cognitive impairment and dementia. Older adults may be particularly susceptible to the adverse mental effects of excess alcohol as well as illicit drugs. Some studies have suggested that moderate drinking (e.g., a glass of wine daily) may have health benefits, including protection from cognitive decline and possibly Alzheimer's. However, other studies contradict these findings, so the research is not clear-cut on the brain benefits of a drink or two a day.

Underlying Health Conditions

Clearly, neurological disease or injury (e.g., stroke, head trauma) can impact learning and memory processes, sometimes severely. Depression is the most common cause of reversible cognitive impairment and dementia in older adults, and can be treated effectively in the majority of people. There is also increasing evidence that cardiovascular disease impairs cognition, and that many of the risk factors associated with heart disease—particularly high blood pressure, high cholesterol and diabetes—also increase the risk of cognitive problems. These conditions demand medical management. Any sudden change in mental functioning, particularly if it interferes with daily activities, warrants immediate medical evaluation by a qualified health care professional.

Checklist for a Brain-Healthy Lifestyle

Do	Don't
Exercise your body regularly and get involved in physically active leisure pursuits.	Drink to excess, smoke, or use illicit drugs.
Keep your mind exercised! Engage in active learning throughout life and pursue new experiences.	Ignore sudden changes in mental status, but don't be overly concerned about normal slips of memory like forgetting names or where you put the keys.
Stay socially engaged with friends, family and community groups.	Put off going to the doctor if you notice changes in your health, physically or mentally.
Maintain a positive attitude and a sense of control over your life.	Overlook the possibility of drug interactions that can affect mental functioning, especially if you are taking more than one prescription medication.
Take steps to manage stress.	Become isolated in your home.
Eat a brain-healthy, balanced diet rich in antioxidants and omega-3 fatty acids, and consider taking a multivitamin supplement that includes antioxidants and folate.	Think you're too old to take up something new!
Mind your numbers: lose any extra pounds, lower your cholesterol if it is high, and keep your blood glucose and blood pressure under control.	
Get adequate sleep.	
Get proper medical attention and treatment for any underlying health problems.	

Further Reading

The Brain That Changes Itself: Stories of Personal Triumph from the Frontiers of Brain Science, by Norman Doidge, M.D. (Penguin Books, 2007)

The Dana Guide To Brain Health, edited by Floyd E. Bloom, M.D., M. Flint Beal, M.D., and David J. Kupfer, M.D. (Dana Press, Nov. 2006)

Train Your Mind, Change Your Brain: How a New Science Reveals Our Extraordinary Potential to Transform Ourselves, by Sharon Begley (Ballantine Books, 2007)

The Attention Revolution: Unlocking the Power of the Focused Mind, by B. Allan Wallace (Wisdom Publications, 2006)

Memory: Remembering and Forgetting in Everyday Life, by Barry Gordon, M.D., Ph.D. (Intelligence Amplification Inc., 2004)

Memory and Emotion: The Making of Lasting Memories, by James L. McGaugh (Columbia University Press, 2003)

Intelligent Memory, by Barry Gordon, M.D., Ph.D. and Lisa Berger (Viking, 2003)

Keep Your Brain Young: The Complete Guide to Physical and Emotional Health and Longevity, by Guy McKhann and Marilyn Albert (John Wiley & Sons, Inc., 2002)

The Memory Bible: An Innovative Strategy for Keeping Your Brain Young, by Gary Small, M.D. (Hyperion Books, 2002)

Memory: From Mind to Molecules, by Eric R. Kandel and Larry R. Squire (W.H. Freeman & Co., 2000)

Keep Your Brain Alive: 83 Neurobic Exercises, by Lawrence C. Katz, Ph.D. Manning Rubin and David Suter (Workman Publishing Company, 1999)

The Brain Fitness Program (DVD), starring Peter Coyote. Released in 2008.

Welcome to Your Brain: Why You Lose Your Car Keys but Never Forget How to Drive and Other Puzzles of Everyday Life (Paperback) by Sam Wang, Ph.D. and Sandra Aamodt, Ph.D. (Bloomsbury, 2008)

Resources

AARP

www.aarp.org

Alliance for Aging Research

Telephone: 202-293-2856

Fax: 202-785-8574

www.agingresearch.org

Alzheimer's Association

Telephone: 1-800-272-3900

Fax: 312-335-1110

www.alz.org

Alzheimer's Disease Education and Referral Center

Telephone: 1-800-438-4380

Fax: 301-495-3334

www.alzheimers.org

www.nia.nih.gov/alzheimers

National Council on Aging

Telephone: 202-479-1200

Fax: 202-479-0735

www.ncoa.org

National Institute on Aging

Telephone: 301-496-1752

www.nia.nih.gov

National Sleep Foundation

Telephone: 202-347-3471

Fax: 202-347-3472

www.sleepfoundation.org

The Dana Foundation

www.dana.org

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[1] Karlene Ball, PhD; Daniel B. Berch, PhD; Karin F. Helmers, PhD; Jared B. Jobe, PhD; Mary D. Leveck, PhD; Michael Marsiske, PhD; John N. Morris, PhD; George W. Rebok, PhD; David M. Smith, MD; Sharon L. Tennstedt, PhD; Frederick W. Unverzagt, PhD; Sherry L. Willis, PhD; for the ACTIVE Study Group. Effects of Cognitive Training20Interventions With Older Adults: A Randomized Controlled Trial. JAMA. 2002; 288:2271-2281.

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