THINK SMART

A Neuroscientist's Prescription for Improving Your Brain's Performance

"One of the world's most important scientific thinkers."

Scientific American

RICHARD RESTAK, M.D.

Bestselling author of Mozart's Brain and the Fighter Pilot
EPILOGUE:
THE TWENTY-FIRST-CENTURY BRAIN

As I have emphasized throughout this book, healthy brain functioning involves a good diet, exercise, and, most of all, mental stimulation. The earlier you start on a program incorporating these factors into your life, the greater your cerebral reserve will be—your best bet when it comes to offsetting the effects of brain aging.

Here are my suggestions, based on discussions with renowned neuroscientists and my own observations. They are divided into four areas.

- First, nutrition:
  - Reduce your cholesterol level either by diet or, if necessary, by taking a statin or one of the other cholesterol-lowering drugs. The value of lowering cholesterol was illustrated by an imaging study (PET) on mentally fit older people. Those with higher cholesterol had decreased brain cell activity in those brain regions known to be at risk in Alzheimer’s disease as well as areas impaired by normal aging. This suggests that
high cholesterol plays an early role in tilting the brain toward an Alzheimer’s pattern of brain cell loss. “Higher cholesterol levels conspire with other risk factors to trigger Alzheimer’s,” according to neuroscientist Eric Reiman of the Banner Alzheimer Institute in Phoenix, who carried out the imaging study on 117 healthy people in their fifties and sixties. Reiman’s findings suggest that cholesterol-lowering treatments might reduce the risk of Alzheimer’s disease.

- **Try to include walnuts and blueberries in your daily diet.**

Even though much of the research on the brain benefits of walnuts and blueberries involved animals rather than people, I believe the parallels with humans are sufficiently robust that you should probably include both of these in your daily diet. Walnuts contain an essential omega-3 fatty acid along with a host of other chemicals that act as powerful antioxidants to block the actions of free radicals that lead to inflammation and brain cell damage. The walnuts also inhibit the action of the enzyme acetylcholinesterase, which breaks down acetylcholine, the brain’s key learning and memory-processing neurotransmitter. Eating between one and one and a half ounces of walnuts per day is sufficient to obtain the benefits, according to scientists at the U.S. Department of Agriculture Human Nutrition Research Center at Tufts University in Boston. A 2 percent extract of blueberries, or about half a cup per day, is considered sufficient to enhance brain circuits. If you don’t like blueberries, strawberries do just as well, at least in animal research, in reversing age-related deficits in motor and cognitive behavior. Whichever fruit you select, the aim is to employ naturally occurring (and commercially avail-
able) compounds to halt or reverse some age-associated brain changes.

- Consider increasing your daily intake of caffeine. I say “consider” because not everyone can take caffeine. In some people it causes heartbeat irregularities (arrhythmias) and/or nervousness, sometimes called “coffee nerves.” (I can’t drink more than four or five cups of tea a day without feeling edgy.) Learn from your own past experience with caffeine and check with your doctor before increasing your caffeine intake. According to a recently initiated clinical trial measuring cognitive improvement on caffeine, memory impairment can be slowed and even reversed in mice given the human equivalent of five cups of coffee per day—about 500 milligrams. Caffeine isn’t limited to coffee, of course, but can be taken in tea, sodas, and chocolate. But since not all of us can take caffeine, the best approach at this time is a cautious one. In the meantime, expect to hear a lot more over the next year or two about caffeine and its positive effects on brain function.

In order to improve cognitive performance, I suggest you try the following:

- Avoid the principal factors shown to be associated with a decline in brain information-processing ability (cognitive decline): insufficient physical and mental activity, a decreased number of friends, too much empty spare time, infrequent opportunities to converse, and excessive alcohol use.

- Increase your capacity for sustained attention and concentration. To do this, resist the pressures to multitask. In most
cases, multitasking serves as a substitute for prioritizing. Even worse, it chisels away at your ability to remain mentally focused. And if you can’t focus, your brain remains stunted and incapable of achieving its true potential.

- **Work on strengthening your memory.** Thanks to living in the most advanced technological society in human history, we rarely have to remember anything for more than the few moments it takes to enter that information into a PDA or PC. Since I’m always entering information into my digital recorder (random thoughts or on-the-spot interviews with people whom I’ve recognized as having something interesting to say), it’s all the more important that I frequently exercise my own memory rather than use an electronic assistant. For instance, when I shop for groceries I don’t read the items on my grocery list but challenge myself to remember them. Only when I’m ready to go to the checkout counter do I check the list for any omissions.

Learn memory exercises and perform them regularly. Specific suggestions can be found in this book for sensory memory, general memory, and working memory (see Part Three). Memory is our most vital mental faculty. It is also the first faculty to be affected by Alzheimer’s disease. Strengthening memory is an important step in lessening the odds of developing that dreadful illness. As a neurologist I have personally observed improvements in my patients during the early stages of Alzheimer’s among those who took active steps to improve their memory.

- **Increase your hand and finger dexterity.** Increased hand and finger dexterity has been shown to increase both mental agility and longevity. I suggest the game of Jenga as a fun tool
for doing this; it combines manual dexterity with mental skills. It is played with fifty-four wooden blocks arranged so as to create an eighteen-story tower. Taking turns, each player removes one block at a time from any story except the top one. The removed block is then placed on the top of the tower. Additional blocks are then removed one by one from any of the lower seventeen stories and placed on the topmost story. The idea is to select blocks for removal and placement in a way that will not destabilize the tower and lead to its collapse. The game can be played either alone or with others.

For an additional benefit, combine finger-hand dexterity exercises like Jenga with juggling, which enhances the perception and spatial anticipation of moving objects—hence, an exercise that stimulates a wide swath of brain tissue that processes complex visual motion. What’s more, the more skilled you become, the greater the resulting brain growth, according to the research of neuroscientist Bogdan Draganski of the Functional Imaging Library of University College London. Best of all, you don’t have to achieve the skill level of a circus performer to see a benefit. Draganski found that the classic and easily learned three-ball cascade is sufficient. But once you learn to juggle, don’t neglect your newfound skill. Spend a few minutes a day practicing to maintain the brain-enhancing advantages. In a Draganski study the brains of the volunteers who learned to juggle reverted to their pre-juggling pattern within three months of neglecting to practice a few minutes a day—a dramatic example that the brain’s plasticity works both ways. Whatever activity induces a favorable change in brain structure or function must be continued to maintain that change.
• Start playing video action games as a means of increasing your sensory sensitivity and rapid responsiveness.

• Buy and use a GPS, especially if you're over fifty-five. Starting in middle age, the brain suffers difficulty correlating landmarks with the correct orientation and direction. Even when a relevant landmark is recognized, the person over fifty-five, for example, frequently turns right when he should be turning left. In response to the tendency to make such errors some people over fifty-five avoid long drives in unfamiliar surroundings. Part of the explanation for this deteriorating sense of direction is that as we grow older our hippocampus—the area of the brain concerned with navigation—activates less efficiently in situations where we're required to make decisions about direction. This decrease in proficiency isn't true just for our sense of direction; as we age our spatial sense in general tends to decline more than our language powers. You can counter this by using the GPS, but to get the most benefit, actively anticipate rather than passively respond: mentally construct a map linking where you are with where you're going. Do this even in familiar places. (Can you name all of the streets and roads you regularly encounter when driving from home to work?) The goal is to use the GPS not as a substitute for a failing sense of direction, but as a means of strengthening it.

• Spend less time watching television. A study published in the March 2006 issue of the journal Neurology compared the rates of cognitive impairment in a group of more than five thousand people fifty-five years and older. The researchers found that more time spent watching television was associated with a 20 percent increased risk of cognitive impair-
“Increasingly, it seems prudent to encourage persons of all ages, not just older persons, to turn the TV off,” counsels an accompanying lead editorial. Not surprisingly, during the two months after the publication of the study, not many TV news outlets reported this research, which counseled viewers to turn off their sets because watching TV leads to a deterioration of their mental powers. Yet this is a message that sorely needs to be delivered in a society where the average school-age child spends twenty-seven hours a week watching TV. By the time that child reaches age seventy, he or she will have spent ten years of their lives watching TV. And by age seventy that lifetime of TV watching will be taking a cumulative toll on a brain already at great risk for cognitive impairment.

Why does watching TV exert such a stultifying influence on mental performance? It is not simply a matter of social isolation, or the noninteractive nature of television, or the concentration-jarring effects of repeated commercial interruptions, although each of these plays a part. Television induces changes in brain activity, shifting the balance slightly from the left hemisphere, which processes language and logic (organizing, judging, and analyzing information), to the right hemisphere, which favors impressionistic perception. Thus, emotional rather than analytical interpretations are more likely to come into play when watching a televised discussion about a topic than when reading about the same topic in a newspaper or magazine. In addition, television also induces passivity via an increase in alpha brain activity, a rhythm typically associated with unfocused receptive states of consciousness. We've all experienced this passivity. We become bored and tired of watching TV and yet we just can’t summon the
energy to turn it off. Most striking of all is our lack of intellectual engagement with TV as opposed to, say, the computer. As Steve Jobs puts it, “You watch television to turn your brain off, and you work on your computer when you want to turn your brain on.”

- Develop an appreciation of art. Neuroscientists have recently discovered that different brain areas are activated by varied styles of painting such as Impressionism and Surrealism. Indeed, the brain’s responses to the various styles are sufficiently distinctive that it’s possible by brain imaging (fMRI) to distinguish whether a viewer is looking at a picture by Dalí or Picasso. This suggests that by increasing our familiarity with different schools of art we can exercise different brain circuits and enhance general brain activity.

- Engage in reminiscence exercises. For example, how many things can you remember that happened in 1994, or any other year of your choice? I perform this brain-stimulating exercise regularly. I jog my memory to come up with the major world events for a given year: who were the political candidates, the Oscar winners, the victorious teams in the World Series or the Super Bowl? Along with these details, I try to remember the specific circumstances of my life at that time. Each time I perform this exercise I find myself coming up with more details. That’s because, as suggested by recent research by L.-H. Tsai of the Picower Institute for Learning and Memory at MIT, memory impairments may involve not actual loss, but rather failure on the part of the brain’s neural networks to properly process memories. Based on her research, Tsai has concluded that new nerve cell networks can be activated to revive lost memories. Thus memories
aren't permanently lost but potentially recoverable. "Past memories can be recovered even after a significant number of neurons have been lost in the brain," Tsai told me. This is a revolutionary and hopeful revision of traditional ideas about memory loss.

- **Develop a magnificent obsession.** I've observed that most successful people have obsessive character traits that they use to their advantage. That's the good news. The bad news is that these same traits also render them prone to negative obsessions: tendencies to ruminate, worry, fret, and kvetch about things that aren't under their control. One antidote for this is to develop what I refer to as a magnificent obsession: take up something that interests you but is far removed from your background, education, or life experience. Then start learning everything you can about the subject over the space of the next year. During periods of stress or whenever your mind drifts into negativity (worry, low moods, obsessions), shift mental gears from current preoccupations and devote a few moments to something related to your magnificent obsession.

If you're interested in World War II history, for instance, read every book that you can on the subject and make notes based on your reading; study film and video clips of the war; locate veterans in your area and interview them. Finally, collate all of this information in one document (I use a program called Microsoft OneNote). That way everything that you have accumulated can be accessed at one source. As it expands, read this document regularly. Finally, in order to keep yourself challenged, look for a program that creates new and creative rearrangement of the information you've gath-
ered (Mindjet MindManager is one currently available program that can do this). At a certain point you’ll be ready to contact experts in the field. While some experts may not welcome “amateurs,” many of them, in my experience, are intrigued by a nonprofessional who achieves near-expert knowledge or performance in their field. In addition, join the relevant professional associations and attend their annual meetings. Each of these steps will increase your long-term memory storage. It will also help build up cerebral reserve.

Nor do the benefits depend on what subject you’ve chosen for your magnificent obsession. A magnificent obsession doesn’t necessarily have to involve scholarly pursuits. An information specialist friend of mine became interested in carpentry several years ago and devotes some time every day to building furniture and working on home improvements. For complicated projects beyond his current abilities, he hires a professional carpenter and takes time off from his regular job to observe the pro and gain knowledge from him.

But whatever obsession you choose, keep in mind that different choices will engage different brain networks. Studying a historical period such as the Renaissance, for instance, engages the left hemisphere, primarily areas having to do with memory, reading, listening, imaging, and the pleasurable emotions that accompany learning new facts. My amateur carpenter friend is developing brain circuitry involved in form, scale, eye-hand coordination, and manual dexterity, along with the emotional satisfaction of creating something that can be seen, felt, and put to practical use.

One caveat: Since your intention is to enhance brain
function rather than achieve a level of competitive expert performance, too big a daily time commitment to your interest is likely to interfere with your job and your relationships. You can achieve most of the benefits from your project through regular, consistent efforts of no more than an hour to an hour and a half a day.

- Every day find an hour to improve through practice a specific aspect of your performance in an activity that interests you. If you're interested in golf, for instance, resist the impulse to go to a driving range and mindlessly hit buckets of golf balls. Instead, spend the time working on your greatest weakness—whether it be putting, chipping, or something else. "It is only human nature to practice what you can always do well, since it's a hell of a lot less work and a hell of a lot more fun. Sad to say, though, it doesn't do a lot to lower your handicap," said Sam Snead, widely considered one of the best golfers of the twentieth century. But practice isn't limited to athletics. Hobbies and special interests provide opportunities too. For instance, take up dancing. After a year of regular dancing once a week or more, you can expect improvements in your reaction time, fine-motor performance, posture and balance, attention, and nonverbal intelligence. These improvements not only are greater than what's found among people who do little or no exercise, but also exceed the brain benefits found among regular exercisers such as swimmers or those working out on exercise machines. Along with providing physical exercise, dancing gets us out of ourselves: we cooperatively engage with other people in learning the various dances and maneuvers; we improve our sense of rhythm and timing; we
improve balance and coordination; finally, we counteract feelings of isolation.

In regard to mood:

- **Try to induce positive moods in yourself.** Longevity and general well-being have long been known to be favorably influenced by a positive mood. Maintaining a positive mood and attitude is especially important if you are sixty years of age or older, according to Dilip Jeste of the Stein Institute for Research on Aging. He has found decreased cardiovascular response to stress, along with a seven-and-a-half-year increase in longevity, among older people who remain upbeat and positive about their lives as they get older.

- **Use music to elevate your mood.** Research conducted over the past three years has shown that music elicits intense responses from the brain regions that process emotion, reward, motivation, and arousal. These are the same brain structures that become active in response to food and sex.

  According to neuroscientists at the University of Zurich, it’s possible to lift one’s mood via a seventy-second exercise consisting of nothing more complicated than listening to a musical selection while looking at what the experimenters call “happiness” pictures (a man holding his smiling baby or laughing children playing by the ocean).

  For example, in the emotional induction method developed by neuroscientists at the University of Zurich, the third movement of Beethoven’s Sixth Symphony, when combined with a “happiness” picture, reliably lifts a person’s mood. In each instance, the subjects were simply told to look at the
pictures, listen to the music, and mentally place themselves into the same mood. In all instances the mood changes occurred within seventy seconds. Most important, their emotional experiences were most powerful in response to the pictures and the music together rather than either the music alone or the pictures alone. Combining the music with the pictures also induced the strongest activation in a distributed emotional network plus parts of the frontal, temporal, and occipital lobes of the brain. When you do this exercise, select musical selections with pictures that you find emotionally appealing. After combining pictures and music enough times, you'll find that you no longer need the pictures but can produce the same positive effect on your mood by mentally recreating the pictures in your imagination.

In another study on the effect of music on mood, carried out at the University of Pennsylvania, volunteers reported feeling happier after listening to selected music clips (a "jazzed-up" version of Bach's Brandenburg Concerto Number 3, for instance). While in this state of heightened mood the subjects performed better on memory tests than did participants in the experiment who didn't listen to mood-uplifting music. It's speculated that this memory improvement results from a positive mood-induced increase in attention. But whatever the explanation, the results suggest that you can use music to simultaneously lift your mood and increase your memory.

Obviously, the musical selections will vary from one person to another.

Discover the particular musical selections that arouse in you positive emotions under different circumstances. Think about your iPod musical library in a completely different way.
Why do I enjoy listening to Bach while home alone in the evening but enjoy Van Morrison while driving to work? By exploring questions like this you will discover the particular musical selections that arouse positive emotions under particular circumstances.

- **If you're prone to loneliness**, combat it by scanning a few names from your address list and selecting one of them. Then, after putting your relationship with that person into context in your own mind (a good friend, an acquaintance, business associate), consider calling the person and suggesting getting together for lunch or after-dinner drinks. Over the years I've often called writers, doctors, and lawyers I've known and suggested we meet. Even if the person can't get together immediately, I've felt less lonely after setting up a meeting for the near future.

- **Schedule regular naps during the workweek.** Naps not only improve your mood but also restore concentration and focus and increase creativity. I try to take a twenty-minute nap every afternoon.

Whether or not you're currently following any of the above suggestions, it's never too late to enhance brain function, according to a UCLA study involving subjects ranging in age from thirty-five to sixty-nine, with the mean age of fifty-three. The subjects in the study followed a program consisting of:

- A diet high in omega-3 fats from olive oil or fish, as well as fruits and vegetables rich in antioxidants (basically the Mediterranean diet, described on page 37).
• **Physical exercises** with the emphasis on cardiovascular conditioning such as brisk daily walks.

• **Mental exercises** aimed at strengthening memory and other cognitive functions. For instance, as a means of improving memory, the subjects learned to focus their attention by concentrating on, for later recall, random details of the clothing and accessories of family members. This was followed by other exercises aimed at improving visualization skills and the use of one of the mnemonic techniques as described in Part Three, combined with puzzles and brain teasers.

• The practice of various relaxation techniques **aimed at reducing stress**. After only fourteen days on this program the participants showed greater word fluency along with a decrease in activity in an area of the left prefrontal lobe associated with verbal fluency, working memory, and anxiety. It's speculated by the UCLA team that the memory and other mental exercises, combined with the relaxation techniques, caused the brain to function more efficiently with a decrease in the demand for glucose and other resources. The key finding, however, is the short time period in which these changes were brought about. Only fourteen days of a healthy diet, physical and mental exercise, and stress reduction induced **dramatic improvements in cognitive efficiency** in a part of the brain involved in memory and verbal fluency.

Although the UCLA study was a small one that enrolled only seventeen people, it has huge implications for brain enhancement. The brain, it's turning out, is even more plastic and malleable than the most enthusiastic researchers have
heretofore imagined. Perhaps enhancement doesn’t require months and even years of effort, but worthwhile alterations can be brought about in the brain in as short a time frame as two weeks (as occurred in the juggling study mentioned on page 241). Moreover, improvement doesn’t entail expensive or inconvenient measures: no spas, health clubs, or specially prepackaged meals.

Most important, a brain-enhancement program confers benefits that can be discerned on testing five years later, as shown in the ACTIVE (Advanced Cognitive Training for Independent and Vital Elderly) trial conducted by the National Institutes of Health discussed on page 221. This study also involved a short time frame of ten sessions lasting a little over an hour. In the NIH study, the emphasis was on improving memory, mental processing speed, and reasoning.

Given all this, how should we think about the brain? What metaphor is most appropriate? Historically, many metaphors have been suggested. One of the more recent ones emphasizes the similarity between the brain and a computer. And while it’s true that some of the brain’s functions can be likened to the operations of a computer, this metaphor breaks down when it comes to physical structure and natural life cycles. Computers don’t change in terms of their physical components; they continue to operate at maximal capacity until, at some unpredictable time in the future—and usually without warning, and under the most inconvenient circumstances—they abruptly cease to function. In many cases, after suitable fixes they can be restored to full function.

The brain, in contrast, changes in both size and function as it ages. The brain reaches its maximum size (measured by
weight) somewhere between twenty and thirty years of age and decreases progressively for the remainder of its life span. Function too changes with age: as we age we experience decreases in reaction time, spatial processing, and working memory, among other functions. Yet these changes aren’t due so much to brain cell loss—as was formerly believed—but to failures to maintain the neuronal circuitry linking neurons to one another. In support of this view, neuroscientists have found that the number of synapses linking neurons to one another in the cerebral cortex decreases with age, while the number of neurons themselves doesn’t change very much.

Given these facts about the brain, the metaphor of brain-as-computer is of limited usefulness. What metaphor will enable us to put into practice all of the different pathways to brain enhancement and improvement suggested in this book?

The best and most helpful metaphor for the brain that I have come across was suggested by neurologist Kenneth Rockwood of Dalhousie University, Halifax, Nova Scotia, Canada. "Perhaps we should think of the metaphor of a series of marathons," he says. "As our brains age, we must prepare them to resist injury—equip them with good education, train them thoughtfully with challenging regimens, support them with nurturing environments, and be prepared to refresh them from time to time."

Rockwood’s metaphor allows for both the structural and functional changes that accompany brain growth, development, and aging, as well as the active approach that will enable us to help our brain to achieve optimal performance throughout our lives. The metaphor also is consistent with the brain’s varying performance depending upon its physical
conditioning, which can always be improved by additional effort and training.

Rockwood concludes: "We should recognize that performance can vary dramatically from one marathon to the next. Perhaps the most important consequences of such a metaphor are that we should aim to see cognitive aging as a challenge for which we must prepare, that we gain enough equanimity to accept the slowing that even elite athletes experience, and that we reflect on what has been achieved along the way."