EXPERIENCE L!FE

Upgrade Your Brain

Your brain changes over the course of your lifetime -- for better or for worse. Here's how to make the most of your gray matter.

By Jon Spayde / October 2010

Our descriptions of the human brain are often awash with computer metaphors, as if it were nothing more than a hard drive planted in our heads. We talk about downloading information, rebooting a tired mind or recoding our neurons to produce more positive thoughts. We've gotten so used to thinking of the brain as a special piece of computing "wetware" that we sometimes forget that this super-organ is closely related to almost every aspect of our physical health.

Indeed, brain scientists in recent years have discovered a number of surprising ways that the brain influences our overall health, as well as how our behavior influences the health of our brain. And unlike in the days of old — when scientists believed the brain was "fixed" after childhood, only to start an inexorable decline in the middle to later years — today, research is showing that the brain is perfectly capable of changing, healing and "rewiring" itself to an unexpected degree.

"Ever since a Canadian researcher took his adult lab rats home to run around in his house and later found that those rats were considerably smarter than those rats left behind in their boring cages, neuroscience has systematically upended the idea that the adult brain cannot change its structure or improve how it works," writes *New York Times* science editor Barbara Strauch in *The Secret Life of the Grown-Up Brain* (Viking, 2010). "It can and does. What we do changes the architecture of our brains. It's called neuroplasticity and it's the underpinning of everything we now know about the brain."

It turns out that the age of your brain may be a lesser influence on its structure than what you *do* with it. Pursuits that require intense mental focus, like language learning, "switch on" the nucleus basalis, the control mechanism for neuroplasticity. This actively promotes synapse connections and leads to strong neural "wiring," and the fact that you can affect this wiring with conscious effort is good for more than just your command of French. In some cases of brain damage, therapists have helped patients recover by insisting they attempt to function as usual, however difficult it might be.

If a stroke affecting the left hemisphere of the brain has rendered the right hand temporarily useless, for instance, they've found that steady, tiny efforts to use the hand can slowly "rewire" a nearby area of the brain to take over that function.

In short, neuroplasticity means you have some control over your cranial fitness. While brain function naturally deteriorates somewhat as you age (though not nearly as much as you might think), various strategic approaches can create new neural pathways and strengthen existing ones as long as you live. What's more, these efforts to build a better brain can deliver lasting rewards for your overall health.

Here are just a few of neuroscience's most empowering recent discoveries.

Your Thoughts Affect Your Genes

We tend to think of our genetic heritage as a *fait accompli*. At our conception, our parents handed down whatever genetic legacy they inherited — genes for baldness, tallness, disease or whatever — and now we're left playing the hand of DNA we were dealt. But, in fact, our genes are open to being influenced throughout our lifetime, both by what we do and by what we think, feel and believe.

The new and growing field of "epigenetics" studies extra-cellular factors that influence genetic expression. While you may have heard that genes can be influenced by diet and exercise, many researchers are now exploring the ways that thoughts, feelings and beliefs can exert the same epigenetic effect. It turns out that the chemicals catalyzed by our mental activity can interact with our genes in a powerful way. Much like the impacts of diet, exercise and environmental toxins, various thought patterns have been shown to turn certain genes "on" or "off."

The Research

In his book The Genie in Your Genes (Elite Books, 2009), researcher Dawson Church, PhD, explains the relationship between thought and belief patterns and the expression of healing- or disease-related genes. "Your body reads your mind," Church says. "Science is discovering that while we may have a fixed set of genes in our chromosomes, which of those genes is active has a great deal to do with our subjective experiences, and how we process them."

One recent study conducted at Ohio University demonstrates vividly the effect of mental stress on healing. Researchers gave married couples small suction blisters on their skin, after which they were instructed to discuss either a neutral topic or a topic

of dispute for half an hour. Researchers then monitored the production of three wound-repair proteins in the subjects' bodies for the next several weeks, and found that the blisters healed 40 percent slower in those who'd had especially sarcastic, argumentative conversations than those who'd had neutral ones.

Church explains how this works. The body sends a protein signal to activate the genes associated with wound healing, and those activated genes then code blank stem cells to create new skin cells to seal the wound. But when the body's energy is being "sucked up" by the production of stress biochemicals like cortisol, adrenaline and norepinephrine, like it is during a nasty fight, the signal to your wound-healing genes is significantly weaker, and the repair process slows way down. By contrast, when the body is not preparing for a perceived threat, its energy stores remain readily available for healing missions.

Why It Matters to You
Just about every body comes equipped with the genetic material it needs to deal optimally with the physical challenges of daily life, and the degree to which you can maintain your mental equilibrium has a real impact on your body's ability to access those genetic resources. While habits of mind can be challenging to break, deliberate activities like meditation (see the following studies) can help you refashion your neural pathways to support less reactive thought patterns.

Chronic Stress Can Prematurely Age Your Brain

"There's always going to be stress in the environment," says Howard Fillit, MD, clinical professor of geriatrics and medicine at New York's Mount Sinai School of Medicine and executive director of the Alzheimer's Drug Discovery Foundation. "But what's damaging is the distress we feel internally in response to it."

Fillit's distinction points to the bodywide reaction our bodies experience when we routinely respond to stress by going into fight-or-flight mode. In our brains, the stress response can cause memory and other aspects of cognition to become impaired, which is a risk factor for Alzheimer's disease and accelerated memory loss with aging. One thing that can happen is you can start feeling a lot older, mentally, than you are.

"Patients come in complaining of faulty memory and wonder if they're beginning to get Alzheimer's," says Roberta Lee, MD, vice-chair of the Department of Integrative Medicine at Beth Israel Medical Center and author of *The Superstress Solution* (Random House, 2010). "Their workups and MRI scans look normal. In the interview, I ask them about their lifestyle and almost invariably they have compounded stress."

The Research
Studies at the University of California–San Francisco have shown that repeated instances of the stress response (and their accompanying floods of cortisol) can cause shrinkage of the hippocampus — a key part of the brain's limbic system vital to both stress regulation and long-term memory. Call it the downside of neuroplasticity.

Why It Matters to You
Aside from the obvious — no one wants his or her brain to age faster than it's already going to — this research matters because it suggests that you have some influence over the rate of your own cognitive change.

To protect the brain from cortisol-related premature aging, Lee suggests building stress disruptors into your regular routine: "A five-minute period in the middle of every day during which you do absolutely nothing — nothing! — can help a lot, especially if you are consistent about it," she says.

Her other recommendations include eating breakfast every day — complex carbohydrates (whole grains, veggies) and some protein. "Breakfast helps your metabolism feel like it won't be stressed — caught up in a starvation-gluttony pattern," she explains.

And when anxiety does strike, a good way to initiate the relaxation response is her "four-five breath" routine: breathing in through the nose to a count of four, then out through the mouth to a count of five. "Repeat it four times and you'll feel the relaxation," she says. "Best of all, do the four breaths twice daily, at the beginning and end of the day."

Meditation Rewires Your Brain

Meditation and other forms of relaxation and mindfulness not only change your immediate state of mind (and, correspondingly, your biochemical stress level and gene expression), they also can alter the very structure of your brain. Neuropsychologist Rick Hanson, PhD, cofounder of the San Francisco–based Wellspring Institute for Neuroscience and Contemplative Wisdom, has extensively studied the effect of meditation on the brain, with a particular focus on how neuroplasticity allows for permanent changes for the better in your gray matter.

The Research
"Of all the mental trainings — affirmations, psychotherapy, positive thinking, yoga — the one that has been far and away the most studied, in terms of effects on the brain, is meditation," Hanson says. Some of the most prominent research has come from the collaboration between French-born Buddhist monk and author Matthieu Ricard and University of Wisconsin–Madison

neuroscientist Richard Davidson, PhD. Their studies have shown that a high ratio of activity in the left prefrontal areas of the brain can mark either a fleeting positive mood or a more ingrained positive outlook.

Brain-imaging tests have shown that Ricard and other veteran Buddhist meditators demonstrate initial heightened activity in this region, along with a rapid ability to recover from negative responses brought on by frightening images shown to them by researchers. This suggests that their long-term meditation practice has helped build brains that are able to not just enjoy but sustain a sense of positive well-being, even in stressful moments.

Why It Matters to You
"Stimulating areas of the brain that handle positive emotions strengthens those neural networks, just as working muscles strengthens them," Hanson says, repeating one of the basic premises of neuroplasticity. The inverse is also true, he explains: "If you routinely think about things that make you feel mad or wounded, you are sensitizing and strengthening the amygdala, which is primed to respond to negative experiences. So it will become more reactive, and you will get more upset more easily in the future."

By contrast, meditative practices stimulate the anterior cingulate cortex, the part of the brain's outermost layer that controls attention (this is how meditation can lead to greater mindfulness, Hanson explains), as well as the insula, which controls interoception — the internal awareness of one's own body. "Being in tune with your body via interoception keeps you from damaging it when you exercise," Hanson says, "as well as building that pleasant, simple sense of being 'in your body.'" Another plus of a strong insula is an increased sensitivity to "gut feelings" and intuitions and greater empathy with others.

Perhaps best of all, meditation develops the circuitry in the left prefrontal cortex, where the unruffled monks showed so much activity. "That's an area that dampens negative emotion, so you don't get so rattled by anger or fear, shame or sorrow," Hanson says.

"Deciding to be mindful can alter your brain so that being mindful is easier and more natural," he explains. "In other words, you can use your mind to change your brain to affect your mind."

Your Brain Learns By Doing

The mirror neuron system is the name for those regions of the brain with synapses that fire whether you're actually doing or merely watching an action — as long as you've done it previously. Doing an action lays down neural connections that fire again when you watch the same action. This accounts for the connection you feel when viewing a sport you've played, or why you wince when you see someone else get hurt.

The Research
Giacomo Rizzolatti and his colleagues in the Department of Neuroscience at the University of Parma in Italy first noted the mirror effect while studying the brains of macaque monkeys. When a monkey was watching one of the researchers pick up a peanut, the same neurons fired as if the monkey — likely a seasoned peanut gatherer — had picked up the nut itself. The researchers labeled these specific cells "mirror neurons." In the human brain, entire regions light up in response to a familiar action; this endows us with a full-fledged mirror system.

Why It Matters to You
The existence of the mirror system helps explain why learning a new skill is easier if you try doing it early in life. This includes doing it clumsily, rather than hanging back watching your instructor or a video until you think you "have it." Watching before you try means that you will probably see very little; watching after you try will engage the mirror system, increasing your brain's power to "get it."

As London-based neuroscientist Daniel Glaser, PhD, puts it, "When you look at something you have done before, you are actually using more of your brain to see it, so there's a richer information flow. Until you started playing tennis, you couldn't see the difference between a good topspin stroke and a bad one; after a few weeks of practice, when your coach demonstrates the stroke, you really get it visually. And you can thank the mirror system for that."

The mirror system is also what endows you with the empathic ability to feel the pain or joy of others, based on what you register on their faces. "When we see someone else suffering or in pain, mirror neurons help us to read her or his facial expression and actually make us feel the suffering or the pain of the other person," writes UCLA neurologist Marco Iacoboni, MD, PhD, in his book, *Mirroring People* (Farrar, Straus and Giroux, 2008). "These moments, I will argue, are the foundation of empathy."

Growing Older Can Make You Smarter

For some time, the prevailing view of a brain at midlife was that it's "simply a young brain slowly closing down," observes Barbara Strauch. But she notes that recent research has shown that middle age is actually a kind of cranial prime time, with a few comedic twists thrown in for fun.
"Researchers have found that — despite some bad habits — the brain is at its peak in those years. As it helps us navigate through our lives, the middle-age brain cuts through the muddle to find solutions, knows whom and what to ignore, when to zig

and when to zag," she writes. "It stays cool. It adjusts."

The Research
Brain scientists used to be convinced that the main "driver" of brain aging was loss of neurons — brain-cell death. But new scanning technology has shown that most brains maintain most of their neurons over time. And, while some aspects of the aging process do involve losses — to memory, to reaction time — there are also some net gains, including a neat trick researchers call "bilateralization," which involves using both the brain's right and left hemispheres at once.

Strauch cites a University of Toronto study from the 1990s, soon after scanning technology became available, that measured the comparative ability of young and middle-age research subjects to match faces with names. The expected outcome was that older subjects would do worse at the task, but not only were they just as competent as younger subjects, PET scans revealed that, in addition to the brain circuits used by the younger crowd, the older subjects also tapped into the brain's powerful prefrontal cortex. As some of their circuits weakened, they compensated by using other parts of the brain.

Ultimately, this means the effects of age caused them to use — and strengthen — more of their brains, not less.

Why It Matters to You
Gene Cohen, MD, PhD, who directs the Center on Aging, Health and Humanities at George Washington University Medical Center, notes that this ability to use more of your cognitive reserves strengthens your problem-solving ability as you enter the middle years, and it makes you more capable of comfortably negotiating contradictory thoughts and emotions. "This neural integration makes it easier to reconcile our thoughts with our feelings," he wrote in "The Myth of the Midlife Crisis" (*Newsweek*, Jan. 16, 2006). Like meditation, the middle-age tendency toward bilateralization seems to promote your ability to stay cool under pressure.

There are things you can do to amplify this increased strength. "Our brains are built to roll with the punches," Strauch writes, "and better — or more carefully cared for — brains roll best." Studies show multiple ways to build long-term brain health: from healthy eating, exercise and conscious relaxation to active social bonds, challenging work and continuing education. Good advice, it would seem, for a brain at any age.

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Web Extra!

The Teenage Brain

While it was once thought that the brain's architecture was basically set by age five or six, New York Times medical science and health editor Barbara Strauch explains her book The Primal Teen: What the New Discoveries About the Teenage Brain Tell Us About Our Kids (Anchor, 2003), new research shows that the teen brain is "still very much a work in progress, a giant construction project. Millions of connections are being hooked up; millions more are swept away. Neurochemicals wash over the teenage brain, giving it a new paint job, a new look, a new chance at life."

The neurochemical dopamine floods the teen brain, increasing alertness, sensitivity, movement, and the capacity to feel intense pleasure; it's a recipe for risk-taking. And, as anyone who has tried to rouse a sleepy teen should appreciate, brain chemicals that help set sleep patterns go through major shifts.

Knowing about these brain gyrations in young people can help parents be a little more patient and tolerant—and they offer some opportunities too. As Jay Giedd told PBS's Frontline, "If a teen is doing music or sports or academics [during this period of brain change and consolidation], those are the cells and connections that will be hardwired. If they're lying on the couch or playing video games or MTV, those are the cells and connections that are going to survive."