Digital games are incapable of giving the entire brain a full workout. These digital programs can't really exercise the cerebellum (Latin: "Little Brain") and, therefore, are literally only training half your brain. These "brain-training workouts" are the equivalent of only ever doing upper body workouts, without ever working out your lower body.

Although the cerebellum is only 10 percent of brain volume, it houses over 50 percent of the brain's total neurons. Neuroscientists are perplexed by this disproportionate ratio of neurons... Whatever the cerebellum is doing to optimize brain function and improve cognition, it recruits a lot of neurons to do it.

Brain-Training Games Increase Sedentary Screen Time

In order to give your brain a full workout, you need to engage both hemispheres of the cerebrum, and both hemispheres of the cerebellum. You can only do this by practicing, exploring, and learning new things in the three-dimensions of the real world—not while being sedentary in front of a flat screen in a cyber reality.

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On March 11, the New York Times published an article about the "brain fitness business" titled, *Do Brain Workouts Work? Science Isn't Sure*. I believe the answer is no. Without a variety of other daily habits, these "brain-training games" cannot stave off mental decline or dramatically improve cognitive function.

Most of these brain-training games will have some benefits—but it's impossible to optimize brain connectivity and maximize neurogenesis (growth of new neurons) sitting in a chair while playing a video game on a two-dimensional screen.

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The simplest strategy for dealing with trolls is to ignore them.

Robert Biswas-Diener

Christopher Bergland is a world-class endurance athlete, coach, author, and political activist.

*more...*
screen time to a person’s day. This additional time spent on a mobile device or computer takes away from time that people could spend: breaking a sweat, exploring the world, interacting with friends and family, making art, playing a musical instrument, writing, reading a novel, daydreaming, practicing mindfulness meditation, etc.

I have written dozens of Psychology Today blog posts about lifestyle choices and daily habits that improve brain structure, connectivity, and cognitive function. For this post, I did a meta-analysis of the most recent neuroscience studies and compiled a list of habits that can improve cognitive function for people from every generation. These eight habits can improve cognitive function and protect against cognitive decline for a lifespan.

Eight Habits that Improve Cognitive Function

1. Physical Activity
2. Openness to Experience
3. Curiosity and Creativity
4. Social Connections
5. Mindfulness Meditation
6. Brain-Training Games
7. Get Enough Sleep
8. Reduce Chronic Stress

1. Physical Activity

Last December, researchers at Boston University School of Medicine (BUSM) discovered more evidence that physical activity is beneficial for brain health and cognition. The study found that certain hormones, which are increased during exercise, may help improve memory. The researchers were able to correlate blood hormone levels from aerobic fitness, and identify positive effects on memory function linked to exercise.
In October of 2013, researchers at Dana-Farber and Harvard Medical School released a study showing a specific molecule released during endurance exercise that improves cognition and protects the brain against degeneration. I wrote a post about this called "Scientists Discover Why Exercise Makes You Smarter."

In their breakthrough discovery, scientists honed in on a specific molecule called **irisin** that is produced in the brain during endurance exercise through a chain reaction. Irisin is believed to have neuroprotective effects. Researchers were also able to artificially increase the levels of irisin in the blood which activated genes involved in learning and memory.

A 2013 study from Finland with children investigated the link between cardiovascular fitness, motor skills, and academic test scores. The researchers found that first graders with poor motor skills also had poorer reading and arithmetic test scores. Across the board, children with better performance in fitness and motor skills had higher cognitive function and scored better in reading and arithmetic tests.

### 2. Openness to Experience

A study from October 2013 titled, "The Impact of Sustained Engagement on Cognitive Function in Older Adults: The Synapse Project" found that learning new and demanding skills while maintaining an engaged social network are key to staying sharp as we age.

The findings reveal that less demanding activities, such as listening to classical music or simply completing word puzzles, probably doesn't provide noticeable benefits to an aging mind and brain. Older adults have long been encouraged to stay active and to flex their memory and learning like any muscle that you have to "use it or lose it." However, this new research indicates that not all mind-engaging activities improve cognitive function.

Lead researcher Denise Park of the University of Texas at Dallas says, "It seems it is not enough just to get out and do something—it is important to get out and do something that is unfamiliar and mentally challenging, and that provides broad stimulation mentally and socially. When you are inside
Another study, from January 2012, found that a training program designed to boost cognition in older adults also increased their openness to new experiences demonstrating for the first time that a non-drug intervention in older adults can change a personality trait once thought to be fixed throughout a person's lifespan.

3. Curiosity and Creativity

In October of 2013, a study from Michigan State University found that childhood participation in arts and crafts leads to innovation, patents, and increases the odds of starting a business as an adult. The researchers found that people who own businesses or patents received up to eight times more exposure to the arts as children than the general public.

“The most interesting finding was the importance of sustained participation in those activities,” said Rex LaMore, director of MSU’s Center for Community and Economic Development. “If you started as a young child and continued in your adult years, you’re more likely to be an inventor as measured by the number of patents generated, businesses formed, or articles published. And that was something we were surprised to discover.”

Last year, neuroscientists discovered multiple ways that musical training improves the function and connectivity of different brain regions and improves cognitive function. Practicing a musical instrument increases brain volume and strengthens communication between brain areas.

Playing an instrument changes how the brain interprets and integrates a wide range of sensory information, especially for those who start before age seven. The findings were presented at the Neuroscience 2013 conference in San Diego.

In a press briefing Gottfried Schlaug, MD, PhD—who is an expert on music, neuroimaging and brain plasticity from Harvard Medical School—summarized the new research from three different presentations at the conference. He said, “These insights suggest potential new roles for musical training including fostering plasticity in the brain; have strong implications for using musical training as a tool in education; and for treating a range of learning disabilities.”

Another study published in July of 2013 found that reading books, writing, and participating in brain-stimulating activities at any age may preserve memory. Neuroscientists discovered that reading a novel can improve brain function on a variety of levels. This study on the brain benefits of reading fiction was conducted at Emory University. The study was titled, “Short- and Long-Term Effects of a Novel on Connectivity in the Brain,” and was published in the journal Brain Connectivity.
The researchers found that becoming engrossed in a novel enhances connectivity in the brain and improves brain function. Interestingly, reading fiction was found to improve the reader's ability to put themselves in another person's shoes and flex the imagination in a way that is similar to the visualization an athlete would do while mentally rehearsing a motion in sports.

"Our study suggests that exercising your brain by taking part in activities such as these across a person's lifetime, from childhood through old age, is important for brain health in old age," concluded co-author Robert S. Wilson, PhD.

4. Social Connections

In February 2014 Professor of Psychology, John Cacioppo, from University of Chicago, presented findings which identified that the health consequences of feeling lonely can trigger psychological and cognitive decline. Cacioppo's researcher found that feeling isolated from others can: disrupt sleep, elevate blood pressure, increase morning rises in the stress hormone cortisol, alter gene expression in immune cells, increase depression, and lower overall subjective well-being...all of these factors conspire to disrupt optimal brain function, connectivity, and reduce cognitive function.

5. Mindfulness Meditation

A 2013 pilot study by researchers at Harvard's Beth Israel Deaconess Medical Center identified that the brain changes associated with meditation and subsequent stress reduction may play an important role in slowing the progression of age-related cognitive disorders like Alzheimer's disease and other dementias.
First author Rebecca Erwin Wells, MD, MPH, explained, "We were particularly interested in looking at the default mode network (DMN)—the brain system that is engaged when people remember past events or envision the future, for example—and the hippocampus—the part of the brain responsible for emotions, learning and memory—because the hippocampus is known to atrophy as people progress toward mild cognitive impairment and Alzheimer's disease. We also know that as people age, there's a high correlation between perceived stress and Alzheimer's disease, so we wanted to know if stress reduction through meditation might improve cognitive reserve."

6. Brain-Training Games

Scientists are beginning to better understand the specific mechanisms of how patterns of electrical pulses (called “spikes”) trigger a cascade of changes in neural circuits linked to learning and memory. In a report published in April of 2013, researchers from Tel Aviv University found that "stimulant-rich" environments and problem solving puzzles could be a contributing factor in preventing or delaying the onset of Alzheimer's disease in some people.

Researchers at University of California, San Francisco (UCSF) have created a specialized video game that may help older people boost mental skills like handling multiple tasks at once. Dr. Adam Gazzaley of UCSF and colleagues published their findings in the September 2013 journal Nature.

In January of 2014, researchers at Johns Hopkins University reported that as few as 10 sessions of cognitive training improved an older person's reasoning ability and speed-of-processing for up to a decade after the intervention. If someone received additional "booster" sessions over the next three years, the improvements were even more dramatic.

7. Get Enough Sleep

Scientists have known for decades that the brain requires sleep to consolidate learning and memory. At the annual meeting of the Society for Neuroscience in San Diego in November of 2013, sleep researchers from Brown University presented groundbreaking new research that helps explain the specifics of how the sleeping brain masters a new task.

"It's an intensive activity for the brain to consolidate learning and so the brain may benefit from sleep perhaps because more energy is available, or whatever happens during the night," said Dr. Michaela Goedel of Brown University, who presented the new research.
"Sleep is not just a waste of time," Yuka Sasaki concludes. The extent of reorganization that the brain accomplishes during sleep is suggested by the distinct roles the two brainwave oscillations appear to play. The authors conclude "that the delta oscillations appeared to govern the changes in the SMA's connectivity with other areas of the cortex, while the fast-sigma oscillations appeared to pertain to changes within the SMA itself."

A February 2014 study from University of California, San Francisco (UCSF) found an association between poor sleep quality and reduced gray matter volume in the brain's frontal lobe, which helps control important processes such as working memory and executive function.

"Previous imaging studies have suggested that sleep disturbances may be associated with structural brain changes in certain regions of the frontal lobe," said lead author Linda Chao, associate adjunct professor in the Departments of Radiology and Biomedical Imaging and Psychiatry at UCSF. "The surprising thing about this study is that it suggests poor sleep quality is associated with reduced gray matter volume throughout the entire frontal lobe and also globally in the brain."

8. Reduce Chronic Stress

Neuroscientists have discovered that chronic stress and high levels of cortisol can damage the brain. A wide range of recent studies have affirmed the importance of maintaining healthy brain structure and connectivity by reducing chronic stress, which lowers cortisol.

Neuroscientists at the University of California, Berkeley, found that chronic stress triggers long-term changes in brain structure and function which can lead to cognitive decline. Their findings might explain why young people who are exposed to chronic stress early in life are prone to mental problems such as anxiety and mood disorders later in life, as well as learning difficulties.

The "stress hormone" cortisol is believed to create a domino effect that hard-wires pathways between the hippocampus and amygdala in a way that might create a vicious cycle by creating a brain that becomes predisposed to be in a constant state of fight-or-flight.

The researchers found that hardening wires, may be at the heart of the hyper-connected circuits associated with prolonged stress. This results in an excess of myelin—and too much white matter—in some areas of the brain. Ideally, the brain likes to trim the fat of excess wiring through neural pruning in order to maintain efficiency and streamlined communication within the brain.

Chronic stress has the ability to flip a switch in stem cells that turns them into a type of cell that inhibits connections to the prefrontal cortex, which would improve learning and memory, but lays down durable scaffolding linked to anxiety, depression, and post-traumatic stress disorder.
Yoga has been proven to lower cortisol levels and reduce chronic stress. I wrote a *Psychology Today* post about this titled, "Yoga Has Potent Health Benefits."

**Conclusion: Brain Fitness Programs Should Flex Every Brain Hemisphere**

The secret to optimizing cognitive function can be found in daily habits and exercises that flex both hemispheres of the cerebrum, and both hemispheres of the cerebellum. The eight habits I recommend here exercise all four brain hemispheres. If performed consistently, these habits can improve cognitive function and protect against cognitive decline.

If you'd like to read more about how the cerebellum and cerebrum work together, check out my *Psychology Today* blog posts:

- "The Secret to Better Decision Making"
- "Neuroscientists Discover How Practice Makes Perfect"
- "No. 1 Reason Practice Makes Perfect"
- "Toward a New Split-Brain Model: Up Brain-Down Brain"
- "How Is the Cerebellum Linked to Autism Spectrum Disorders?"
- "Childhood Family Problems Can Stunt Brain Development"
- "The Neuroscience of Calming a Baby"
- "Why Is Dancing So Good For Your Brain?"
- "The Neuroscience of Madonna’s Enduring Success"
- "Gesturing Engages All Four Brain Hemispheres"
- "The Neuroscience of Superfluidity"
- "One More Reason to Unplug Your Television"
- "Better Motor Skills Linked to Higher Academic Scores"
- "The Neuroscience of Imagination"
- "Too Much Crystallized Knowledge Lowers Fluid Intelligence"

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