Brain Plasticity and the "P" Words

In the last hundred years, brain scientists were convinced that the brain stopped growing and changing after childhood, and was "fixed" at the age of 25. After age 25, the belief was that all of the connections in the brain would stay there or die off; nothing new could be created.

Think about the ramifications of this belief for a moment: Our IQ is fixed, our ways of thinking are fixed, we are bound for life by our genetics, and we can only learn what we already have the capability for. These narrow beliefs limited scientists' research throughout the entire 20th century, and individuals who bought into this belief limited themselves. It was easy and convenient to blame our shortcomings on our limited brains. We could use the excuse that we were born that way when we failed at something.

Today, for about half of the population, these false beliefs persist.[1] Luckily, research performed in 1998 in a Swiss lab has finally and definitively proved these beliefs false.

The Swiss research showed that every day of our lives, even when we are 90 years old, our brains are growing new cells.[2] The new cells represent new learning, new skills, new experiences, new thoughts, and new memories. These new memories and skills become part of who we are. Lifelong brain growth makes sense, because every day we meet new people, do new things, adapt to changes, and visit new places that stay in our brains long after the moment they happened. When these things happen, new cells and new connections are physically formed in your brain. There is a physical file cabinet in your brain for many of your activities and thoughts, present and past.[3]

This ability of your brain to change is called plasticity. Plasticity is the first "p" word that allows you to begin to understand the unlimited capabilities of your brain.

Brain Growth

Have you ever ridden in a London taxicab? Those boxy, black cars that have passenger doors that open the wrong way are one of London's lovely cultural symbols. Taxi drivers in London are a special breed as well. To become certified as a taxi driver in London, you must take a course for two years called The Knowledge and pass a test that includes memorizing 25,000 roads within a six mile radius, knowing 320 standard routes, and deciding on a route without a map.

Eleanor Maguire and her colleagues at University College in London scanned and measured the brains of taxi drivers in 2000.[4] There is a part of the brain called the hippocampus that we use for navigation. They found that part of the hippocampus is larger in taxi drivers than in people who do not drive a cab. When we study and especially when we practice, we have the ability to make our brains bigger – to build up the neurons and connections inside our brains. When we practice a skill over and over again, we physically strengthen and expand the part of the brain that we are using in that task.[5]

Maguire's team also found that the taxi drivers who had the most experience – thirty years of driving a taxi -- had the largest brain parts. The more inexperienced taxi drivers had proportionally smaller brain parts. There is a correlation between how much experience we have at a task and the physical size of the corresponding part of the brain. The more we practice, the bigger our brains get. Isn't it nice to know we are in control of developing our own expertise? Does this research make you wonder about the brain size of those men who absolutely refuse to ask for directions?!

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It's not just in navigation that we can expand certain parts of our brains. Scientists also studied the brains of musicians who played stringed instruments, specifically violinists. A violinist uses her fingers to play her instrument. The scientists found that the part of the brain that controls finger movement was larger in violinists than non-violinists. The musicians had developed, through practice, much more sensitivity in their fingers than non-musicians.[6]

Older people can expand their gray matter too, as shown in a German experiment.[7] Subjects aged 50 to 67 learned to juggle three balls for the first time in their lives and increased the visual motion area of their brains. They did not become expert jugglers, but the learning limitations were due more to arthritis and bifocals than their brains! Those who didn't keep practicing lost the new brain growth after three months.

Brain plasticity can help people who have lost brain cells due to stroke or illness, even if the stroke or illness occurred years earlier. One experiment instructed victims of a stroke *four years earlier* (on average) to walk on a treadmill for six months. They not only became faster walkers and more fit; they showed increased brain activity in the midbrain and cortex.[8] Another study showed how brain loss was reversed in patients with chronic fatigue syndrome who rehabilitated with cognitive behavioral therapy.[9]

There are many more examples of how experience and practice have changed and enhanced a person's brain, in sickness and in health, but here is one more, my favorite one.

Richard Davidson's team at the University of Michigan has discovered what has come to be called a happiness set-point in our frontal cortex.[10] An individual's level of happiness can be determined by how much brain activity exists in the left frontal cortex compared to the right one. If a person has more activity on the left side, they are happier. If they have more activity on the right side, they are less happy. My favorite example of brain change is the study of Buddhist monks, who have put many years of practice into a form of meditation that generates compassionate or positive emotions.

When Davidson's scientists scanned the monks' brains, they found much more activity in their left frontal cortex – the place for positive emotions -- than in non-meditators.[11] Amazingly, the monks' activity was not just incrementally higher; it was exponentially higher: seven to eight times higher than any scanned non-meditator.

This experiment shows that although people are born with a particular level of happiness, their life experiences can move their happiness level up or down. The monks' example suggests that exercising the "compassion muscle" of the brain through meditation strengthens the practitioner's feelings of enthusiasm, alertness, interest, and happiness.

Isn't it exciting to know that you have the ability to change your brain just by practice? When you take the time to practice a new skill or emotion, you incorporate the effects of the practice into your brain cells and connections. Developing skills and changing emotions, including being happier, is simply a matter of persistence and training and practice.

To me, this is a breakthrough belief that can change our lives overnight. We can make parts of our brains bigger. We are in control of how we can change our brains, and the key is practice. All we have to do to become high performers is to practice, practice, practice.

The second "p" word, then, is Practice. For our two "p" words, Plasticity and Practice, we can bring in a third and make a "p" formula:

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Plasticity enables Practice, which results in high Performance.

One of the major keys to high performance, therefore, is practice. If you want to become great at something, if you want to succeed beyond your wildest dreams, if you want to change your brain, practicing is the first step.

What miracles can plasticity enable in your brain?

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[1] C. Dweck, *Mindset: The New Psychology of Success,* New York: Random House, 2006.
[2] P.S. Eriksson, E. Perfilieva, T. Bjork-Eriksson, A.M. Aborn, C. Nordborg, D.A. Peterson, and F.H. Gage. (1998). "Neurogenesis in the Adult Human Hippocampus." *Nature Medicine*, 4:11, 1313-7.
[3] This is a bit of a sweeping statement that needs two qualifications. First, our consciousness does not have access to the entire file cabinet at once; however, I believe our subconscious does and so do certain individuals who are wired unusually and exhibit exception memory capabilities. Second, attention is required to make physical changes in the brain, per research by Michael Merzenich of the University of California, San Francisco as quoted in S. Begley, Science column, *The Wall Street Journal*, April 28, 2006.
[4] Eleanor A. Maguire, David G. Gadian, Ingrid S. Johnsrude, Catriona D. Good, John Asburner, Richard S.J. Frackowiak, and Christopher D. Frith. (2000). "Navigation Related Structural Change in the Hippocampi of Taxi Drivers," *PNAS*, 97:8, 4398-4403.
[5] Clarification: we can make part of our brains bigger: the part related to the skill we are practicing.
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[7] "Juggling Boosts the Brain," *Nature Review Neuroscience*, Volume 5 No 3, March 2004, page 170.
[8] A.R. Luft et al. "Treadmill Exercise Activates Subcortical Neural Networks and Improves Walking After Stroke. A Randomized Controlled Trial," *Stroke: Journal of American Heart Association*, August 28, 2008.
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