Neuroplasticity: Your brain on meditation

For most of the past 100 years, mainstream medicine and science believed that the brain was fixed after childhood. Function could decline, our brains could be damaged, but we could not purposely affect how the brain changed.

In just the past 20 years scientists have learned that the brain **is** able to change its structure and patterns as a result of experiences we have as well as our thoughts. The brain is not "hardwired" like a computer.

This is called neuroplasticity.

Blind people who learn to read Braille as an adult show an increase in the size and activity of areas of the brain that control movement and receive tactile sensation from the reading fingers.

This might be expected, but their visual cortex which is shown here also changes. The visual cortex takes up a large part of our brain and was thought to be hard wired to process signals from the eyes so it should be dormant in a blind person.

In the blind Braille readers however, it changed to take on the job of processing sensations from the fingers rather than input from the eyes. When the visual cortex is not accessed to perform its intended function we now know it can rewire itself to perform other functions. This discovery was so unexpected that leading neuroscientists refused to believe it when the study was first published in 1996.

This study and many others showed that the dogma was wrong. Adult brains can be changed by something external to the brain like touch. There were also hints that brain change can occur with no help from the outside world. It can change as the result of our thoughts.

The one in the baseball cap is the Dali Lama. The guy in the suit is Richard Davidson. He is a neuroscientist and professor of psychology and psychiatry at UW–Madison as well as founder and chair of the Center for Investigating Healthy Minds.

A meeting with the Dali Lama in 1992 completely changed the course of his career. The Dali Lama challenged him to use the tools of modern neuroscience to study kindness and compassion and encouraged him to study the brains of monks who had been meditating for decades.

Davidson had been meditating since he was in graduate school at Harvard in the 70's and was interested in studying its affects at that time. His Harvard mentors, however made clear to him that if he wanted a successful scientific career, studying meditation was not a good place to start. Although he remained a closet meditator it wasn't until he had been granted tenure at UW-Madison and had a long list of scientific publications and honors that he returned to meditation as a subject of scientific study.

Another even bigger impediment to the study of meditation was that brain imaging had not been invented in the 70's. EEGs could detect electrical activity in the surface of the brain near where the electrodes were pasted but no deeper. The vast majority of the brain was not visible to science until functional MRIs came into common use in the 1990s.

Davidson's first attempt to study Tibetan monks was a failure. He and his team carried heavy equipment up into the hills where there were no roads. The monks who had spent their whole lives in those hills were afraid of that equipment and too humble to allow themselves to be called expert meditators.

The Dali Lama suggested he study only monks who had been to the West before. Matthieu Ricard was his first long-term meditation subject. Ricard earned a Ph.D. in molecular biology from the Pasteur Institute in 1972 and then decided to move to the Himalayas and become a Buddhist monk.

He was the perfect subject. He was willing to travel to Madison, WI and understood the rigorous scientific method Davidson needed to use. Those first findings were dramatic. During different types of meditation, different areas of his brain were highly activated.

The monks Davidson studied meditated for at least two hours a day, seven days a week, for many years. To be considered a long-term meditator they must have practiced at least 10,000 hours of meditation. The average was 35,000 hours.

Most of us with families, jobs, and other claims on our time like eating and sleeping would never be able to match that. Rather than compare long-term meditators to non-meditators, Davidson decided to also study the effects of shorter-term mediation and track people over time to see if their brains changed.

He convinced the CEO of a biotech company near Madison to let him offer his employees, mindfulness meditation lessons and then asses how it affected some measures of their health and mental function.

Volunteers were tested before and after receiving 8 weeks of mindfulness meditation training. A control group of volunteers were also tested during the same time period. They were promised the same training after the study was over.

Prior to the start of the meditation study all participants were given a flu shot. The study ended just prior to Thanksgiving -- so prime flu season. They tested both groups blood after the meditation instruction. The meditators produced 5 percent higher levels of antibodies than the control group.

The participants who received mindfulness meditation training, showed that anxiety symptoms fell 12 percent. The control group's symptoms stayed about the same. The meditators also showed a significant shift toward greater left-side prefrontal cortex brain activation. The left-side activation tripled after 4 months. The control group showed less left-side activation than before the study started. Meditators who showed the larger brain response also showed a larger response to the flu vaccine.

The prefrontal cortex is considered the seat of human reason, the location of forethought, wisdom, rationality, and other cognitive functions that distinguish us from lower animals. But Davidson's early experiments showed that the prefrontal cortex also rules our emotions.

The left prefrontal cortex that showed more activation in the meditators is associated with resilience and well-being emotions as opposed to the negative emotions in the right prefrontal cortex.

This is the amygdala. It is also involved in negative emotion and distress, snapping to attention and activity when we feel anxious, afraid, or threatened.

In an earlier experiment Davidson used electrodes to measure brain activity. Volunteers were shown 51 pictures each for 6 seconds each. One-third of the pictures showed upsetting images such as a baby with

a tumor growing out of its eye; one-third showed something happier, such as a radiant mother embracing her infant; one-third showed a neutral scene such as a nondescript room.

They found that people with greater activation on the left side of the prefrontal cortex during the baseline period recovered much more quickly even from the strongest feelings of disgust, horror, anger, and fear evoked by the images.

Research from other labs had already shown that people with less activation in certain zones of the prefrontal cortex show more long-lasting amygdala activity in the wake of an experience that evokes a negative emotion; they are less able to turn off negative emotion once it is turned on.

Davidson's research found the flip side of that: Activity in the left prefrontal cortex shortens the period of amygdala activation, allowing the brain to bounce back from an upsetting experience.

Signals from the prefrontal cortex to the amygdala, and from the amygdala to the prefrontal cortex, determine how quickly the brain will recover from an upsetting experience. Thanks to MRIs we now know that the more white matter lying between the prefrontal cortex and the amygdala, the more resilient you are.

But we are not stuck with the white matter we have today. According to Davidson's studies we can increase our white matter and neural pathways. We can change our brains using mindfulness practices like meditation.

In recent years there have been lots of studies on meditators by Davidson and many others. Meditation is no longer just something practiced by people who burn incense, gaze into crystals, and play John Tesch music. There is an increasing body neuroscience evidence behind its benefits now.

The NIH now funds meditation studies and cites the following on its website:

- In a 2012 study, researchers compared brain images from 50 adults who meditate and 50 adults who don't meditate. Results suggested that people who practiced meditation for many years have more folds in the outer layer of the brain. This process may increase the brain's ability to process information.
- A 2013 review of three studies suggests that meditation may slow, stall, or even reverse changes that take place in the brain due to normal aging.
- Results from a 2012 NIH-funded study suggest that meditation can affect activity in the amygdala, and that different types of meditation can affect the amygdala differently even when the person is not meditating.
- Research about meditation's ability to reduce pain has produced mixed results. However, in some studies scientists suggest that meditation activates certain areas of the brain in response to pain.

> "Mindfulness means paying attention in a particular way; on purpose, in the present moment, and non-judgmentally." – Jon Kabat-Zinn, PhD

Meditation helps us be more mindful of the present moment. We spend a lot of time thinking about what isn't going on at the moment. We think about what happened in the past and what might or might not happen in the future. Mind-wandering appears to be the human brain's default mode of operation. A recent study of 2,250 volunteers using an iPhone app showed this. The app contacted the volunteers at random intervals and asked them to immediately answer three questions:

- What are you doing right now?
- What are you thinking about right now?
- How happy are you right now?

They collected 250,000 data points and found that the participants' minds were wandering 46.9 percent of the time and when the mind was wandering participants were much less likely to report being happy. They were much more likely to report being happy when their mind was focused on the task at hand, even when it was a mundane task like washing dishes.

Our brains are like a snow globe, with thoughts constantly swirling around and blocking out the center until we set it down and let it settle.

Meditation helps train our brains to be more mindful. Although meditation has probably been studied the most, there are other practices like yoga that can also train us to be more mindful. But meditation is so easy, right?

Breathe in. Breathe out. Repeat.

I first became interested in meditation when I took a course on Transcendental Meditation way back when I was in high school. Although I enjoyed the experience, I did not keep up the practice. I would go back and pick it up every once in a while, but then stop again for years. Even now it is the first thing I skip when I am stressed and short on time. Which, of course, is when it could be most helpful.

There are lots of great resources available on mindfulness and meditation. My current favorite is *Joy on Demand* by Chade-Meng Tan. He was an early engineer at Google when he started holding meditation classes for his coworkers. That's when he was given the official title, "Jolly Good Fellow which no one can deny." The book has a nerdy sense of humor which I enjoy.

One of its concepts that I find especially useful takes less than a minute.

Paying attention to thin slices of joy. Things like holding a warm cup of coffee or tea on a cold day or the way the sun shines in a window. These aren't WOW moments. They are just kind of nice. Thin slices of joy occur in life all the time … and once you start noticing them, you find them everywhere. Joy becomes something you can count on because you're familiarizing the mind with it.

Tan bases this idea on neurological research about how we form habits. Habitual behaviors are controlled by the basal ganglia region of the brain, which also plays a role in the development of memories and emotions. The better we become at something, the easier it becomes to repeat that behavior without much cognitive effort.

Tan's "thin slice" exercise contains a trigger, a routine, and a reward — the three parts necessary to build a habit. The trigger is the pleasant moment, the routine is the noticing of it, and the reward is the feeling of joy itself.

> "The brain exists within the body and engages in bidirectional communication with it, so that the state of the mind influences the body and the state of the body influences the mind." – Richard Davidson

Davidson says that each of us has an emotional style composed of six elements: Outlook, Resilience, Social Intuition, Self-Awareness, Sensitivity to Context, and Attention. He recommends using different mindfulness practices to improve different measures of emotion.

For example, to improve self-awareness, do body scan meditations. Systematically starting at your head or your toes focus on each area of your body and relax anywhere you find tension.

One of the most powerful forms of meditation is called metta.

METTA is an ancient Buddhist term meaning loving-kindness, compassion, and friendliness. It is a strong wish for the welfare and happiness of others.

According to Davidson, "There is nothing in Western psychology about how to cultivate compassion. It is no more than a mission statement—that compassion is an admirable human value. But this amorphous thing called the cultivation of compassion actually leads to measurable changes in the brain."

A 2014 Psychology Today article says, "Research shows that Loving Kindness Meditation has a tremendous amount of benefits ranging from benefitting well-being, to giving relief from illness and improving emotional intelligence." The article includes a list of 18 scientific-backed benefits of doing this kind of meditation.

The guided audio meditations from UW listed below include a good one on compassion if you would like to try it. There are also links to others at the end of the Psychology Today article.

Resources

Books

The Emotional Life of Your Brain by Richard J. Davidson, Ph.D. with Sharon Begley
Train Your Mind Change Your Brain by Sharon Begley
The Brain that Changes Itself by Norman Doidge, MD
Cure: A Journey into the Science of Mind Over Body by Jo Marchant, Ph.D.
Joy on Demand by Chade-Meng Tan
Happiness: A Guide to Developing Life's Most Important Skill by Matthieu Ricard

Websites

NIH: https://nccih.nih.gov/health/meditation/overview.htm

UW-Madison Center for Healthy Minds: https://centerhealthyminds.org/

Guided audio meditations: http://uwcultivatingwellbeing.com/guided-audio-practices/

Magazine articles: http://www.mindful.org/

Psychology Today article: https://www.psychologytoday.com/blog/feeling-it/201409/18-science-backed-reasons-try-loving-kindness-meditation

Apps

Happify
Calm.com
Insight Timer
Stop, Breathe, Think
Mindfulness Based Stress Reduction
Tergar Meditation
Insight Meditation