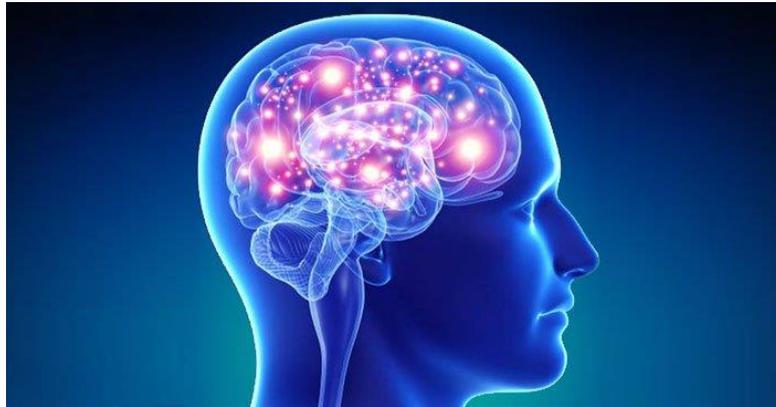


# Neuroplasticity: Learn and Adapt at Any Age

By Andrew Rader, LAc, MS



There is now a tremendous body of science, which is continually growing, which substantiates how **the process of new thinking patterns and new behaviours can lead to real, physical changes in the cellular structures of the brain, which solidify the new patterns of thinking and behaving.** These discoveries are having profound influences on the fields of health and healing, aging, learning and memory, addiction studies and cognitive science. In fact, there is no area of human endeavour that will not be affected by this knowledge.

Neuroplasticity is a yin yang process, meaning that it has an inhibitory aspect and a growth aspect. In order for new pathways to be created, old pathways need to be deleted. The deletion is called "synaptic pruning." When we are very young we have the potential to learn anything. We have not yet selected which areas we are going to focus on. We can learn any language. We can learn any behaviour, distinguish any sound, and acquire any taste. Then at a certain point, when neural real estate becomes more valuable, decisions have to be made as to what potentialities we can let go of. Take a Japanese baby, for example. Studies have shown that a Japanese infant, if exposed to English early in life, will be able to perceive and produce the sound of an English "R." If that same infant remains in Japan, with no exposure to the sounds of English, at a certain point the ability to perceive and speak an "R" sound is jettisoned because it is not necessary. Our plastic brains are able to respond to the needs of the environment we find ourselves in. If we need to speak Japanese, we will.

If we need to adapt to cold temperatures, as Inuit babies find themselves in, we will. We do this by watching, imitating and repeating. This process leads to physical changes in the wiring of our neurology. It happens at all ages.

Learning can be broken down to four stages:

- Unconscious incompetence; or not knowing that we don't know.
- Conscious incompetence; or knowing that we don't know.
- Conscious competence; or knowing that we are capable.
- Unconscious competence; where we are able to perform without any awareness of it.

Let's take for example, learning how to tie our shoes. The very young child doesn't even know that there is something called a shoelace and that there is a skill involved with tying it. This is the stage of unconscious incompetence, where there isn't even an awareness that there is something to be learned.

When that child enters the kindergarten classroom, she may observe another child tying her shoe and it is at that point that she becomes conscious of the fact that there is a skill, tying shoes, that she is not able to do. This is conscious incompetence, where she is aware of what she doesn't know. Now desire to learn has to be activated before anything else happens. If that desire is there, to learn how to tie a shoe, then next comes the learning stage where the child is actually learning the skill becomes able to tie her shoe with focus and concentration. This is the state of conscious competence, where attention is needed to complete the task or recall the information. The final stage comes after repeated practice and the skill or information simply becomes unconscious. As adults, we are all able to tie our shoes without thinking about it; we can do it automatically. Anything we can do automatically indicates the stage of unconscious competence. Driving a car is another example of this type of learning. Once we have learned how to drive and have driven enough, we can drive, "without thinking about it."

Repetition is crucial to this process. Tie the shoe over and over, practice a song repeatedly and soon enough it becomes automatic. The neural pathways that need to be created get laid down and become a part of our physical neurology. Change the behavior in any way and the neural pathway responds with pruning and reconnecting new pathways to respond to the new behavior. Again, if the new behavior is repeated it takes over real estate in the brain.

Learning involves memory. We have short- term and long- term memory. Short- term memory involves primarily chemical or electrical processes, or synaptic transmission that use synaptic connections that already exist in the neural network. We can only work with what we already know. Imagine being in a lecture hall and listening to a lecture on something we know very little about,

such as nuclear physics. You would not be able to retain much of the lecture. You have no existing framework to hook new information onto. However, another physicist in the audience would be able to remember much more information because her networks already are set up to process similar information.

However, if we began to study nuclear physics, slowly, after hearing and working with the information over and over again we would begin the process of making new synaptic connections, which enables long-term memory to happen. This repetition triggers a process called "synaptic reverberation." The theory states that once an experience is considered important enough, neurons begin to feedback to each other. Instead of an impulse only going from one neuron to the next, the impulse is sent back and forth. Much the same way important information is communicated between two people. It is repeated and confirmed.

"Hi my name is Craig."

"Oh, I have a brother named Greg."

"My name is Craig, spelled with a "C."

"Oh, excuse me, Craig. Now I know you are Craig and not Greg."

When we engage in a behavior that feels good, dopamine is released. The dopamine also serves to consolidate the neuronal connections that are leading to the response that just made us feel good. Dr. Merzenich, a UCSF neuroscientist who has done much to substantiate the theory of plasticity, did an experiment where he used an electrode to stimulate dopamine release in the brain while he played a particular frequency of sound, much like Pavlov feeding the dog after ringing a bell. A particular sound was coupled with dopamine release. What he found was that the auditory area of the brain responsible for interpreting that sound grew. Repetition, mediated by dopamine, causes new neural networks to form, creating the structure for long-term memory, or unconscious competence to occur.

The theory of neuroplasticity compels us to look at addictions in a whole new light. Instead of focusing on the addictive substance being the cause of the addiction, we can look at the brain's own response to the behavior. This model can help us better understand "addictive" behaviors that clearly lack a chemical dependency, such as pornography, Facebook, video gaming and gambling. Basically, any behavior that we repeat will lead to the laying down of new neural pathways that get reinforced by dopamine each time the behavior is repeated. Ultimately it becomes unconscious

competence, a habit, and we pursue it without awareness. Treating addictions and changing unwanted habits most successfully would have to involve creating new patterns of thinking and behaving, which would enable the brain to rewire itself.

Dr. Marian Diamond, another pioneer in the field of neuroanatomy, is a living example of what she has discovered in her long career; that the mind throughout life is capable of changing and learning given the right stimulation. Dr. Diamond now in her eighties, is still one of the most popular professors at UC Berkeley, continuing her research, and living a rich full life. Her latest book, "Magic Trees of the Mind" is on how children learn.

In the book, Diamond notes: "We like to think this book can change how people view childhood and its cognitive opportunities, how they see human brain development and its ongoing plasticity... Fully two-thirds of American adults have sedentary lifestyles; and the majority have high-fat, high-calorie diets; seldom read or create things for pleasure; and watch television for hours every day. It would be surprising, then, if the average child had a regimen any different. If our book has the kind of positive effect we envision, it will inspire a new level of mental and physical activity in all age groups. It doesn't take money to create a climate for enchanted minds to grow. It just takes information, imagination, motivation, and effort. Once the habit of active involvement is entrained, experience will take over and those stimulated minds will do the rest for themselves in surprising and delightful ways."

Neuroplasticity is a modern understanding of what wisdom traditions have known intuitively for a very long time. We have incredible qualities of adaptability. We are capable of learning and growing at any age. We can change our habits, and thus change the trajectory of our lives. Neuroplasticity is simply a more detailed picture of how this happens.