

Neuroplasticity: Exciting discovery that the brain continues to grow and change



For decades, the prevailing dogma in neuroscience was that you can't teach old dog new tricks - meaning that the adult human brain is essentially unchangeable. The general consensus among neuroscientists, as well as popular belief, was that brain architectures become fixed and cannot change past adulthood.

Ongoing research has overthrown the old beliefs. In its place has come the realization that the adult brain has impressive powers of "neuroplasticity"- the ability to change its structure and function in response to direct experience.

Making neurons connect and sync could be life altering for those suffering from brain lesions or movement disorders. "Imagine not being able to have full control of your arms or legs. It could due to a variety of conditions like a balance issue or pain," says Mindy McCleery, director of

rehabilitation for Orchard Park Health Center. "These are some of the problems that therapists try to solve with bio-feedback tools that lead to changes in the brain and enable improved function," she says.

"Neuroplasticity is the ability of the central nervous system to remodel itself. In the last few decades, we have learned that neuroplasticity is not only possible but that it is also constantly occurring; the brain is always changing. Neuroplasticity is how we adapt to changing conditions, learn new facts, and develop new skills," says Dr. Mark Hallett, noted in the Journal of Rehabilitation Research and Development (JRRD). Dr. Hallett is chief of Human Motor Control Section at the National Institute of Neurological Disorders and Stroke and National Institutes of Health that's located in Bethesda, MD.

"The next issue is the question of whether or not neuroplasticity is just something that the young enjoy...," says Dr. Ginger Campbell, developer and host of the highly rated Brain Science Podcast. In episode #10, she expounds on recent scientific discoveries and unravels age-old brain mysteries. "However, it turns out that it's not just for the young," she says.

Patients with a history of brain lesions, such as stroke conditions and Parkinson's movement disorders, may have the most to gain. The implication that neuroplasticity is possible in adults may be a game-changer for those affected.

How to tap into neuroplasticity

According to McCleery, brain rewiring takes hard work. You must perform repetitive correct practice to make new connections.

Because brain processing is a culmination of all the thoughts and experiences you have had up to this very moment, it takes guided repetition to change. Essentially, movement is the language of the brain and the mechanism through which we live.

Think of your brain like it's a ski hill. Each time you plow down the hill on your skis you imbed a path in the snow. If you repeatedly go down that same trail, the path gets deeper and deeper making it more difficult to take a new direction.

Likened that to someone who is having problems with balance, stroke or pain. They get up and walk but the neurons that encode memory aren't being rewired. You're being led down the same path. The brain continues to bear the former footprints that dictate our steps.

"Today's rehabilitation therapists work to drive the brain to new connections and use technology and techniques to encourage the neuronal changes necessary for improved function," says McCleery, "And patients can learn a better way of moving just by having new input, regardless of age."

"The job for those of us interested in rehabilitation is to promote plasticity in the right direction and, sometimes, to correct it if it has taken a wrong turn. We must, therefore, understand neuroplasticity and learn to control it," says Dr. Hallett in JRRD.

Learning how to control it is good news for today's therapist. One of the biggest theories guiding physical therapy treatments to help recover mobility, walking and balance, is the idea of incorporating interactive bio-feedback devices with movement.

Bio-Feedback can improve mental processes that guide thought and action

Biofeedback is a method that uses some forms of visual, tactile and auditory/verbal input to help control a body function that normally operates automatically.

McCleery reports using many forms of bio-feedback found on the newest rehabilitative equipment. Tactile input from air pressure or water support coupled with electronic monitoring systems found in cameras, live video, flat-screen monitors and interactive balance platforms, can be assistive.

One look inside a progressive clinic using these techniques and you'll see patients using weight supported treadmills or underwater treadmills. Monitors are up front and personal. You can see each step visually in front of you through the use of a live video recording and flat screen monitors.

Of course the newest gadgets are great but would be far less effective without direct intervention of a skilled therapist. Therapeutic cues are very specific towards each patient's condition.

Patients can see, hear and feel those prompts and make needed corrections. Viewing the monitors in front validate taking the right steps. When transmission from our senses and body enters into our cortex, the brain expands and it essentially allows for more neuronal connections necessary for motor learning.

Motor learning is about using our neuromuscular system to perform specific tasks and this can be enhanced with bio-feedback. "Today's rehab equipment comes loaded with bio-feedback options," says McCleery. Handle bars that sense and report heart rate intermittently show body reaction to physical output. Therapists' direction helps patients to improve breathing techniques and employ energy conservation methods that are geared to improve tolerance to exercise.

Interactive balance platforms, such as those found on Biodex or Biosway devices, also give a live monitored presentation on reactions to weight shifts and abnormal postural deviations. Tactile and visual cueing from therapists make it easier to incorporate the proper movement. Also, it leads to improved sensory reply to varied perturbations. These technologies also have a way of scoring each session and showing the limits and progress of a patient's stability.

"Biofeedback is advantageous. The more information we are allowed to receive regarding our motor performance, the easier it is for the brain to change. This is a general principle," says Dr. Hallett. He says that his research is primarily regarding brain lesions but he does consider that some bio-feedback techniques found in physical rehabilitation can be beneficial in aiding our neuromuscular abilities.

The burgeoning theories are driving us to new frontiers. It leads us to hope because brain plasticity means we have potential to improve our strengths and, when necessary, accommodate our weaknesses.

