

## Book Review

# The Brain that Changes Itself: Discovering the Science of Brain Plasticity

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In his book *The Brain That Changes Itself: Stories of Personal Triumph from the Frontiers of Brain Science*, Norman Doidge, M. D., delves deeply into the contemporary neuroscience of brain plasticity. Doidge is a psychiatrist and psychoanalyst and works as a researcher at the Columbia University Center for Psychoanalytic Training and Research in New York and as a faculty member in the University of Toronto's Department of Psychiatry. His artistry with words reflects the fact that he is a four-time recipient of Canada's National Magazine Gold Award, and his style of writing makes reading his work possible for not only those with a graduate-level understanding of the material, but also for those completely new to the topic. *The Brain That Changes Itself* clocks in at only 285 pages, with an additional 142 pages of appendices, notes, references, and index. It is divided into eleven chapters, each dealing with a different aspect of brain plasticity.

The discovery of brain plasticity is a recent and exciting development, and Doidge does an excellent job covering all angles of the subject. Drawing on the works of several leaders in the field, such as Paul Bach-y-Rita, Aleksandr Luria, Mark Rosenzweig, Michael Merzenich, Edward Taub, V. S. Ramachandran, Alvaro Pascual-Leone, and Eric Kandel, he provides a detailed description of how brain plasticity works, its scientific implications, and how research on plasticity may aid those with impairments caused by Alzheimer's disease, mental retardation, stroke, obsessive-compulsive disorder, phantom limbs, and even blindness. After reading each example of those who have harnessed the power

of brain plasticity to overcome tragedies in their lives, it is hard not to become as excited as Doidge concerning the possible benefits of future research.

Until very recently, it was widely believed that the brain anatomy was fixed, or hard-wired, and that after childhood, the brain only changed as it declined with age. As a result, there was a common misconception that people with brain damage or specific brain impairments couldn't be helped in any way. With the contemporary knowledge that the brain is plastic in nature, we now know that damaged brains can reorganize themselves to compensate and still function normally, we have a new understanding of the impact that the environment can have on altering our brain structure, and it is contested by many that dead brain cells can even be replaced by new ones (Doidge, 2007).

Doidge lists four types of plasticity as described by the research scientist Jordan Grafman:

- 1) Map expansion (occurs primarily at boundaries between brain areas and results from daily activities)
- 2) Sensory reassignment (occurs when one sense is impaired in some way and its sensory input is relocated to another sense)
- 3) Compensatory masquerade (the ability of the human brain to achieve certain functions in several different ways)
- 4) Mirror region takeover (the concept that when part of one hemisphere fails, the mirror region in the opposite hemisphere changes to compensate)

He also strongly emphasizes both Hebb's Law (neurons that fire together wire together), and the

principle of “use it or lose it,” which together lay a strong fundamental foundation for how neuroplasticity operates. Each concept that he introduces is thoroughly described through scientific interpretation and made easy to understand through the inclusion of several real-life examples. In fact, it is these very examples that make the book such a pleasurable and informative read.

One story that Doidge includes in the first chapter of the book describes a woman with a dysfunctional vestibular apparatus (a sensory organ used for the balance system) who feels as if she is perpetually falling, and as a result, actually falls quite frequently. However, she soon consults with Paul Bach-y-Rita, who has developed a device that he calls an accelerometer, which replaces her vestibular apparatus and sends her balance signals to her brain through stimuli on her tongue. Using the device, she is soon able to train her brain to compensate for the 95-100% loss of vestibular function, and she can easily navigate the physical world without fear of falling and injuring herself. This is an excellent example of how the plastic brain is capable of re-organizing its neuronal pathways in beneficial ways.

Another story, found in chapter 2, details a mentally challenged woman with an impairment in Broca’s area, limited spatial reasoning skills, kinesthetic dysfunction, visual disability, and problems with grammar, math, and logic. By independently studying (systematically reading and re-reading difficult passages repetitively) the work of the neurophysiologist Aleksandr Luria and Mark Rosenzweig’s work on neuroplasticity, she was able to design her own unique mental exercises, improving her cognitive functioning in all of the aforementioned areas. She later went on to open the Arrowsmith School in Toronto, which utilizes neuroplasticity-based techniques to help others overcome their own weak brain functions.

Chapter 3 covers the remarkable work of the neuroplastician Michael Merzenich, considered by many to be the world’s foremost brain plasticity researcher. By mapping a monkey’s hand map in its brain, amputating its middle finger, and then several months later re-mapping the monkey’s brain, Merzenich noticed that the map for the amputated finger was gone, being replaced by the maps for each adjacent finger. This research shed much light on Hebb’s Law and the idea of competitive plasticity. Doidge also discusses Merzenich’s other extensive contributions to brain science, which include the development of “Fast ForWord,” a training program

for children with language and learning disabilities, and his founding of the company Posit Science, which is devoted to helping people use plasticity to fight the adverse effects of aging on mental functioning.

Another uplifting story, found in chapter 7, describes a man who at the age of 17 lost his arm in a car accident, yet suffered from the bizarre phenomenon called “phantom limbs” thereafter. Those with phantom limbs still “feel” their missing limbs, sometimes even feeling recurring pain in those limbs. With the aid of the noted neurologist V. S. Ramachandran, the man was able to “amputate” his phantom limb through the use of a mirror box, which tricked his brain into re-wiring itself. Ramachandran’s work in this area demonstrates how pain, feeling, and body image are closely related, and illustrates how neuropathic pain is processed in the brain.

Perhaps the most remarkable story, highlighted in chapter 11, is that of Michelle Mack, a girl who was born with only half of a brain. Lacking her entire left hemisphere, Michelle’s right hemisphere was forced to compensate for functions normally resigned to the left hemisphere, such as speech and language functions. Despite her shocking limitation, she is able to speak rather normally, enjoy daily activities such as watching movies, and even read. She does show some physical signs of her impairment, such as motor problems with her right side, vision deficiencies from her right side, and a slightly bent and twisted (but usable) right wrist, but the simple fact that she is capable of functioning on a fairly normal level is staggering. Her achievements in life are examples of the best that neuroplasticity has to offer, and are an excellent depiction of the brain’s capacity for massive reorganization.

These are just a few examples selected from Doidge’s book, yet they reflect the feel and theme of the work. There are several more fascinating stories to be found within, such as how plasticity influences sexual preferences, romantic love, and addiction, how constraint-induced movement therapy is aiding those afflicted with cerebral palsy, spinal cord injuries, Parkinson’s, Muscular Dystrophy, arthritis, and strokes, and how we can enact plastic change through the simple use of our imaginations. The book is replete with amazing facts and anecdotal stories, and is an excellent introduction to the fascinating fields of neuroscience and neuroplasticity.

*The Brain That Changes Itself* is a highly-entertaining and informative read, and I recommend this book to anyone who is curious about how the brain operates. It is written in an informal fashion that

should attract even the most casual of readers, yet still manages to remain informative. Blending a comprehensive understanding of the subject matter with his impressive writing skills, Doidge has produced a masterful book on the topic of brain plasticity. If you have an interest in neuroscience, psychology, or human cognition, you won't be disappointed.

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