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Neuroplasticity and Neurogenesis: Changing a Dogma in the Therapeutic approach in the Brain Disorders

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For nearly one decade there has been an unchallenged dogma about the potential of change in the brain. It was believed that brain has a fixed structure and function because of no neuronal appearance after the birth. Moreover early on it was assumed that animals had different brain maps due to genetic background without any role for lifetime experience. Even though the brain had been previously proved to be an inflexible and unchangeable organism, further studies showed evidences against this point of view. Hence there are many studies which have shown that the brain can rewire itself. Neuroplasticity refers to a broad entity for any adaptive changes in structure or function of the nervous system during development, recovery from injury, and aging. The term gained prominence in the latter half of the 20th century when researchers showed many aspects of the brain remain changeable or plastic even into adulthood. This notion contrasts with the previous scientific consensus that the brain develops during a critical period in early childhood then remains relatively unchangeable or static afterward. The first evidence was down by Kass and Merzenikh who showed that if one finger of owl monkey was denervated, the related of the cortex would be remapped by the other fingers. In addition, the earliest evidence about the appearance of new neurons in the hippocampus was found in 1962. Eventually several crucial studies showed neurogenesis in the song areas of bird brains, neurogenesis in the brain of rats and primates hippocampus, discovery of stem cells that could go on to become new. The important finding that new neurons could incorporate themselves into the functional architecture of the brain proved the concept of Neuroplasticity and Neurogenesis. At first it was assumed that neuroplasticity can occur just in the young brain because of remarkable potential of kids' brain to tolerate the burden of CNS lesions.

Cross Model Neuroplasticity

Cross Model Neuroplasticity is integration of the functions of two or more sensory systems in the brain due to the adaptive reorganization of neurons. This type of reorganization of the neural network occurs, following the damage of the brain at an early age, or long term sensory deprivation. Neville study on deaf people showed that they had better peripheral vision than normal subjects, larger area of visual cortex associated with motion and more activity in the areas associated with different sensory inputs indicating the first proof of brain change in the patients with deafness because of showing the potential of to be changed over to doing peripheral vision and motion. She found similar results in a study on blind people which showed better hearing function in the peripheral "sounds" that could stimulate "visual cortex". Using brain PET Scan Sadato showed that visual cortex is activated when a blind person is activated during reading Braille and this phenomenon happens just when a person loses the sight early on. It is also shown that blind people have improved recall of words just when the visual cortex is activated. Moreover it has been shown that visual cortex in the blind people is able to be active in a language task such as making a verb after listening to a noun while this does not happen in a sighted person. Determining the neuronal mechanisms behind this type of cross-modal plasticity is an important basis for understanding brain development and the impact on recovery from brain damage. One possibility, called the reorganization hypothesis, is that the reorganization of the deprived brain leads to the establishment of new mediating pathways. The second possibility, the unmasking hypothesis, is that damage induces unmasking and strengthening of existing neuronal connections. It should be emphasized that the key part of neuroplasticity is attention. It requires enough mental effort and practice. So more effort is needed when an adult decides to learn a new skill compared to a younger person.

Conclusion: it seems brain specialization is not a just a function of anatomy or dictated be genes. It is a result of experience and re-experience. It should be emphasized on the role of motivation, attention and practice and also enjoy. Neuroplasticity is a reality. The brain can change itself. Although our capacity for changing the brain is limited by aging it is not lost. Genetic control is not tight as some has assumed. The impact of neuroplasticity phenomenon can modify the current concept of rehabilitation programs not only in the patients with traumatic brain injuries in neurosurgery but can alter the disappointing horizon of therapeutic approach in the degenerative neurological disorders which seem to be frustrating.

Biography

Maryam Noroozian is currently a Professor of Neurology at Tehran University of Medical Sciences (TUMS). She completed her degree as a neurologist at TUMS and sabbatical at New York University (Aging and Dementia Research Center). She is the founder and director of the first Memory and Behavioral Neurology Division in Iran and the chief of the first geriatric medicine department in Iran. She has published more than 61 papers in reputed journals. Moreover she has been candidate for the WHO Prize for Research in Health Promotion from Iran in 2015 because of her endeavours and persistence in development and advocacy for elderly population mental health and dementia.

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