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NEYROPLASTIKLIK KOGNITIV JARAYONLAR HARAKATLANTIRUVCHI OMILI SIFATIDA: NAZARIY TAMOYILLAR VA AMALIY IMPLIKATSIYALAR

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Annotatsiya

Neyroplastiklik jarayonlari haqidagi bilimlar bizga nafaqat miyaning ishlashini nazariy jihatdan tushunish imkonini beradi, balki samaraliroq ta’lim olish, jarohatlardan keyingi tiklanish, butun umr davomida kognitiv salomatlikni saqlash hamda ruhiy qiyinchiliklarni yengillashtirish uchun amaliy vositalarni ham taqdim etadi. Neyroplastiklik mexanizmlarini aniqlash orqali biz ularni istalgan kompetensiyalarni shakllantirish va barqaror xulq-atvor andozalarini qayta qurish maqsadida strategik tarzda qo‘llashimiz mumkin.

Kalit so‘zlar: neyroplastiklik, kognitiv jarayonlar, yangi ko‘nikmalar, konsepsiya, neyron tarmoqlar, samaradorlik.

НЕЙРОПЛАСТИЧНОСТЬ КАК ДВИГАТЕЛЬ КОГНИТИВНЫХ ПРОЦЕССОВ: ТЕОРЕТИЧЕСКИЕ ПРИНЦИПЫ И ПРАКТИЧЕСКИЕ ИМПЛИКАЦИИ

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Аннотация

Знание процессов нейропластичности предоставляет нам не только возможность теоретически понять функционирование мозга, но и практические инструменты для повышения эффективности обучения, восстановления после травм, поддержания когнитивного благополучия на протяжении всей жизни и снижения выраженности психических трудностей. Определяя механизмы нейропластичности, мы можем стратегически использовать их для формирования желаемых компетенций и изменения устойчивых поведенческих паттернов.

Ключевые слова: нейропластичность, когнитивные процессы, новые навыки, концепция, нейронные сети, эффективность.

NEUROPLASTICITY AS A COGNITIVE PROCESS MOTOR: THEORETICAL PRINCIPLES AND PRACTICAL IMPLICATIONS

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Abstract

The knowledge of neuroplasticity processes provides us not only with an opportunity to understand the functioning of the brain theoretically but also with practical tools to obtain more effective learning, post-injury recovery, lifelong cognitive well-being, and alleviation of mental challenges. Defining the mechanics of neuroplasticity, we can strategically harness them to shape the competencies that we desire and remake fixed behavioral patterns.

Keywords: neuroplasticity, cognitive processes, new skills, concept, neural networks, efficiency.

The understanding of neuroplastic mechanisms broadens the theoretical perspectives in terms of brain functioning and offers the tangible approaches toward the maximization of learning, rehabilitation following injury, maintenance of cognitive capacities throughout life, and coping with psychological issues. Understanding of the operation of neuroplasticity enables us to be aware of the ability to consciously control such processes in order to gain the necessary skills and alter the behavioral patterns. Since, as Nobel laureate neuroscientist Eric Kandel pointed out, all learning is the strengthening or weakening of synaptic relationships between neurons, it is necessary to stress the biological nature of change driven by experience [1].

The brain experiences quantifiable changes in the process of learning. In order to understand this phenomenon better, we need to consider the aspects in favor of brain plasticity and investigate the practical ways through which we can optimally exploit this extraordinary capacity. The understanding that the brain is plastic in nature allows the realization that one can always learn and develop all the way until the very end of his/her life, and do not fear the old-fashioned view of the adult brain as rigid and inert. Types of Brain Plasticity. Brain plasticity is not a solitary and isolated phenomenon, but a heterogenous set of processes that allow the brain to change and adapt. Modern neurobiological studies recognize several important types of plasticity that in combination define the phenomenal ability of the brain to transform [2].

Structural plasticity is a type of brain variation that is associated with physical alterations, such as the creation of new synaptic connections, the enhancement of the existing neural pathways, and the production of new neurons in some areas. When one sets aside time to train a new skill, those same regions of the brain quite literally grow new neural paths, which form the material basis of the new skill. This concept is consistent with the famous rule by Donald Hebb: “Neurons that fire together, wire together”, that continues to be one of the pillars of contemporary neuroscience.

Synaptic plasticity is another essential aspect of learning and memory the capability of particular synapses to become stronger or weaker in accordance with the intensity of their activity. Long-term potentiation (LTP) and long-term depression (LTD) are the mechanisms that are involved in this process and enhance synaptic transmission efficiency upon repeated coactivation of neurons, while weakening connections that are not used as frequently, respectively. The LTP is particularly more pronounced in the hippocampus, an area of the brain that plays a central role in forming new memory, and LTD facilitates the removal of inefficient neural connections thus optimizing the neural networks [3].

Sensory Integration, attention and Learning Efficiency. Multisensory learning method is an important way of improving information retention. Studies have revealed that the material that has undergone more than one way of sensory processing is better learnt and retained over a long time. There is experimental evidence that memory can be enhanced by 50-75 percent in comparison to single modality learning by the activation of other sensory systems. This effect is due to the fact that every channel of sense has its distinct neural connections that enrich the neural network of memory. At the same time information is received in the brain via more than one pathway, more integrated and elaborated representation of that information is created, which allows more in-depth comprehension and conceptual synthesis. Indicatively, studying human anatomy would be significantly more efficient when students would integrate reading and visual study with hands-on exposure to three-dimensional models.

The capacity to focus and maintain concentration is also crucial. One of the strongest forces of neuroplasticity is the focused attention. The work of cognitive neuroscience proves that attention can be seen as a neural spotlight and enhances activity in areas of the brain that are task-relevant and facilitates the development of new connections in the very areas that are required. By focusing on a particular task, neurons that deal with the processing of the relevant

task show synchrony, especially in the gamma frequency range. Such synchronization provides an ideal environment to the synaptic plasticity and learning.

Attention also helps in improving the clarity of the signal as it maximizes the action of the neurons that encode the important information and inhibits the action of the neurons that encode irrelevant information. This contrast enhances the signal-noise ratio, which is easier to form new connections in the brain. It is a matter of dialing in the radio until one finds the right frequency: once the right frequency is arrived at, the signal is clear, and the background noise disappears.

When neuroplasticity works against us. The neuroplastic processes that promote learning and adaptation may also support undesired behavior, thinking and emotional reaction patterns. The knowledge of these processes will explain the formation of negative habits and dependencies and understand the way they can be modified. Among the mechanisms, the reinforcement of dopamine mechanisms by immediate rewards plays a major role. The brain is designed to reinforce the neural connections with pleasant experiences. The effect of repeatedly triggering the reward system with negative long-term outcomes, like obsessive scrolling through social-media or unthoughtful purchases, creates issues. The excitement of dopamine related to these activities forms a strong reward that strengthens circuits that promote recurrent behavior despite individuals being aware of the damaging effects of the behavior.

The other process that is significant is the development of automatic stress responses. In a case where stressful situations are repeated, the brain forms quicker, less conscious routes of reaction. In case that the adopted coping mechanism is maladaptive, e.g. overeating in response to stress, then it may turn into a habitual reaction to stress. This tendency is formed in the same way as classical conditioning, where stress is paired with temporary relief which is accompanied by destructive behavior . Such association intensifies and becomes increasingly unconscious.

Also, cycles of negative expectation and confirmation promote maladaptive patterns. People can be subconsciously concerned with the information that confirms the pessimistic beliefs and disregard the counterevidence. The same selective attention reinforces over time neural circuitry that is related to negative thinking, resulting in the stabilization of patterns of pessimism. These processes are especially strong in depression and anxiety, where the tendency to respond to negative stimuli in general, and catastrophic characterization of neutral events, establish a vicious cycle of self-perpetuation of maladaptive neural processes. According to Norman Doidge, it is a two-sided sword, because the brain can become better or worse in plasticity [4].

REFERENCES

1. Moheb Kostandi. "Neuroplasticity". Tochka Publishing Group, 2017. ISBN-978-5-9908700-1-7 P.176.
2. K.I. Pavlov, V.N. Mukhin. Physiological mechanisms of neuroplasticity as the basis of mental processes and socio-professional adaptation (part 1). Psychology Journal. Psychophysiology". 2021. Vol. 14, No. 3. pp. 119-136.
3. The modern concept of neuroplasticity (theoretical aspects and practical significance) C.A. Zhivolupov, I.N. Samartsev, F.A. Syroezhkin. The Journal of Neurology and Psychiatry. 10, 2013. pp.103-108.
4. Norman Doidge. "Brain Plasticity: Amazing facts about how thoughts can change the structure and function of our brain." Publishing house. Eksmo. 2018. P. 544.