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How does neural plasticity support strategic thinking?

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Abstract.

Plasticity is the change force within the human brain. It is the biological, chemical, and physical capacity of the brain to reorganize its structure and function. It induces shifts in functions and function instrument allocation. It is vital for the process of accommodating brain environmental change as well as brain trauma accommodation. It is also a key to brain function restructuring as well as the management of brain "behavior." This role is spelled out in many contexts from learning to memory formation, yet the process of strategic thinking is seldom addressed within the overall framework of plasticity. Strategic thinking demands, after all, the creation of scenarios, choice between multiple scenarios as much as the isolation of a scenario compatible with proper modes of strategic behavior. All are inner brain processes.

How does this vital element of brain performance take shape? This will be the focus of this article.

The article defines plasticity and identifies plasticity driving forces as a point of start. It then proceeds to relate plasticity driving forces to the cognitive processes of memory and learning, being key pivots of strategic thinking. The outcome is a set of hypotheses relating plasticity to the core of the strategic thinking concept as well as the choice and expression of strategies.

The article relies on current work on plasticity as a neural process. It also refers to recent work on strategic thinking. It could be of relevance to the development of the conceptual framework of strategy as well as the enhancement of strategy formulating competencies.

1. Keyword

Neuroplasticity; Strategic Thinking; Strategic Cognition; Learning and Memory; Cognitive Adaptation; Decision-Making; Scenario Planning; Strategy Formulation

2. What is neuralplasticity?

Neuroplasticity, also called brain plasticity, refers to the capacity of the brain to change and adapt in structure and function in response to learning and experience. Put differently it is the capacity of the nervous system to modify itself, functionally and structurally, in response to experience and injury.

Neuroplasticity significance lies in two driving forces, learning and memory. The first theoretical notions of neural plasticity were developed in the nineteenth century (The Principles of Psychology, William James, 1890).In the twentieth century others proposed that neurons in adults break down and rebuild (Fuchs & Flügge, 2014).

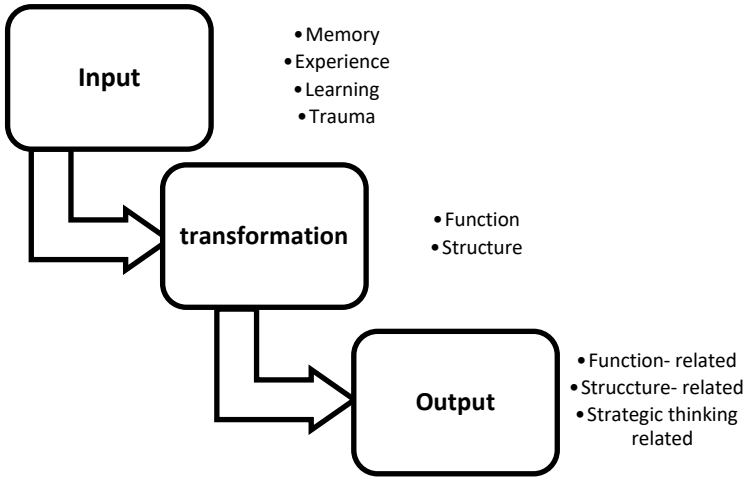
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Scientists now think that neuroplasticity occurs throughout all life stages, from childhood onwards (Doidge, 2007).The brain can rearrange itself in terms of the functions it carries out, as well as in terms of the basic underlying structure (Zilles, 1992).

3. The systemsapproach neural plasticity

Neural plasticity could be looked at as a force field with system constituent elements i.e. Input, output and transformation mechanisms. Inputs are delivered through learning, memory and experience. Transformation occurs through the functional and structural processes of the phenomenon. Outputs could be function induced orstructure induced.

Figure: Systems framework of the Neural Plasticity force field



3.1 The input

Memory

Let us start by distinguishing different types of memory. Functionally, memory could be explicit or implicit. Explicit (declarative) memory includes semantics (words) and episodic (events) memory. Implicit (non-declarative) memory includes, primarily, nonverbal and motor memory.

A temporal perspective ofmemory can divide memory into working, short term and long term. The working memory is a cognitive system with a limited short-term capacity that holds information temporarily(less than 30 seconds). Information canthen be temporarily stored “online” in the brain, so that it is available for further cognitive processing (Baddeley, 2000).Short-term memory provides the capacity for holding, but not manipulating, a small amount of active, readily available information for a short period of time.Long-term memory: may last a lifetime but can be modified.

Structural plasticity performs several memory related tasks. It can increase storage efficiency in sparsely connected neural networks, and it could also increase stability of long-term memories.(The rewiring brain, a computational approach to structural plasticity in the adult brain 2017, pages 361-386,Chapter 17 - Impact of Structural Plasticity on Memory Formation and Decline).

Learning

Neuroplasticity underlies the capacity for learning as it enables mental and behavioral flexibility. Learning induces the brain to create new synapsesor gaps between one neuron cell and anotherthat carry electrochemical information between neurons.

Learning is to accumulate and process knowledge and information through experiences Neuroscientists stress that if one performs a task or recalls some information that causes different neurons to fire in concert, it strengthens the connections between those cells. Over time, these connections become prime routes that link various parts of the brain -- and stimulating one neuron in the sequence is more likely to trigger the next one to fire(Bernard S, 2010).

Learning and new experiences cause new neural pathways to strengthen whereas neural pathways which are used infrequently become weak and eventually die. This process is called synaptic pruning. Mature brains continue to show plasticity because of learning.

Experience

Two types of experiencerelated toneural plasticity have been described in the literature. One is experience-expectant, and the other is experience-dependent.

Experience-dependent neural plasticity allows the nervous system to incorporate other types of information from environmental experiences that are relatively unpredictable and idiosyncratic. These experiences are unique to the individual and depend on the context in which development occurs, such as the physical, social, and cultural environment(Donna J. Cech DHS, PT, PCS, Suzanne “Tink” Martin MACT, PT, in Functional Movement Development Across the Life Span (Third Edition), 2012).

Experience-Expectant Plasticity describes the normal, generalized development of neuron connections that occur because of common experiences that all humans are exposed to in a normal environment. These early universal experiences are visual stimulation, sound (specifically voices), and bodily movement.

3.2 The transformation

Transformation takes place through functional or structural plasticity.

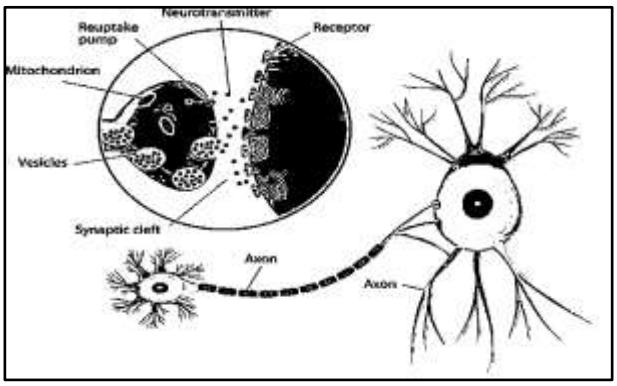
Functional plasticity connotes the brain’s ability to move functions from a damaged area of the brain to other undamaged areas. Functional plasticity moves functions across the brain areas.

Structural plasticity connotes the brain’s ability to change its physical structure because of learning. This happens throughprocesses suchas axonal sprouting, homologous area adaptation,cross modal reassignment, map expansion and compensatory masquerade. Structural plasticity may be required to form novels or to delete existing synapses.

Brain structural plasticity is an extraordinary tool that allows the mature brain to adapt to environmental changes, to learn, to repair itself after lesions or disease, and to slow aging.

Developmental plasticity is yet another transformational process whereby undamaged axons grow new nerve endings to reconnect the neurons whose links have been severed.

Figure



Source: Where are memories stored in the brain, Source: Don Arnold, USC Dorsife College of Letters, Arts and Sciences, Jan 10, 2022.

4. Theoutput

Fundamentally, the nervous system needs to rearrange itself to adapt to the unfolding situation that it faces. The genes program the body to have neuroplasticity so that one can survive in unpredictable environments

- Functional plasticity output could cover a wide range from H**omologous Area AdaptationandCross-Modal Reassignment to Map Expansion.**

- **Structural Plasticity output: How Experience Changes Brain PlasticityStructural neuroplasticity is the brain's ability to change its physical structure because of learning, involving reshaping individual neurons (nerve cells).**

Both will have an impact on the Task, the Trauma and the Memory. (Gamma, E. (2021, March 24). *What is brain plasticity*? Simply Psychology. www.simplypsychology.org/brain-plasticity.html)

4.1 Strategic thinking output.

Strategic thinking is a cognitive process that delivers visions and goals and ways and means of fulfillment. Today's complex and uncertain environment demands compatible strategic thinking processes.

It is the author'scontention (hypothesis) that neural plasticity accommodates those environmental disruptions and, as a result, induces three strategic thinking -related cognitive competencies: the conceiving of visions, the conversion of learning data into a learning curve and the resort to implicit memory data in order to create strategic control parameters**.**

Visions

Visions are mental perceptions of the kind of environment an individual, or an organization, aspires to create within a broad time horizon and the underlying conditions for the actualization of this perception". It could also be a "concept for a new and desirable future reality that can be communicated throughout the organization" (ibid: 25).

Visions are the outcome of three processes: creativity, competitive advantage and pertinent resources (El Namaki, 1992).

Neuroplasticity leads to better diffused thinking, i.e. connecting different regions of the brain to get an insight. Many of these complex concepts involving different areas of the brain induce those insights. It is the author's contention (or hypothesis) that visions could be derived from interrelated insights.(Ayk Martirosyan August 23, 2021, Neuroscience)

The learning curve

The learning curve theory proposes that a learner's productivityin the conduct of a task improves with the repeated performance of the taskover time.Learning curve models is derived from the basic premise that individuals acquireknowledge and competency, by the repeated conduct of an effort. Experiencederived from repetition induces relatively permanent changes in individualbehavior. Experience-based learning could, then, be closely correlated with enhanced output. "Experience and Learning Curves." (Encyclopedia of Management. . . Retrieved March 21, 2022).

The author should like to hypothesize that the experience and learning inputs or drivingforces of plasticity could induce learning curve symptoms. Neural plasticity, in this situation, enhances and stimulates the cumulative knowledge associated with the learning curve phenomenon. Learning associated with neural plasticity could provide a stimulus to the cumulative knowledge base of the learning curve. (Bronfman et al, 2014). (Galván A., 2010)

Strategic control

Control is an essential element of the process of strategic thinking. Yet different types of control require different inputs and deliver different outcomes. Operational and managerial control, the prime instruments,could provide an answer to the question "have we reached the once identified goals" (El namaki, 2006) butcould failat providing an answer to the strategic control question of "are we where we should have been!

It is the authors' contention (hypothesis) that the three driving forces of neural plasticity, memory, experience and learning,could help generating an answer the core question of strategic control": are we where we should have been and if not how to get there":Learning may be the most instrumental element here as it calls upon insights and juxtaposes those to extrapolations based on experience and memories. Implicit memorycould playan important role here.

5. Summary and conclusions

Plasticity is the change force within the human brain. It is the biological, chemical, and physical capacity for the brain to reorganize its structure and function. It induces shifts in functions and function instrument allocation. It is vital for the process of accommodating brain environmental change as well as brain trauma accommodation. It is also a key to brain function restructuring as well as the management

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