

The Learning and the Memory Processes Carried Out in Human Brain. A Short Review

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ABSTRACT

Introduction: Different parts of the brain act as important nodes of the neural network that encode, store and retrieve the information that will be used to generate memories. The communication among diverse living organisms involves the integrity of CNS which creates brain activity such as provocation, attention, learning and memory.

Methods: Different research articles were download for extensive research based paper mostly contains published research articles from different journals of health and medicines. All the research articles were downloaded from Google Scholars website online

Results: Different molecular pathways and mechanism been found in this short review which are essential for the formation of memory and learning capabilities in brain. The Table-1 show all these mechanism and their factors which contribute to such processes

Conclusion: The participation of genetic factors in memory is inspiring the interest of an improving count of investigators, which will undoubtedly transform our indulgent of how the CNS works and how we form both temporary and continuing memories. Furthermore, the progressive investigation of molecular mechanisms in cognition promises a future where genetic therapy may help to combat or alleviate memory diseases.

Keywords: Learning, memory, brain, molecular processes

INTRODUCTION

Interface of living organisms among themselves and with the environment is necessary for survival. The communication among diverse living organisms involves the integrity of CNS which creates brain activity such as provocation, attention, learning and memory (13). Different parts of the brain act as important nodes of the neural network that encode, store and retrieve the information that will be used to generate memories. The functioning of neural structures in the brain are responsible for the formation of memories (1). On the basis of cellular assemblies for oscillation, investigational results are discussed which sustain the hypothesis that short-term memory demands lead to a synchronization (raise in band power) in the theta band, whereas long-term (semantic) memory demands lead to a task-specific desynchronization (reduction in power) in the upper alpha band. These results suggest that, new memory model is proposing neurophysiological, cognitive, and anatomical (9).

Memories and Types

Enhancement of motor skills through exercise, which are associated with long-lasting neuronal changes, this is known as Motor learning. They are dependent initially on the initial motor cortex, premotor and supplementary motor cortices, cerebellum, thalamus, and striatal areas (23; 25; 26; 27). It keeps a proper area in the brain memory region. Nevertheless, procedural memories construct on other processes similar to those of non motor memories which are differentiated in encoding, consolidation and long-term stability, retrieval (23; 24).

The information residence for very short period of time in the brain like up-to seconds or minutes which is very necessary for cognition are known Short-term memories (22; 21). STMs are known as working memories. It does not require any rehearsal in terms of retrieval but composed of very low level of mental brain capacity. Short term memory is believed to dependent mostly on an acoustic code for

storing information, and to a lesser extent a visual code (36). Those memories which are stored in the brain for very long span of time and easily retrieved without any disturbance is called Long-term memory (19; 18; 20). LTMs have capability of storing bulk of information for unlimited time (37). Encoding and retrieval: throughout encoding, a variety of event disseminated across neocortical areas are held actively online through processes guided by the PFC (17, 16). The psychological and physical acts of future oriented behaviours conducted by brain intention is known as Prospective memory. In turn to realize a goal in the future, intention should be actively retain on good and right time (15). Working memory: Temporary, dynamic preservation and treatment of information required for complex tasks, while ignoring immaterial information involving external and internal stimuli. It also composed of retrieval and encoding stage (12). The information retained for less than a second after perceive is known as Sensory Memory. To remember something after a very short time of sense or observation is a good example of sensory memory (35). The flexible and brain intentional and conscious control of the brain is called Declarative Memory (38). Implicit Memory: Neither declarative nor implicit memory are stored another way relying on its acquire. "Fear conditioning" involves the amygdala. Operant conditioning composed of striatum and cerebellum (39).

Learning and Types

Skills and information gaining is known as learning while its retrieval at another time is called memory (14). There are four procedures involved in learning according to the Wittrock's model of generative learning (a) motivation, (b) attention (c) knowledge and preconceptions, and (d) generation. All of these procedures composed of generative brain functions (3). D-amphetamine (10 µg/0.5 ml) administered into the amygdala, hippocampus, or caudate nucleus. In rats which demonstrate Post training intracerebral injection of d-amphetamine improved preservation time of brain (5). The storage site of brain in engram is known as cerebellum which is evident that this region is responsible for simple motor response learning. But these types of investigation shows cerebellar target areas are storage sites rather than cerebellum (7). There is interspecies level differentiation between the capabilities of remembrance and learning which has investigated by breeding designs according to a study (11). Associative Learning: In associative learning, two stimuli are linked with one another or that a

response is connected with a given occasion or has a given outcome. possibly significant in clinical considerations, an individual can also learn that a result is not connected with a outcome. An individual perhaps learn that what happens to him is not correlated to what he does (28). Classical Conditioning: The Pavlov's experiment in which he pretends meat to dog to salivate the dog. He rang bell so that comes to know about the meat presence. After many time the same rehearsal, the dog comes to with bell rang even no meat there. After a while, the bell stopped predicting the presentation of meat powder for the dog and it ceased salivating when it was rung. This process is called extinction (29). Operant Conditioning: Operant conditioning from psychologist B.F. Skinner's experiments, composed using timetable of reinforcements or rewards and punishments until the behavior is learned. For example, if the dog were to hear the bell and step on a lever, it would receive the dog biscuit the reward. instead, if the dog were to step on the lever when the bell doesn't ring and receive a shock - a positive punishment that would shape behavior in the opposite direction (30). Non Associative Learning: It is difference in strength of response towards stimulus because of frequent stimulus exposure. It usually involves a single stimulus event exposure which presumes not to reflect learning of a relationship between many events (31). Habituation: Habituation is a type of learning in which an individual decreases or ceases to react to a spur after frequent exposure. Fundamentally, the organism learns to halt reacting to a stimulus which is no longer biologically pertinent (32, 33). Sensitization: Sensitization is a non-associative learning course in which frequent direction of stimulus outcomes in the progressive strengthening of a reaction (34).

PROCESSES INVOLVED IN LEARNING AND MEMORIES

The chromatin content of human genome is said to be the primary learning and memory enhancing material while composed of round about 20000 different proteins encoded by. Synthesis and degradation of chromatin is not progressive so it is a very stable molecule composed of transcriptional regulation site that might subserve signal transduction (2). The synaptic plasticity and long term potential of the brain is mostly dependent upon (BDNF), Brain derived neurotrophic factor which shows primary important role. Once the mRNA synthesis of BDNF increases it directly activates TrkB proteins for synaptic plasticity. These

process are activity dependent changes strengths of synapsis in neurons. Depletion of TrkB and BDNF causes malfunction over the memory and learning process. Radial arm maze test, creation of the TrkB/phosphatidylinositol-3 kinase (PI3-K) signaling passageway in the hippocampus is connected with consolidation of spatial memory (4). The removal of BDNF factor relying on Cre protein for glial line drastically recapitulated the effects of microglial reduction. Tropomysin related kinase receptor B phosphorylation is directly elevated by BDNF, which is responsible for better plasticity in neural synops, so it is known that microglia is a very important tissue in physiological functions in learning (6). Glucocorticoid, (a corticosteroid hormone released from adrenal cortex of adrenal gland) induced enhancement have also many positive impacts on brain learning and memory showed by different research investigation but however many other studies have shown negative impacts of this hormone over the memory function. After training activation of glucocorticoid-sensitive pathways relating glucocorticoid receptors improves memory consolidation. So many further research investigation are required to find the memory processes related to glucocorticoid activation on cognition (10). Synapse-Associated Protein 102 /dlgh3 associates the NMDA Receptor to exact Plasticity Pathways and Learning Strategies.

The NMDA receptors makes multiprotein complexes by linking to synaptic membrane-associated guanylate kinase (MAGUK) proteins comprising synapse-associated protein 102 (SAP102). Genetic mutation in SAP102 is directly related to mental retardation in human beings (41). DLG3, it is a part of the membrane-associated guanylate kinase (MAGUK) protein family composing many other proteins like PSD98, PSD 95, and PSD93. DLG3 actually codes for SAP102 protien present in the excitatory neural synaps of post-synaptic dense region (PSD), binding NR2 subunit showing an significant character in synaptic plasticity (40). Drug addiction, consequences of frequent subversion by addictive drugs of striatum-dependent operant and Pavlovian learning mechanisms usually involved in the control over behavior by stimuli linked with natural reinforcement (8).

MATERIALS AND METHOD

Study Selection

We conducted review on the memory and learning processes of the brain which contains types of learning, types of memories and the physiological processes involved in memory and

learning processes of the brain. We screened the titles and abstracts of all identified records and excluded articles in a standardized manner.

Literature

This review article is an extensive research based paper mostly contains published research articles from different journals of health and medicines. All the research articles were downloaded from Google Scholars website online. The names of the publishing journals includes, international journal of psychophysiology, journal of pharmacological sciences, Elsevier brain research reviews, elsvier behavioral brain research, journal of educational psychologist, Brazilian journal of medical and biological research, essays in biochemistry and so many other journals.

Eligibility Criteria

We identified all studies evaluating the procedures, processes and mechanisms happen in brain. Both case series evaluating the learning and memories processes of the brains and cohort studies were determined. We adopted no language restrictions.

RESULTS

We found certain molecular mechanism which are actively involved in brain system to create the ability of memory retrivel and learning processes. This short review composed of some pathways which are cited from original authentic published articles from different researches publish in different national and international journal.

Table1.

Serial No:	Pathways and factors
1	Brain-derived neurotrophic factor (BDNF) plays an important role in activity-dependent synaptic plasticity
2	Cre-dependent removal of brain-derived neurotrophic factor (BDNF) from microglia largely recapitulated the effects of microglia depletion
3	Glucocorticoid-induced memory enhancement
5	Synapse-Associated Protein 102/dlgh3 Couples the NMDA Receptor to Specific Plasticity Pathways
6	The SAP102 protein, also known as DLG3, is a member of the membrane-associated guanylate kinase (MAGUK)

CONCLUSION

A vital tenet in the field of medicine has been that the genome is static following cellular

expansion and discrimination. Although this criterion not solely restricted to a single cell but to many types of cells, the review article in this investigation shows indicate that this is always the case for neurons. There is increasing evidence that neurons and specific genes within neurons retain their sensitivity to proper factors beyond development, and that regulation of gene transcription is a necessary component in central nervous system plasticity and memory. The participation of genetic factors in memory is inspiring the interest of an improving count of investigators, which will undoubtedly transform our indulgent of how the CNS works and how we form both temporary and continuing memories. Furthermore, the progressive investigation of molecular mechanisms in cognition promises a future where genetic therapy may help to combat or alleviate memory diseases famous for malfunctions in central nervous systems.

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