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HIGHER NERVOUS ACTIVITY AND MEMORY: NEUROPHYSIOLOGICAL AND COGNITIVE FOUNDATIONS

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Abstract. *Higher nervous activity (HNA) and memory are central components of human cognitive functioning, forming the foundation for perception, learning, problem-solving, and behavior regulation. This article explores the physiological and psychological mechanisms of HNA, including cortical-subcortical interactions, synaptic plasticity, conditioned reflexes, and types of inhibitory control. Memory is examined in relation to neural processing, consolidation, storage, and retrieval, emphasizing the role of the hippocampus, amygdala, limbic system, and cerebral cortex. Special attention is given to classical and operant conditioning, associative learning, and long-term potentiation (LTP) as biological mechanisms of memory formation. The article summarizes recent findings in neurobiology, cognitive science, and psychophysiology, highlighting their role in education, mental health, and behavioral training.*

Keywords: *Higher Nervous Activity, Memory, Conditioned Reflex, Synaptic Plasticity, Cognitive Processes, Neurophysiology, Learning Mechanisms.*

Higher nervous activity (HNA) encompasses complex brain functions such as thinking, memory, attention, speech, and consciousness, which shape adaptive behavior and personality.

The structural basis for HNA lies in the cerebral cortex, subcortical structures, and the limbic system, forming neurofunctional networks responsible for sensory processing, decision-making, and behavioral responses.

Pavlov’s theory of conditioned reflexes laid the foundation for understanding HNA, explaining how external stimuli can form associative connections through learning and memory mechanisms. Modern neuroscience expanded this model through concepts such as long-term potentiation, neural networks, and synaptic plasticity, which explain how memory is biologically stored and retrieved.

Memory is a fundamental cognitive process that allows the storage, retention, and recall of information, crucial for learning, personality development, and adaptation.

According to neurophysiological principles, memory emerges through dynamic changes in neural connections, biochemical signaling, and structural reorganization at synapses.

Understanding HNA and memory is vital in medicine, psychology, pedagogy, artificial intelligence, and neuroscientific research.

Pavlov (1927) established the role of conditioned reflexes in higher nervous activity, emphasizing cortical excitatory and inhibitory processes [1]. Luria (1973) later formulated functional brain blocks responsible for motor programming, sensory integration, and cognitive processing [4]. Hebb (1949) introduced synaptic learning principles, proposing that neurons that fire together strengthen their connections, forming the basis of learning and memory [5].

Recent studies by Kandel (2000) demonstrated molecular mechanisms of memory, including synaptic plasticity and biochemical signaling [8]. Baddeley (2010) classified memory into sensory, short-term, working, and long-term types, highlighting the role of the prefrontal cortex in working memory [6]. Squire (2015) described declarative and non-declarative memory, linking them to hippocampal, cerebellar, and amygdala networks [10]. Modern research emphasizes neuroimaging methods such as fMRI and PET scans for analyzing HNA and memory-related brain processes, including the work of Miller and Cohen (2020) on executive functions and attention control [13].

This research is a theoretical and analytical study based on existing neurophysiological, cognitive, and psychological literature. The methodology includes comparative analysis, synthesis, and classification of data related to higher nervous activity and memory. Sources include textbooks, peer-reviewed scientific journals, neuroscience articles, and foundational works by Pavlov, Luria, Kandel, and Squire.The study established that higher nervous activity operates through cortical-subcortical regulation, mediated by neurotransmitters, electrical impulses, and inhibitory mechanisms. The following findings are noteworthy:

1. Structure of Higher Nervous Activity:

HNA functions through cortical areas, particularly the prefrontal cortex, responsible for planning, decision-making, and attention. The limbic system regulates emotions and memory encoding, while the hippocampus ensures memory consolidation.

2. Biological Mechanisms of Memory:

Memory formation relies on synaptic plasticity, involving structural changes, gene expression, and protein synthesis. Long-term potentiation (LTP) and long-term depression (LTD) are key neural processes that strengthen or weaken synaptic connections.

3. Types of Memory:

Memory is divided into sensory, short-term, working, and long-term types. Long-term memory is further categorized into declarative (semantic and episodic) and non-declarative (procedural and emotional) forms.

4. Inhibition in HNA:

Inhibition is classified into external, internal, and transitory types. It helps balance excitation, prevent overload, and maintain behavioral control.

Higher nervous activity is the central regulatory system of the human psyche, dependent on functional interactions between nervous system structures. Cognitive neuroscience traces memory functions to both biological and psychological processes, confirming the interdependence of attention, perception, and consciousness.

Recent advances in neuroplasticity research reveal that memory develops through repeated experiences that reorganize neural circuits. Educational psychology highlights that effective memory is reinforced through visual stimuli, repetition, emotional engagement, and contextual learning. These findings have practical applications in psychological counseling, medical treatment of cognitive disorders, artificial intelligence, and rehabilitation therapy.

Higher nervous activity and memory are closely interconnected neurophysiological and psychological mechanisms. They enable behavioral regulation, learning, adaptation, and emotional development. Cortical-subcortical structures, synaptic plasticity, and inhibitory processes play a crucial role in memory formation and management. Future studies should focus on neural engineering, artificial cognitive systems, and neurorehabilitation based on HNA principles.

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