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PSYCHOLOGICAL ASPECTS OF THE PROBLEM OF ARTIFICIAL INTELLIGENCE

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Abstract
In this article, the emergence and historical development of the artificial intelligence problem, as well as current trends in engineering psychology, ergonomics, and general psychology, are briefly analyzed. The discussion highlights the necessity of considering the interaction between humans and the regulated evolutionary environment in the creation of artificial intelligence systems and technologies that have emerged within the technogenic environment of human civilization. Within the frameworks of postclassical psychology and the philosophy of complex self-organizing systems, the article explores promising research directions and challenges related to the use of conceptual apparatus in these fields.

Keywords: Intellect, artificial intelligence, postclassical psychology, self-organization.

Introduction

The concept of intelligence (hereinafter referred to as natural intelligence) was first employed as a psychological category by Francis Galton in his studies. Galton used the term intelligence to explain the hereditary transmission of intellectual differences among individuals. From a psychological perspective, intelligence (from Latin "intellectus" – cognition, understanding, reason) refers to the human mind's ability to comprehend the world intellectually, encompassing all forms and manifestations of cognitive processing. Due to its broad interpretations, this term lacks a formal and universally agreed-upon definition and is interpreted differently across various scientific disciplines such as philosophy, biology, physiology, sociology, psychology, and engineering.

In contemporary technological civilization, one of the most prevalent psychological and technical concepts applied in creating complex systems—controllable machines, mechanisms, robotic systems, and autonomous robots—is "intelligence," along with its technical counterpart, "artificial intelligence." Currently, concepts such as "smart algorithms," "smart cities," "smart dust," "programmable matter," "swarm systems," sensor networks, cyber-physical systems, the Internet of Things, self-learning devices based on personal experience, adaptive interfaces, and brain-computer interfaces are widely discussed. Metaphorically speaking, artificial intelligence is considered the cognitive component of a cybernetic technical system. The concept of "intelligence" has already transcended the boundaries of psychology. Although the term is widely popular across various fields, many individuals actively use it without a precise understanding of its meaning. In Western literature, "intelligence" is often viewed as a broader concept closely related to "mind" within the local scientific community. The "intelligence" category in engineering psychology and ergonomics reflects the demand for innovative concepts and ideas transferred from technology to psychology. The convergent nature of this category is particularly evident in the notion of "artificial intelligence," uniting human, societal, and technogenic environmental evolutionary issues within a single conceptual framework.

Classical Perspectives on Intelligence. In classical psychology, significant research on abilities, intelligence, and the problems associated with their measurement has been contributed by scholars such as G.Y. Eysenck, R. Amthauer, B.G. Ananyev, A. Binet, N. Bostrom, D. Wechsler, H. Gardner, J. Guilford, E.A. Golubeva, V.N. Drujinina, D.N. Zavalishina, T. Kelly, R. Cattell, J. Piaget, K.K. Platonov, J. Raven, S.L. Rubinstein, T. Simon, C. Spearman, R.J. Sternberg, B.M. Teplov, L. Thurstone, O.K. Tikhomirov, J. Thompson, R.L. Thorndike, and W. Stern.
Based on the conceptual models of "intellectual tools" proposed by these researchers, contemporary psychodiagnostic theory and practice have been established, widely utilized in education, vocational selection, counseling, and upbringing.
The term "intelligence" has various definitions, with each author interpreting it freely and emphasizing specific aspects of this complex phenomenon. One of the simplest and clearest definitions was proposed by E. Boring within the testological direction of classical psychology: "Intelligence is what intelligence tests measure."
According to G.Y. Eysenck, intelligence comprises at least three fundamentally distinct conceptions: biological intelligence, psychometric intelligence, and social intelligence. Each conception remains incomplete without the others [1].
Howard Gardner, the author of the theory of multiple intelligences, defines intelligence as "the capacity to solve problems or create products valued within a specific cultural or social context". He identifies seven primary intellectual abilities:
Verbal intelligence – the capacity for speech creation, encompassing phonetics (sounds), syntax (grammar), semantics (meaning), and pragmatics (practical speech use).
Musical intelligence – the ability to perceive and communicate through rhythmic sound sequences, including pitch, rhythm, and timbre.
Logical-mathematical intelligence – the capability to understand relationships among objects or actions without their direct presence, representing abstract thinking.
Spatial intelligence – the precise perception of the visible environment, its modification, and imaginative reconstruction.
Bodily-kinesthetic intelligence – effective use of the entire body to solve problems or create products, controlling both fine and gross motor movements.
Intrapersonal intelligence – the capacity to understand one’s own emotions, intentions, and motivations.
Interpersonal intelligence – the ability to comprehend and distinguish the emotions, perspectives, and intentions of others.Gardner later expanded this list to include existential and naturalistic intelligences, which facilitate understanding human existence, intuitive perception, cognition, metacognition, and interactions between humans and their environment [2].

Joy Paul Guilford proposed a cubic multifactorial model based on divergent thinking, demonstrating the existence of independent intellectual abilities. This model describes intelligence as a three-dimensional system consisting of 120 factors, known as the structure of intelligence [3]. R. Sternberg defines intelligence as "the capacity to adapt to, influence, and alter one's environment" [4]. These concepts align with the natural form of human cognition—knowledge formed within subjective human experience—distinct from artificial intelligence, which directly processes information algorithmically.

Although artificial intelligence flourishes in engineering, the psychological interest in "intelligence" has relatively diminished. Initially, psychologists focused more on intelligence testing, later shifting attention to cognitive styles [5] and specific intellectual abilities [6].

Currently, the concept of intelligence is extending into fields such as pedagogy and engineering, frequently replacing the term "efficiency." In technology, an effective system is often synonymous with an "intelligent" system, i.e., one possessing artificial intelligence. In pedagogy, an intellectual individual is often considered an efficient learner. Furthermore, the term has become a strategic marketing tool for obtaining scientific grants and projects, supported by the fact that early artificial intelligence researchers were primarily systems analysts and highly qualified engineers rather than psychologists. John McCarthy, one of the term's originators, was a programmer and pioneer of functional programming technology. The philosophical-scientific justification of artificial intelligence, modeling human intellectual functions through informational-technical systems, is linked to the informational concept of mind by D.I. Dubrovsky, who proposed that information must be embodied physically, and can manifest through different substrates, highlighting the invariance principle regarding its physical properties.

The invariance principle concerning the physical properties of information carriers leads to the conclusion of iso-functionalism—the idea that identical functions can be reconstructed from different (physically, chemically, structurally diverse) substrates. This conceptual approach opens promising directions in technical design, computer technology advancement, medical prosthetics of organs and their components, as well as non-biological human evolution and transformation of civilization's material manifestations. Classical psychology interprets intelligence as an effective set of intellectual tools aiding in solving complex tasks, laying the groundwork for modern engineering solutions such as automatic control, databases, expert systems, and automation tools. However, the further development of complex world technologies increasingly conflicts with the simplified materialistic worldview formed in classical psychology. Consequently, creating a psychology of the complex world reflecting human development within the technosphere becomes necessary.

This goal is pursued within the frameworks of non-classical and post-non-classical psychology, analyzing human subjective reality and personality through principles of universality, relativity, randomness, systemic nature, and historicity. This approach addresses the challenges associated with developing complex ergatic and robotic systems [8].

• Diversity refers to the qualitative differences among components within complex systems, making them adaptable and responsive to various situations. Diversity exists within dynamic systems, where fragmented elements interact to form new system structures. These processes often occur abruptly and possess nonlinearity. Sometimes, the emergence of new properties can be triggered by very small and seemingly insignificant factors (e.g., the "butterfly effect").

• The concept of imbalance indicates an uneven spatial distribution of concurrently existing forms of matter (energy, substance), leading to local self-organization and the emergence of new systems. A holistic approach to understanding the world is proposed, suggesting that elements perceived as separate through human cognition are, in fact, parts of a unified whole.

• The complexity of self-organizing systems represents the quantitatively and qualitatively incomprehensible continuous dynamics of the world. In this context, both the system and the environment act as active agents: the environment modifies the system, and the system, in turn, shapes the environment. They enter into coevolutionary relationships. This interaction results in structural harmony between system and environment, reflecting the autopoietic systems theory advanced by H. Maturana and F. Varela [6].

Analyzing human psyche activity as an autopoietic system allowed the author to propose the principle of the full autopoietic nature of the psyche [11]. According to this principle, everything generated in the human psyche and subjective reality under the influence of social communication and technological environments has an autopoietic (self-reorganizing) character.

The autopoietic nature of human-scale systems manifests across all their activity and organizational levels. The post-classical scientific rationality paradigm enables a broader understanding of intelligence—as the capability of a complex system to organize its environment and self-organize, reflected in emergent (newly arising) properties of organized or organizing entities.

In the works of S.F. Sergeyev and others, definitions and characteristics of intelligence and intellectual symbiotes according to the post-classical scientific methodology are presented:Intelligence is an active self-organizing form and mechanism of a complex system that engages the user/observer immersed in the environment in creative and purposeful transformations.

Intelligence is embodied as a mechanism organizing the environment.

Forms of intelligence	Systemic organization. relationships among components	Center of activity	Interaction with the environment, boundaries
Natural Intelligence	Self-developing reflective system, autopoietic (self-organizing) formation	Subjective reality, ego-system	Conscious, sensory-mediated, active transformation of the world within the boundaries of subjective reality
Artificial Intelligence	Computational system, execution of software algorithms	Computational algorithms interacting with software environment, data, and databases	Physical sensors, input-output interfaces, mechatronic and cyber-physical actuator systems; within the limits of computational power and feasibility
Hybrid Intelligence	Symbiosis at the interface level of technical and human-scale systems	Organized technosphere or loci within subjective reality	Integration, mutual adaptation, and orientation of communications between natural and artificial intelligences; within interface boundaries
Diffuse Intelligence	Selective connections within self-organizing autopoietic environments	In environments of truth, physical reality, software environment	Structured and structuring essences emerging in heterogeneous environments; boundaries are defined by observers

Research on this class of ergatic systems is still in its initial stage. Psychologists' involvement during the formative stages of technical representations can serve as a valuable source of new concepts and ideas for applying artificial intelligence within self-organizing and evolving environments.

Conclusion:

In developing contemporary artificial intelligence systems and technologies, significance grows not only from the outcomes of studies on information processes in the human brain and biological systems but also from insights into systemic and psychological foundations of complex systems. Therefore, psychology needs to transition to a post-classical scientific paradigm, requiring the implementation of post-classical rationality methods. Psychology has not yet fully realized its potential as a source of ideas for advancing theoretical and applied scientific complexes associated with artificial intelligence systems. Humans continue to remain the primary driving force behind the development of the technogenic world.

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