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PHILOSOPHICAL PROBLEMS OF THE FEEDBACK EVOLUTION IN SELF-ORGANIZING SYSTEMS

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Abstract

Exploring models of perception, perceptual processes and sensory-motor control in various fields and disciplines (including cybernetics, information theory, artificial neural networks theory), some researchers began to apply Bayesian constructs to explain cognitive and psychophysical phenomena and processes. Cybernetic systems are complex dynamic systems of any nature with feedback, without which it is impossible to control such systems. Signals carrying information about how commands are executed are transmitted from the controlled system via the feedback channel. With all the paradigmatic difference between network and system approaches from the point of view of different authors, there is a possibility of their convergence in the making of an interdisciplinary paradigm of complexity. Then there is the problem of the form or manner of their connectedness. Cognitive development is of circular, nonlinear nature here. According to the fundamental principles of cognitive science, mental processes are procedures of information processing. Many mental processes happen unconsciously. Radical enactivism, which is considered to be a new direction in cognitive science, reckons the phenomenon of subjectivity as a problem of explaining the phenomenal aspects of consciousness. The concept of enactive cognition develops in line with constructivist orientations in epistemology, social philosophy, and management theory. Cognitive agent can in this concept be considered as active and interactive. The concepts of autopoiesis, structural determinism and conjugation of systems, operational closure of the system are introduced. Mind/brain descending computational activity, functionally appears as a forward one, while coming from the world activity acts here as a source of feedback.

Keywords: Convergence, cognitive technologies, feedback, self-organization.

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1. Introduction

Historically, the impetus for the convergence of machine intelligence and human intelligence were the renowned Turing tests, which helped to conclude that if the intelligence of a machine fully simulates human responses in the course of communication, it is no different from the human intelligence. The basis for this comparison was the discovery of artificial neural networks, which are a new direction in the development of artificial intelligence technologies (Arshinov & Budanov, 2016).

In the early 1990s, researchers from universities in the United States and the United Kingdom, working at the intersection of mathematics and psychology, began to develop detailed models of perception, perceptual processes and sensory-motor control based on Bayesian decision theory and methods of mathematical statistics. Gradually exploring the ideas and principles of various fields and disciplines on this basis (including cybernetics, information theory, artificial neural networks theory), the authors of this research began to apply Bayesian constructs to explain cognitive and psychophysical phenomena and processes. The basic principles of the Bayesian approach to perception: functional inversion of feedforward and feedback sensory communication. A high-level area communicates its "vision "of a sensory input to a lower layer, where it is translated into a form "understandable" for it and compared directly with the current sensory information received from the five senses. Perception in terms of content is determined by the flow of descending predictive signals. They go down the "steps" of the perceptual neurocomputational hierarchy (Sushchin, 2017).

2. Problem Statement

There is a problem of interrelation between the system and network approaches. Considering the existing paradigm difference, there is a possibility of their convergence within the making of an interdisciplinary paradigm of complexity. The concept of the observer in this process has a key role, and some representations of quantum mechanics and the theory of dissipative structures of Ilya Prigogine are significant as well. The main growth factors are the processes of synergistic convergence of knowledge, research practices in the field of information and communication technologies, nanotechnology, cognitive sciences. This process is called NBIC-convergence.

The theory of systems was developed in the 1930s to overcome the interdisciplinary confrontation between physics and biology. It was further developed in connection with the emergence of cybernetics. The dialogues of Wiener and Bateson, as F. Capra says, opened the door to the understanding of the nature of a mind as a systemic phenomenon. At the same time, the first models of self-organization emerged in line with the emerging cybernetics and systems thinking. These were mathematical models of neural networks developed by W. McCulloch and W. Pitts. In the mid-1970s H. Haken H. Haken and I. Prigogine contributed in developing synergetics and theory of nonequilibrium dissipative structures. Models developed by H. Haken and I. Prigogine can be considered multidisciplinary cyber-physical models. At the same time, H. Maturana and F. Varela suggested the theory of autopoiesis, that is, the theory of biological evolution, based on the ideas of Second-order cybernetics of von Foerster. Bateson, as well as McCulloch and Pitts, can be called the fathers of the cybernetic paradigm. For Bateson, the concept of a network pattern that links a living organism as a system to its environment was important. Bateson considers network as a

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nonlocal manifold of feedback channels (an active system of differences) that generate differences, where emergent effects of self-organization occur. However, Bateson failed to fully implement the idea of congruent introduction of the observer in cybernetic epistemology into the context of the cybernetic dialogue formed with his own participation. It was necessary to find something in common between the worlds of networks and systems, which Foerster did in the 1960s – early 1970s. Von Foerster praised the work of Spencer-Brown, developed the theory of Second-order cybernetics based on it, and initiated the creation of the conceptual scheme that Bateson had been speaking about. The concept of autopoiesis by Maturana and Varela was developed in line with these ideas. Thus, cybernetic and biological realities gained their observers of communication networks after quantum mechanics (Arshinov & Budanov, 2017).

3. Research Questions

Cognitive problems of convergent technologies or interdisciplinary communication and management should be studied in the context of the post-non-classical paradigm of synergistic complexity. Models of Deleuze and Guattari in the paradigm of complexity have self-reference, reflexivity, operational closure, autopoieticity. Then there is the problem of the form or manner of their connectedness. Cognitive development is of circular, nonlinear nature here. According to E. László, we live in an era of a profound transformation, i.e. a shift of civilization, transformation, that he called a macroshift (bifurcation in society evolution, bifurcation of human civilization in its quasi-continuity) (as cited in Gafiatullina, 2019). Describing the convergent-divergent dynamics of the evolutionary process of human society, E. László identifies four stages of the macroshift, of which the main factor is technological innovation. We are currently in a chaotic, third stage of the macroshift. In this unsustainable critical state, human society becomes sensitive to any fluctuations of its environment. The environment is also becoming more and more non-equilibrium, technicalized. Some fluctuations can cause emergent evolutionary leaps, resonance leaps, qualitative changes in an open, nonequilibrium, nonlinear system.

Thus, in the process of its evolution, the earth civilization entered the era of complexity as an essential phenomenon of the globalization process. If we reason from the principles of cause-and-effect relations, it entered this era irreversibly, vaguely, unpredictably. In the last stage of the macroshift, the future is not theoretically predicted, but practically created in the process of recognition of complexity as an attribute of the evolutionary process inherent in cosmological evolution as a whole (as cited in Arshinov & Budanov, 2016).

4. Purpose of the Study

The article deals with the problem of relations between network and system approaches from the point of view of different authors. Considering the paradigm difference, there is a possibility of their convergence within the making of an interdisciplinary paradigm of complexity.

The study of the evolution of feedback in self-organizing living and non-living systems taking into account cognitive and psychophysical phenomena fosters optimal development, increases the speed of information exchange between different communities, for example, ethnic groups, religious organizations and predicts the prospects for the development of information civilization**.**

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5. Research Methods

Interdisciplinary studies have two aspects of integration: the ontological aspect, which is associated with the transition from the atomistic world view to the systemic one; the epistemological aspect, which is associated with the change of cognition itself in the context of interdisciplinary knowledge. The methodology of interdisciplinary research reveals the horizontal connections of reality. The subject of knowledge are complex self-developing systems, including humankind. The model of reality designed includes parameters characterizing both the object and the sphere of practical application of knowledge, its social significance. Cognitive relation from linear subject-object connection in classical science turns into communicative action or complex mediated relations, which can be characterized as recursive determinism. The methodology of cognition of such reality or complex self-developing systems is called the methodology of complexity cognition. At the stage of application of evolutionary-synergistic approach to socio-humanitarian systems, that is, at the stage of formation of social synergetics, studies are called transdisciplinary and are designated as complexity paradigm. Cognition understood as a stage of the global evolutionary process promotes a new level of complexity (Chernikova, 2015).

According to researchers of the complexity paradigm, the principle of recursive determinism provides feedback in the cognition of complex self-developing systems and preserves the integrity of a subject and the environment of its activity. Now a subject does not take an external position in relation to an object. The process of subject-object interaction of cognitive activity changes: a subject is no longer an external observer, but an actor who changes the environment and one's self. The principle of organization of cognition in this process is determined by the term "transdisciplinarity". In such interdisciplinary or transdisciplinary studies, reductionism methodology is complemented by approaches such as holism and emergentism. Thus, the application of anthropological, axiological, system approaches, as well as methods of synergetics and cybernetics helps form a model for the study of feedback in living and inanimate nature (Gafiatullina, 2019; Gafiatullina & Gafiatullin, 2017).

6. Findings

The peoples of the world voluntarily get more and more involved in international relations and, by virtue of the objective processes of globalization, in the global civilization process. In such circumstances, national cultures cease to be closed systems, and cultural differences become relative. In people of different racial and ethnic backgrounds, similarities can be seen when they work in international corporations.

V. S. Stepin believes that humanity can find a way out of global crises with the help of spiritual reformation and a new value system (as cited in Kudashov & Omelchenko, 2014). Arshinov and Budanov (2017) comes up with the aim to stimulate the process of convergent expansion of practices of technocultural anthropologically oriented mediation, cognitive interfaces between converging levels of reality, for example, in the framework of the program of symmetrical anthropology by Bruno Latour, social constructivism in line with the ideas of N. Luhmann, or modern postphenomenology of technology. D. I. Dubrovsky believes that the ability of a self-organizing system to display and control the media is a condition for creating digital models of life phenomena in the form of hybrid, bioelectronic self-organizing systems (as cited in Kudashov & Omelchenko, 2014).

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According to the fundamental principles of cognitive science, mental processes are procedures of information processing. Many mental processes happen unconsciously. It is necessary to understand why some of them imply consciousness. D. Dennett, a philosopher and theorist of cognitive science, believes that the line between conscious and unconscious processes is relative. The entire intellectual history of humankind is a history of pushing cognitive boundaries and crossing conceptual red lines. Radical enactivism, which is considered to be a new direction in cognitive science, reckons the phenomenon of subjectivity as a problem of explaining the phenomenal aspects of consciousness. The problem of consciousness is divided into two problems. The first one is the problem of subjectivity; the second one is the problem of qualia, i.e. of special phenomenal properties. Subjectivity was considered as a basic cognitive characteristic; it is a way of focusing perception on the world. And qualia ARE something present in subjective space. Thus, the brain is a neural network that is capable of learning (as cited in Lektorski et al., 2016).

The concept of enactive cognition develops in line with constructivist orientations in epistemology, social philosophy, and management theory. Cognitive agent can in this concept be considered as active and interactive. Introduced are the concepts of autopoiesis, structural determinism and conjugation of systems, operational closure of the system. Human brain and consciousness process information, establish patterns of change in their own model of organization, and thus organize the external environment as an extension of one's self. Knowledge is a cognitive process (Knyazeva 2013).

In the modern scientific world view, a subject enters the cognized system as an active component of this system-process. Each level of evolution is a closed integrity and is characterized by specific complexity. Cognitive and social systems influence the evolution of nature as a determination from above. Sociogenesis and its form called technogenesis created the possibility of transformation of nature and humankind (Chernikova, 2015).

NBIC-technologies are a convergence of nanotechnology, biotechnology, information technology and cognitive science, projects in the field of artificial intelligence and robotics, the prospects of which are not quite clear at the moment. Robotics has another task: to help intelligent machines gain independence and qualities similar to human ones (Mareyeva, 2014).

According to D. Mumford's model, for interconnected areas of the cerebral cortex, a hierarchically higher-level area makes predictions as to what kind of sensory information a lower-level area deals with. A high-level area communicates its "vision" of a sensory input to a lower layer, where it is translated into a form "understandable" for it and compared directly with the current sensory information received from the five senses. Then, either a prediction of the high-level area, considering observational error, is exhaustive, and the entire system as a whole almost completely predicts sensory input, or the lower-level area is forced to calculate the remainder, describing the piece of the world that was not expected. This prediction error is then sent upwards to make appropriate adjustments to the high-level area patterns in order to make more accurate predictions of the objects perceived. A specific feature of Mumford's model of cognitive architecture, that provided the impetus for subsequent similar theoretical developments, is the actual inversion of the functional roles of feedforward and feedback sensory communication in the brain. This means that perception in terms of contents is almost entirely determined by a flow of descending predictive signals. They go down the "steps" of the perceptual neurocomputational hierarchy and block any

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upward information activity, except for errors in predictions. Thus, descending computational activity, functionally appears as a forward one, while the activity coming from the world acts here as a source of feedback. Perceptual processes occur under the conditions of substantial uncertainty, such as the uncertainty over the objects perceived. In accord with the ideas of Helmholtz, adherents of modern Bayesian approaches proceed from the assumption of the indirect nature of perceptual processes: the perceptual system has no direct access to the "hidden causes" that affect its input. The brain and nervous system have only the input signals, which are subject to comparison with the flow of descending predictive signals produced by the generative model of the brain. For mind/brain-generated predictions to better match the incoming signal flow, the brain has to rely on hierarchical Bayesian inference processes that select the best hypothesis to predict the current sensory input (Sushchin, 2017).

7. Conclusion

Globalization, considered according to the concept of synergistic historicism as a new phenomenon of social life, which is opposed by deglobalization, is viewed as the implementation of the path to global unity through potentially infinite local diversity. This thesis is clearly illustrated by the bifurcation spiral model of global social progress, demonstrating the constructive and deconstructive role of chaos. The synergistic approach to the problem of global development of humankind allows us to reconsider the future as a material embodiment of the absolute, or universal, ideal, which is established in the struggle of private, or relative, ideals for a dominant role in society throughout world history. The authors of the "Global Future 2045" concept attribute a hyperbolic character to the global curve of evolution, while the authors of the "Global future, transhumanism and synergistic philosophy of history" concept attribute the properties of a universal spiral combining the reversibility (repeatability) of qualitative changes in the Universe with the irreversibility (uniqueness) of new formations to the global law of self-organization. At the same time, the authors of both concepts associate global self-organization with the concept of singularity. However, if the first concept considers the singularity as one of the local points of bifurcation, assuming either the collapse of the self-organizing system, or the transition to a qualitatively different state, the second considers the singularity as a superattractor: the state of a self-organizing system which all local, simple, and strange attractors aspire to be in. This state ensures stability of a system to any fluctuations in an external environment, ensuring order, resistant to the effects of the absolute chaos due to the ability of a system to neutralize adverse external influences. It is necessary to emphasize the cybernetic component of synergistic philosophy of history due to the close relation between cybernetics (as a general theory of management) and the essentiology of self-organization (as a general theory of selection and super-selection of dissipative structures). Considering cybernetics as an integral part of synergetics, authors consider it expedient to complement the Cybernetic Manifesto with the Synergistic Manifesto (Bransky, Pozharsky, Mikaylova, Busov, & Zobova, 2017). National (ethnic) identity will be discussed both as "an integral image that an individual makes of one's self, unchanged in all life situations in which an individual is aware of one's self", and as a set of stable parameters of an ethnic group, being awareness of which allows an individual to determine one's belonging to a community (Pruzhinin et al., 2015).

In a globalizing world, achievements of humanization which it took centuries to accomplish are largely devalued. According to S. Khoruzhiy, there is an "anthropological turn", "the modern human has

begun to sharply, uncontrollably, dangerously change, change one's self" (as cited in Gafiatullina, 2019). Thus, generally peculiar to a human desire for otherness, for alterity, i.e., of the other world, now shows a decrease in shape-building energy of a person: from transcendence, ascent to another reality, i.e. religiosity in the broad sense, to surrendering to the unconscious and withdrawal to virtual constructs far from any reality. In addition, people are still forced to provide for their living through labour carried out in the framework of the market economy (very cruel even in the conditions of a welfare state). We should also recall that N. Moiseev called evolution itself a market – since evolution is the process of self-organization of the natural world, which eventually led to the emergence of human society and consists in the fact that species less capable of development are ruthlessly replaced by more viable ones (as cited in Kiselev, 2015). It should be noted that it is uncertainty that presupposes postclassical scientific knowledge that has established the possibility of both smooth and progressive changes in complex systems, and sharp, explosive leaps, or bifurcations which dramatically modify or cancel the previous logic of development (Kiselev, 2015).

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