THE MECHANISM OF INFORMATION PROCESSING IN NEURONAL NETWORKS BY MEANS OF MENTAL PHENOMENA AS A MODEL OF HUMAN-LIKE AI: CAUSALITY AND FREE CHOICE

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One way to achieve human-like AI is reverse engineering of the human mind from a computational point of view by means of Cognitive Science. Practically all neurophysiological investigations are based on predominantly physical parameters of activity of neuronal networks of the brain. At the same time, neuroelectrical, neurochemical, neuromolecular, ionic, etc. processes expressed in physical quantities, are considered, by default, to realize biologically and/or socially expedient information functions. However, scientific experience claims that physical processes are inherently 'indifferent' to a person's biological or social existence (Soloviov, 2019). So, we do not know in what way cognitive (brain informational) activity is biologically and socially expedient.

Accordingly, **the purpose** of this work is to describe the biologically or/and socially expedient mechanism of integration information in neuronal networks of the brain by means of mental phenomena for reproduction in computational paradigm in the context of the problem General AI (Dyachenko et al., 2018.). Mental phenomena are discussed here as product of activity of neuronal networks, which forms in neural networks a specific mental sphere of information processing through subjective assessment of information recorded in the brain. Besides, mental phenomena are discussed as causal entity realizing causation of physically occurring motor acts on the basis of integrated information in environmental conditions of novelty and uncertainty. The postulated mechanism is based on the ability of the limbic region qualitatively evaluate stimuli (through information of them which is recorded in the brain) and to direct by means of this subjective evaluation physic processes in neural networks that implement information operations. Subjective value directs all information processes in the neural networks of the brain to biological and/or social expediency. We insist that the perception of information in the human brain occurs by means of subjective value. We insist that the integration of information is controlled by means of subjective value. We insist that even the storing information in the brain is controlled by means of subjective value. Can we watch the processing of information directly in the physically described activity of neural networks? Cannot. Can we watch this processing during deliberation? Yes, we can (Hills, 2019).

Why do neuronal networks need mental phenomena during processing information? It is precisely because they, being physical, i.e. existing totally in the present, cannot process information about the past to integrate the experience into mental models of future interactions with the physical world. Also, networks need mental phenomena because the subjective choice of wished phenomena (wished through information about these phenomena which is fixed in the brain) may occur only in the mental sphere. Besides, networks need mental phenomena because the integration of already fixed information cannot be carried out in exclusively physically active networks due to their inability to form new biologically and/or socially appropriate neural synaptic connections (Soloviov, 2015). (Physic processes by itself do not "indulge" biological and social processing). These and other functional impossibilities in totally physically active neural networks are compensated precisely by psychic phenomena. So, we need to explain the mechanism of operation of information in the brain by the appeal to mental processes.

Bottom-up exchange of information for the sake of integrating new information in the framework of forming the 'competency' of controlling networks for informationally well-endowed motor acts occur through specific mental phenomena (e.g., mental images). Top-down exchange of control signals for the sake of regulating perception, information integration and regulating motor acts on the basis of already integrated memory occur by means of mental processes (e.g., decision-making, volitional act, etc.). All these cognitive processes of causation by control networks of subcontrol networks occurring through synapses (as dynamic relay devices that change the flows of bioelectricity in networks) appear only by means of subjective choice of information as biologically and/or socially expedient phenomenon (Soloviov, 2015).

This hypothesis can be tested through neural modelling within the Neural Engineering Framework in the software package Nengo for simulating large-scale neural systems (Eliasmith, 2013). For example, the Semantic Pointer Architecture Unified Network (SPAUN) model uses semantic pointers that are neural representations composable into representational structures which support complex cognition (Eliasmith, 2013).

Conclusion. Computational models of human-level AI have to take into account cognitive approach to informational causality which explains the results of causation through the indeterminacy of subjective values (manifested in the selection of biologically and/or socially expedient information) and through the continuum of information fixed in the brain for free subjective choice. We plan to test this hypothesis computationally within the Neural Engineering Framework, employing the Nengo software package.

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