TOWARD PHYSICS OF THE MIND

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Is physics of the mind possible? How would it differ from biophysics or neural networks?

Physics looks for the first principles describing a wide area of reality. Physics develops testable predictive theories. Experimental physics tests predictions and measures events revealing fundamentals of the nature. The talk describes steps towards a physical theory of the mind. First I summarize known first principles of the mind. These include mechanisms of concepts, emotions, the knowledge instinct, the mind hierarchy, and dynamic logic. This dynamic process-logic replaces classical logic operating with static statements. Dynamic logic serves as a basis for a mathematical theory of learning, combining the listed first principles into a hierarchical system of mental processes. Each process proceeds "from vague to crisp," from vague representation-concepts to crisp ones. Brain imaging experiments (Bar et al 2006; Kveraga et al 2007) confirmed this as an adequate model of the brain perception and cognition.

The mathematical basis of this physical theory, dynamic logic overcame the difficulty of computational complexity plaguing modeling of the mind, artificial intelligence, and machine learning since the 1960s. I relate this difficulty to Gödelian problems in logic: computational complexity is a manifestation of Gödelian incompleteness in finite systems, such as computers or brains. The mind is "not logical." The Aristotle's theory of mind is closer to dynamic logic than to classical logic. Engineering applications demonstrate orders of magnitude improvement in classical problems of pattern recognition, data mining, information integration, financial predictions.

The talk presents the dual hierarchy model of interactions between language and cognition. I discuss a number of "mysteries" in this interaction (what is the difference between the two; what is the role of language in cognition, why children can talk before they really understand, how much adults are different from children in this respect, etc.). These are explained in the model, and explanations are confirmed in brain imaging (Binder et al 2005; Price 2012).

The knowledge instinct drives acquisition of cognitive ability and is a foundation of all our higher cognitive abilities. Its satisfaction is experienced as aesthetic emotions (experimentally confirmed in Cabanac et al 2010). The hierarchy of aesthetic emotions is discussed from understanding of everyday objects to understanding of representation-concepts near the top of the mental hierarchy. I discuss contents of these "highest" concepts and relate the corresponding aesthetic emotions to the beautiful. Experimental tests of this conjecture are for the near future.

Contradictions among knowledge are experienced as negative aesthetic emotions, cognitive dissonance. This mechanism counteracts the knowledge instinct and would prevent accumulation of knowledge and the entire human evolution, if not a special ability evolved for overcoming these emotions. It follows from the dual hierarchy model that this mechanism is music. This theoretical prediction has been experimentally confirmed (Masataka et al 2012, 2013). This explains the origin and evolution of music, what Darwin called the greatest mystery.