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The Primary Language of the Human Brain

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Abstract

This paper is written within the scope of investigation of the structure of the Primary Language of the human brain as introduced by J. von Neumann in 1957. This is the first paper with comprehensive introduction to our hypothesis that the Primary Language is the Language of Visual Streams (LVS) that empowers all the human symbolic languages and sciences. The LVS is based on multiple thought experiments, which manifest themselves via visual streams. We introduce various types of streams including the communication and internal streams as well as mundane and science streams. The communication streams include the expression and impression streams. The expression streams pass information from the internal streams to the outer world via converting it into the strings of symbols. The science streams may generate new knowledge because they include the discovery streams controlled by the Algorithm of Discovery (AD). The streams can run concurrently and exchange information between each other. The streams may initiate additional thought experiments, program them, and execute them in due course. The streams are focused employing several types of reasoning including proximity and mosaic reasoning. In this paper, we introduce a discovery program that consists of a series of thought experiments in a way that every experiment either builds new theme of visual streams or utilizes themes built previously.

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1. The Primary Language

In 1957, J. von Neumann[1] hypothesized existence of the Primary Language of the human brain. He suggested that the external language (including multiplicity of natural languages as well as mathematics and computer science) that we use in communicating with each other might be quite different from the internal language used for computation by the human brain. He argued that we are still unaware of the nature of the Primary Language for mental calculation. He writes, "It is only proper to realize that [human] language is largely an historical accident. The basic human languages are traditionally transmitted to us in various forms, but their very multiplicity proves that there is nothing absolute and necessary about them. Just as languages like Greek or Sanskrit are historical facts and not absolute logical necessities, it is only reasonable to assume that logics and mathematics are similarly historical, accidental forms of expression. They may have essential variants, i.e., they may exist in other forms than the ones to which we are accustomed. … The language here involved may well correspond to a short code in the sense described earlier, rather than to a complete code [in modern terms, he means high-level vs. low-level programming languages]: when we talk mathematics, we may be discussing a secondary language, built on the primary language truly used by the central nervous system." Over the last 60 years since J. von Neumann hypothesized existence of the Primary Language, the nature of this language has been unknown.

The existence of a singular primary language for internal computation by the human brain should be considered as yet another application of the principles of simplicity and reuse by the nature. This means that a successful solution found by the nature should spread over space and time. The major example of such solution is the spread of the universal DNA-based life over the history of the whole planet. Going further once developed as a result of evolution of human intelligence the Primary Language should have been used by all the human species, including our direct predecessors Homo Sapience as well as our past relatives such as Neanderthals and Denisovans. In addition, as was suggested by von Neumann, the Primary Language should have been reused as a singular universal foundation for the secondary (symbolic) languages and sciences. Moreover, the same components of the Primary Language that served humanity successfully over millennia before appearance of the secondary languages should have been reused as "semantic" components of those languages.

Extensive investigation of the mental visual streams (mental movies) [2-13], as a foundation of the algorithms essential for evolution of human intelligence and development of humanity led us to observe their powerful universal nature. We suggest that the Primary Language is the Language of Visual Streams (LVS). Following von Neumann, we call the LVS a language although it is not a language in mathematical sense, i.e., it is not a set of strings of symbols. The Primary Language is the engine with the ability to generate visual streams, focus them in desired direction, and reason about them. We will demonstrate that the LVS is the underlying foundation of all the human languages and sciences as it should have been according to J. von Neumann[1] .

2. Where those streams came from

Thought experiments allow us, by pure reflection, to draw conclusions about the laws of nature[14,15]. For example, Galileo before even starting dropping stones from the Tower in Pisa used pure imaginative reasoning to conclude that two bodies of different masses fall at the same speed. The Albert Einstein's thought experiments that inspired his ideas of the special and general relativity are known even better[16, 17]. The efficiency and the very possibility of thought experiments show that our mind incorporates animated models of the reality, e.g., laws of physics, mathematics, human activities, etc. Scientists managed to decode some of the human mental images by visualizing their traces on the cortex[14]. It was shown that when we imagine a shape "in the mind's eye," the activity in the visual areas of the brain sketches the contours of the imagined object; thus, mental images have the analogical nature. It appears that we simulate the laws of nature by physically reflecting the reality in our brain. The human species and even animals would have had difficulty to survive without even minimal "understanding" of the laws of environment. Over the course of evolution and during development of every organism, our nervous system learns to comprehend its environment, i.e., to "literally take it into ourselves" in the form of mental images, which is a small-scale reproduction of the laws of nature. Neuropsychologists discovered that "we carry within ourselves a universe of mental objects whose laws imitate those of physics and geometry,"[14]. We suggested that we also carry the laws of the major human relations including the laws of optimal warfighting[3]. The laws of nature and human relations