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## THE NEUROBIOLOGICAL INFRASTRUCTURE OF NATURAL COMPUTING: INTENTIONALITY

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Brains and computers are both dynamical systems that manipulate symbols, but they differ fundamentally in their architectures and operations. Human brains do mathematics; computers do not. Computers manipulate symbols that humans put into them without grounding them in what they represent. Human brains intentionally direct the body to make symbols, and they use the symbols to represent internal states. The symbols are outside the brain. Inside the brains, the construction is effected by spatiotemporal patterns of neural activity that are operators, not symbols. The operations include formation of sequences of neural activity patterns that we observe by their electrical signs. The process is by neurodynamics, not by logical rule-driven symbol manipulation. The aim of simulating human natural computing should be to simulate the operators. In its simplest form natural computing serves for communication of meaning. Neural operators implement non-symbolic communication of internal states by all mammals, including humans, through intentional actions. The neural operators that implement symbol formation must differ, but how is unknown, so we cannot yet simulate human natural computing. Here, I propose that symbol-making operators evolved from neural mechanisms of intentional action by modification of non-symbolic operators. Both kinds of operators can be investigated by their signs of neuroelectric activity. I propose that the postulated differences should be sought by classification of the spatial textures of the signs in EEG recorded from the scalp overlying those cortical structures unique to humans in the brain that I designate as koniocortex, while the subjects are engaged in elementary arithmetic operations.

**Keywords:** AM pattern; electrocorticogram ECoG; electroencephalogram EEG; koniocortex; neural operator; number; neurodynamics; symbol

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