Review of: "Semblions of Words — The Language of Natural and Artificial Neural Networks"

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Potential competing interests: No potential competing interests to declare.

This paper is an interesting contribution to understanding how words and even abstract concepts can be formed by so-called "semblions". In this model, similarity-based structures of metaphors may be an essential stage toward a successive convergence into higher-order categories and even formal languages.

Reading the paper was quite laborious for me, and I was asking myself for what kind of readership the paper was written. In the following, I will list some points that made reading the paper difficult for me.

Abstract

The term "multilayered architecture of brain fields" seems unclear here. What exactly is a "brain field"? Does "layer" refer to a neuroanatomical structure (e.g., the cell layers within the surface of the neocortex) or to an abstract structure in a black-box model of hierarchical processing?

1. Introduction:

The author's intent seems to target a model that is able to explain the emergence of superordinate concepts via similarity patterns up to abstract concepts, logical operations with such concepts, mathematical thinking, and the development of formal languages.

Overall, this introduction seems a bit vague to me. In particular, it seems unclear whether the author's intent is to further understand "neural structures" underlaying natural and formal languages or to build up a kind of black box model that can be used for both understanding human language and artificial languages.

As an example of the author's vagueness, I consider the statement "Animals communicate effectively in the language of gestures, facial expressions, smells, and inarticulate sounds that cannot be analyzed logically, and their grammar is certainly not formal." This statement about animals seems overgeneralizing to me. The sounds of animals can well be analyzed logically, and many biologists would not label them as "inarticulate". Biologically, the cognitive mechanisms may not be principally different between humans and other animals. So, the author's model of "semblions", in terms of cross-modal linked neuronal information units, may also apply to animals, even if they are not able to transform them into spoken words. (I notice that later in the article, this point is addressed again in a, for my understanding, more satisfactory way.)

2. Tools of the Embodied Mind

The concept of mirror neurons is interesting here, particularly in terms of Gallese, as "an automatic, unconscious, pre-reflective functional mechanism" or as an active simulation mechanism. Originally, the term "mirror neuron" was used to describe the results of an experiment in which single-cell recordings in animals showed similar electrophysiological activity in the case of both own motor behavior and observation of such behavior in other individuals. Actually, however, as mentioned by the author, the mirror system comprises a complex structure including instinctive mechanisms and simulation of mental states which may engage a variety of cortical and subcortical parts of the brain (e.g., the limbic system, the brain stem, and even the cerebellum). So, in my view, a kind of conclusion seems necessary here that relates the mirror system to the author's model of language via "semblions."

The author seems to seek a kind of universal mechanism leading from simple perception to abstract concepts and mathematical operations via similarity patterns that can be expressed by metaphors. On the other hand, he mentions "animal, primitive numerical competencies" that, obviously, do not require the development of metaphors. Thus, we seem to have two different functional systems in our brain, one for bottom-up embodied concept forming and one for mathematical operations. What seems to be missing here is a more detailed hypothesis on how these systems interact with each other in order to enable us to perform "real mathematics" and complex social communication.

When looking at the human brain, we see a largely modular structure in which a variety of mechanisms are working (electrophysiological activity, humoral activity, different neurotransmitters and corresponding membrane receptors, and a neuroanatomically-subdivided macroscopic structure of the brain with a long evolutionary history. Considering this biological structure, the author's imagination of neuronal "semblions" either seems somewhat simplistic, or the semblions, rather than representing bottom-up induced activation patterns within a neural network, are quite complex structures with various submodules.

Apart from such biological considerations, the author's "theory of metaphors" does seem plausible to me from a linguistic-philosophical perspective. On the one hand, it can account for a continuous process of concept building from sensation up to the development of more and more abstract lexical words and symbols. On the other hand, it can also explain the, maybe, 'black sides' of this process: The development of superstition, of (in terms of psychology) "false beliefs," by erroneously interpreting similarities, up to the emergence of complex esoteric models of thinking such as religions or astrology.

"Aspect": I think that many readers may be acquainted with the author's particular use of the word "aspect" that somehow seems to refer to the grammar of some languages.

3. Genesis of cognition

The second paragraph of this section seems a bit outdated to me, ignoring more than a decade of recent neuroscience and arguing with vague concepts such as "neural modeling fields," "the electric fields of signals." Established biological knowledge about basic synaptic processes that is more or less present in all animals is used here as a particular

explanation for similarity processing.

In the third paragraph, I did not understand the sentence " The essence of the conscious architecture model is the ephaptic, transverse couplings between the semblions through adjacent synaptic fields." It seems to me that the author is somehow projecting mental processes onto basic neuronal mechanisms. Of course, this is plausible, and for non-biologists it might be revolutionary in some way. However, in my view, such a consideration should be accomplished by more detailed functional neuroanatomical and neurophysiological findings.

The "instinct of understanding" and the relation of cognition to "eudaimonia" (in contrast to just hedonia) is an interesting point. However, again, the author's biological explanation in terms of "natural neural networks tend to complement the states of neuronal excitations and patterns embedded in memory in proteins …." seems unsatisfactory to me - a kind of pseudo- or quasi-scientific explanation without any essential specific details.

The concept of "Neural Modeling Fields" sounds somewhat scientific, but the explanation "Neural Modeling Fields (NMF) achieve the above-mentioned goal of state complementarity by directing and associating the appropriate excitatory signals with the corresponding synaptic fields, and through continuous associations to maximize the pattern match signal," is too vague to go beyond a hypothesized mechanism within a black box model.

When referring to connectivity between premotor and parietal cortex (citing Pulvermüller 2001), again, two decades in the Neurobiology of Language seem to be ignored, e.g., more recent work on perception-action loops, frontoparietal connectivity, and functional long-distance circuits in general.

4. Models of reality

This part of the paper seems to refer to the author's view of how we perceive reality and how "laws" of nature are derived. The author points out how our world view is formed by the semblions-based mechanism of viewing the world, particularly by the interaction of top-down with bottom-up processes, leading to the emergence of "laws" that are due to simplifications of the actual variability in the real world. Concerning the author's concept of "dynamic semblions", it might be interesting to consider the distinction between declarative and procedural memory systems within the brain. In my view, although the "semblion" has a good heuristic power for forming concepts and mental operations, it should not be overstretched. Additional mechanisms, such as cognitive automatization relying on cerebellar activity, should also be taken into account.

5. The language of artificial neural networks

Here the author gives an outlook on artificial intelligence and its relation to human cognition. Indeed, as concerns computation power and memory capacity, such multi-layer systems may outperform (and in some respects also do so today) humans. However, a basic difference should remain, that is, the biological instinct.

Summary and conclusions

This section, rather than providing a summary and a conclusion, the author, shortly, seems to point toward those aspects

that go beyond the content of the main part of the paper. So, "Summary and outlook" might be a better label here.