Semiotics of Potential Meanings

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Challenges to the main thesis of biosemiotics that "semiosis is coextensive with life"

1. Most biologists think that cell components (organelles, functional macromolecules) are not alive, but these components are essential for many semiotic functions of cells (e.g., molecular communication, transcription, translation).

-- Problem can be resolved by focusing on semiotic agency (a generalization of organism). Semiotic agents include organisms, subagents, multi-organism super-agents, and dependent agents (e.g., human autonomous artifacts)

2. Natural signs exist even if they are not observed by organisms. Examples: smoke is an index of fire, fossilized bone is an index of dinosaur

-- Problem can be resolved by considering *potential meanings* – those tat can be inferred by semiotic agents that are brought in contact with such natural signs.

Charles Peirce and John Deely assume no substantial difference between signs that are communicated and not communicated

Peirce considered sign relations actually existing even when signs are not communicated (CP 8.332).

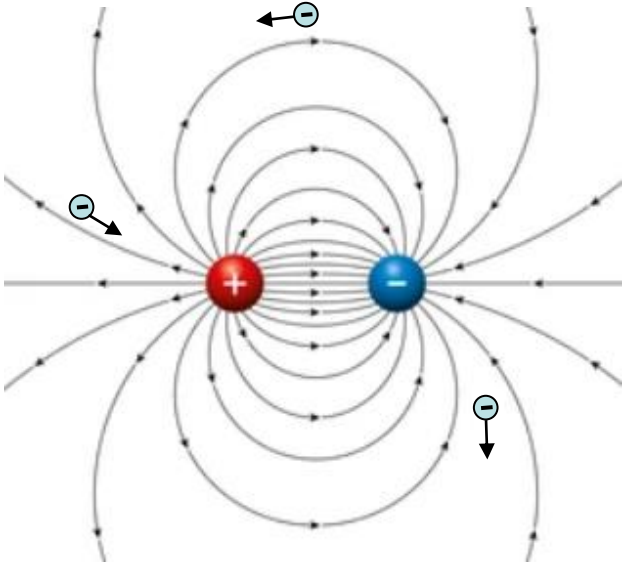
Deely assumed that signs represent “specificative causality” which is “extrinsic formal causality of the specificative or objective type” (1992 Semiotics and biosemiotics: Are sign-science and life-science coextensive? p. 56).

Aristotle’s notion of ‘form’ (in ‘formal causality’) can be understood as spatio-temporal relations by which substance is integrated. The ambiguity of this notion comes from the assumption that ‘form’ is independent from agency (as an observer and/or as maker).

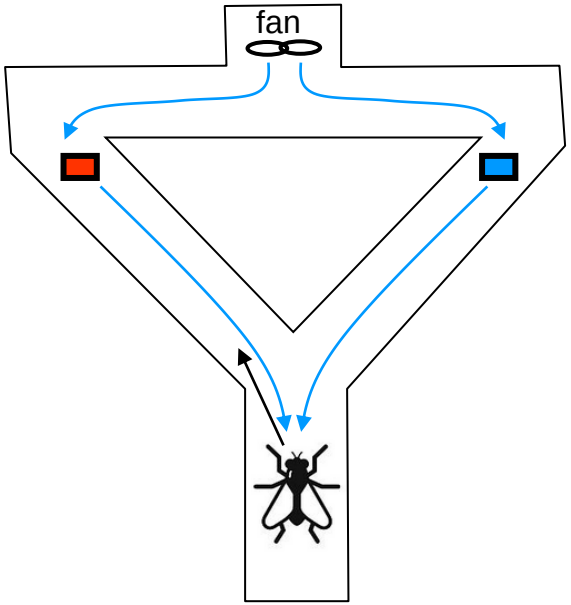
The notion of potential meaning helps to re-establish connection with agency. Rephrasing Bateson, potential meaning is a difference that potentially can make a difference for some agent.

Potential Meaning is a Semiotic Field

To measure electric field we place a charged object/particle and observe its movement



To measure semiotic field we place an organism in a maze and observe its response to a stimulus signal



Animal response may depend on such factors as species, sex, genotype, memory, and physiological state
Thus, physiologists prefer using a subagent: sense organ (antenna) with electrodes

Extrapolating Potential Meanings over Space and Time

We can consider potential meanings of things for an agent that exists somewhere else or is separated in time. Then, semiotic field can be tested by bringing the agent to the meaningful thing or making a synthetic copy of the agent (the latter option is currently available only for simple bacteria). If semiotic field cannot be measured directly, it can be predicted by reconstruction and modeling.

Extrapolating potential meanings in the past requires *retrospective re-evaluation of the past* based on the present knowledge. New knowledge acquired today changes our vision of what possibilities were available for agents in the past.

Example: now we know that the energy of each star comes from the thermonuclear fusion reaction. Thus, our judgement about stars that existed many billions years ago needs to be updated accordingly.

Two Examples of Potential Meaning:

- A natural resource (or its specific feature, e.g. being a catalyst or a source of carbon) that existed before the origin of life could have supported the origin and/or early evolution of primordial agents
- Memory - an artificial entity constructed by an organism for the purpose of transferring its adaptation (affordance) to its future state or future generations. Memory signs are passive and silent (it would be a disaster if they were all active). Thus, the content of memory can be retrieved only after ‘activation’ of memory signs

Example 1. Natural Resource as Potential Meaning

Natural resource is meaningful for organisms if it is either consciously recognized as such (as part of Umwelt) or at least non-consciously utilized in life processes at the level of metabolism. In the latter case, meaningfulness is manifested by molecular-level adaptations targeted at consumption, binding, storing, or catalytic transformation of the resource.

Resources that are not yet utilized by organisms are then – potential meanings. They become actual meanings when they are recognized and utilized by organisms that either come from other places or by native organisms that increased their affordances via semiogenesis (evolution or learning).

Before the origin of life there were no organisms, but we still can evaluate availability of natural resources at that time based on our reconstruction of hypothetical primordial agents.

John Deely on Accumulation of Resources as a Necessary Step towards the Origin of Life

“Out of cosmic dust, stellar systems form through subatomic, atomic, and molecular interactions. At various stages of the process, even as now on earth we can in laboratories bring into being a few elements not existent in nature itself, new elements not previously given in nature precipitate from the natural interactions. These new elements, in turn, prove essential to the formation in planetary systems of the conditions under which living beings become possible [...]”

Deely, J. (**1992** “Semiotics and biosemiotics: Are sign-science and life-science coextensive?”, p. 61)

“Those intermittent gradual steps whereby a virtual semiosis latent in the purely physical interactions of the components of the universe moved the universe here and there closer and closer to the possibility of life I might compare to the repeated unsuccessful attempts of a smoker to light his cigarette.”

Deely, J. (**2014** “Semiotic entanglement: The concepts of environment, Umwelt, and Lebenswelt in semiotic perspective”, p. 38)

John Deely's Concept of Virtual Semiosis

- Increase of complexity is not limited to the world of living organisms; it also happens in non-living evolving systems
- This process of production, retention, and amplification of new forms is based on purely physical interactions (physiosemiosis or virtual semiosis)
- Accumulation of new components increases the chances of the origin of life

Concept of Potential Meaning

- There is no physiosemiosis or virtual semiosis. However, physico-chemical self-organization can inadvertently produce more complex local environments enriched with non-redundant resources (potential meanings)
- We can imagine bringing living organisms into the world before the origin of life and evaluate its habitability by "counting" co-occurring non-redundant resources
- Potential meanings should be evaluated in relation to hypothetical primordial systems that initiated evolution towards life as we know it

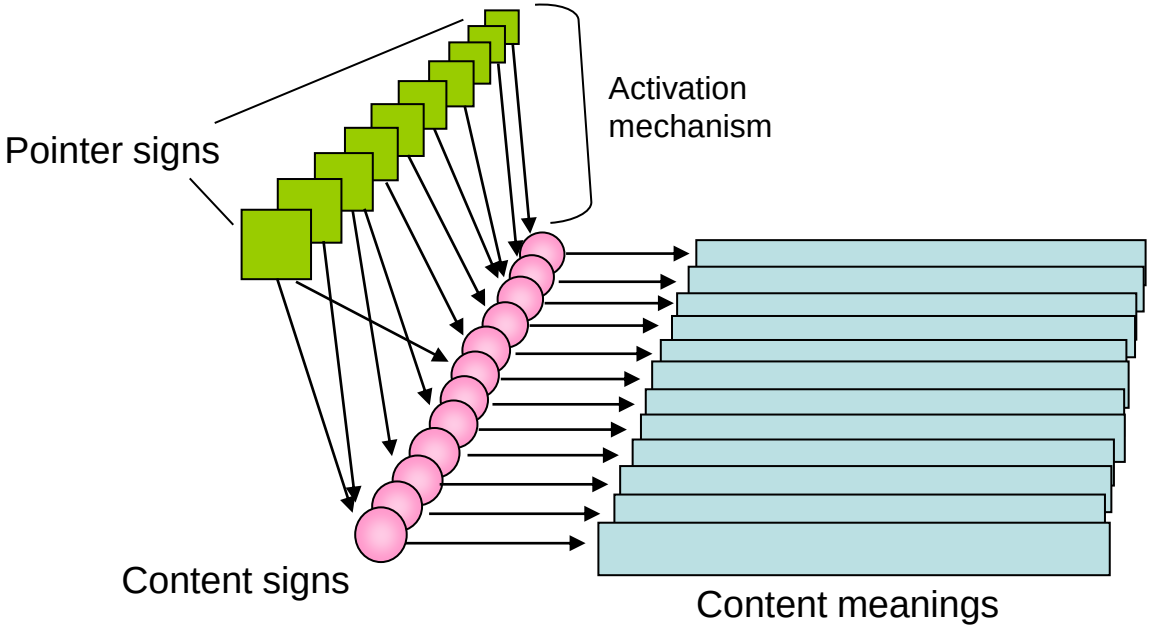
Actualization of Already Existing Potential Meanings after the Origin of Life

Emergence of living organisms and their evolution led to actualization of some already existing potential meanings, and these actualized natural meanings together with new artificial meanings became encoded by organisms in hereditary signs (i.e., memory) for the purpose of reusing them when necessary within the lifespan and beyond - in the progeny.

Once actualized, meanings tend to spread among semiotic agents via interaction or communication and further evolve at longer time scales.

Example 2. Memory as a Repository of Potential Meaning

Memory is a collection of passive content signs (with potential meaning) accumulated by semiotic agency for the purpose of reusing them in the future when necessary. Thus, memory needs “activation mechanism” that activates content signs, which then initiate content meanings (e.g., activities).



Memory Systems of Various Complexity Levels

Prokaryote genome (low complexity): content signs are operons; each operon is a coregulated cluster of genes that together perform a certain function. Activation mechanism is binding of RNA polymerase and transcription factors to promoter. Functions mostly as “read only”.

Eukaryote genome (medium complexity): content signs are individual genes. Activation mechanism includes a hierarchy of regulators: epigenetic mechanisms control chromatin condensation (accessibility); transcription factors bind to promoters and enhancers; enhancers become selectively connected to promoters making chromatin loops. Chromatin structure serves as an additional layer of memory that is both readable and writable.

Neural memory (high complexity): spatially-distributed networks of neurons capable of fast auto-tuning and learning. Content signs are meaningful patterns of neural activity that are activated by complex patterns of sensorial input which are recognized as objects via perception and categorization.

Conclusions

- Potential meanings are those that are not interpreted/used by semiotic agents but can be interpreted by certain agents
- Potentiality in physics is conceptualized as a field; similarly, potential meaning is a semiotic field measured by a semiotic agent (or subagent)
- An example of potential meaning is natural resource that initially has not been utilized by organisms. Accumulation of such potential resources was a necessary step towards the origin of life (following Deely)
- Memory in organisms is a repository of potential meanings (i.e., passive sigs that can be activated) that enables organisms to adapt on demand by selective activation of such potential meanings.