

Barbieri, M. (2014). From biosemiotics to code biology. *Biological Theory*, 9 (2), 239-249.

In biosemiotics, all forms of life are seen as communicating via signs (icons, indexes, and symbols). Barbieri takes issue with this position. He contends that, at the level of cells, communication is done via codes (organic codes) that are essentially mechanisms which can be described, tested, and demonstrated via mechanistic models. Since signs require interpretation, he argues that they cannot be studied scientifically. The biological mechanism involving codes can be described by models that Barbieri sees as equivalent to hypotheses in scientific reasoning. Barbieri believes that a sign perspective on cellular communication that takes on non-mechanistic, qualitative approach will "prevent [biosemiotics] from growing into a true science" (242), because a scientific approach to the problem of organic meaning requires that meaning is generated by coding, not interpretation.

Barbieri defines a code as: "a small set of arbitrary rules selected from a potentially unlimited number in order to ensure a specific correspondence between two independent worlds" (242). He notes that codes representing a fixed set of rules between entities characterize many aspects of cellular biology; the genetic code, signal transition codes (between first and second messengers), adhesive codes, splicing codes, sugar code, histone code, and compartment codes. Barbieri seems to restrict code-bearing-meaning (organic codes) to single cells. He notes that single cells do not "build internal representations of the world and therefore cannot interpret them" (245). He restricts representation to multicellular organisms.

Barbieri suggests that when animals evolved nervous systems, they developed neural codes for mental images subserving "feelings, sensations, perceptions" (7), high level states likely involving several different neural codes. He suggests that organic codes and neural codes in animals all stem from "a virtually original code" (7). But animal nervous systems were not solely based on hardwired codes that consist of fixed rules. "Some animals evolved the ability to *interpret* what goes on

in the world around them and this skill is a true evolutionary novelty, something that is not reducible to coding" (245).

With the ability to interpret, organisms could glean meaning/significance based on current context, the memory of past experience, and learning. From this limited information (called abduction) signs could be interpreted on the basis of identity and association "with results that may not be perfect but are good enough for the purpose of survival" (245).

These abilities seem to represent a divide between code semiosis in single cells and sign-based symbiosis of animals. Barbieri doesn't mention plants. He suggests three types of symbiosis: organic, animal, and human semiosis "based on coding, interpretation and language" (246). (It's not clear to me why he does not include signs in his characterization of human semiosis. Mentioning codes may be justified because there may be some conservation of animal codes that now operate in human life.

Barbieri's focus on code biology seems to be most relevant to single cells. My knowledge of biology is in the area of neuroanatomy. Therefore, I can't evaluate his claims about the role of codes at the cellular level. So, I currently do not have a basis to reject his proposal that at the organic level, codes prevail.

Barbieri argues that "a sign... Is always linked to a *meaning*... Sign and meaning... cannot be taken apart because they are two sides of the same coin... it is the study of signs and meanings together... a world of entities that we call *signs*, and a world of entities that represent their *meanings*" (244). This sounds very close to his characterization of codes. "A code... Is a set of rules that establish a correspondence between the objects of two independent worlds" (244). He argues that the code is the meaning of the object. It seems to me that the issue in (human) semiotics is not the correspondence between signs and meaning because the association is not automatic as it is between a code and its object. The issue in semiotics is the interpretant. There is no fixed relation between a sign and meaning. The meaning is assigned by, imputed by, interpreted by an interpretant. At the symbolic level, the sign is not the meaning of the object; meaning is the interpretation of the object. Different interpreters may make different interpretations, and the same interpreter may make different interpretations of a sign in different contexts.

This seems to be particularly important when a sign (e.g. a word) refers to a nonphysical symbolic concept such as "democracy," "emotion," "motivation," "aim," "duty," "collusion," "patriotism," "science," "interpretation," "code". The codes that Barbieri refers to are all related to physical objects and processes. So, code semiotics is in a different world from sign/symbol semiotics where a particular interpretation can never be guaranteed. Therefore, I see Barbieri as restricting his code to the physical world where science seems to work best and where interpretation does not play a role. His argument seems to support the notion that the social sciences cannot be studied scientifically because interpretation is central to them. Thus, care should be taken not to attempt to scientize these fields.

What we want to understand is how life came out of nonlife (Deacon 1997, 2012), how codes came out of life, how signs developed out of or in addition to codes, and how signs (icons and indexes) in animals led to full-blown symbolic reference in humans. Now since icons, indexes, and symbols all involve interpretation, and following Barbieri, interpretation precludes a scientific approach, it would appear that humanity must turn from sciences to its other sources of knowledge (the arts, the humanities, and the social sciences) which all require interpretation. Barbieri's position is that biosemiotics can only be scientific if it sticks to the code systems of cellular processes and avoids the interpretation that is required by sign reference. Thus, semiotics would be unscientific, particularly at the symbolic level. If this is true, then semiotics has very little use for science in general and for biology beyond the cellular level. It would appear that science is only applicable to a very narrow band of knowledge. I find this implication (i.e., interpretation) from Barbieri's work very satisfying. Science certainly holds an extremely important place as a source of knowledge, but extending it beyond its boundaries is mere scientism. Interpretation is the cornerstone of semiosis. We should render unto science that which is scientific; to extend science beyond its legitimate domain is an epistemological distortion.

Barbieri notes that "most biosemioticians acknowledged that what we find in a single cell is only coding and decoding, but maintained that cells are nevertheless capable of interpretation because we can define decoding as a form of interpretation" (246).

Humans live in a world composed of several spheres: the nanosphere (the subatomic world), the physiosphere (the inorganic physical world), the biosphere (the organic world of living beings, life), and the symbolosphere (the symbolic world that includes nonphysical entities). With life came organisms with aims and purposes (Sherman, 2017). When human organisms became capable of symbolic reference (Deacon, 1997), they could create nonphysical, nonmaterial nonlife in the form of ideas, ideologies, idealization, concepts, conceptualizations, unreal worlds, fiction etc. Science, as traditionally conceived, seems to have difficulty with both ends of the continuum: the nanosphere, and the symbolosphere. This may be because science developed to explain the physiosphere, and we might say it has done brilliantly. Biosemiotics studies both the biosphere and the symbolosphere, and this involves both physical and nonphysical domains. Some aspects of the biosphere are compatible with the tenets of science and the scientific method and others are not. Barbieri places his focus on signaling in single cell organisms where he is thoroughly in the physical world. Brier (2015) believes that biosemiotics should be a *wissenschaft* and not just a science. It should include the social sciences and the humanities. It should "encompass natural, life, technical, social and human sciences" (4). This is very different from what Barbieri would like. Apparently, he would limit biosemiotics to physical life as manifest in single cell organisms. And that way, it could be a true science, and excluded all of the social sciences and humanities. Barbieri would see C. S. Peirce's sign theory as unscientific.

But we could ask whether it's necessary to be bound by the nonphysical symbolic concept, "science". There is no Archimedean point outside the universe that defines science. And if a field of inquiry involves the interpretation of subjective experience and signs to assess meaning, it may be outside the domain of science, the scientific method, the isolation of variables, and laboratory experimentation. In Brier's view, Barbieri's position means there are no qualitative sciences. But should we worry that there are no qualitative sciences? If we have first rate qualitative scholarship, research, *wissenschaft*, inquiry etc. that takes us beyond the limited purview of science, then we always have another invaluable source of knowledge – interpretation. If we cease to interpret, impute, conceptualize,

stipulate, hypothesize, speculate, and suggest, we'll have lost a normal source of human knowing. If our work is not "science", it is because the domain of science is too limited to allow us to use the full range of our ability to produce knowledge and understanding of the world. At the same time, it also cuts us off from the sources of knowledge that are generated by imagination, creativity and inspiration that come from the arts and the humanities.

From my own perspective the tenets of science (as seen by Barbieri) leave it no access to the nonmaterial aspects of human existence that come from our capacity for symbolic reference and language. The symbolosphere with its augmentation by all types of media comprises an enormous segment of the human world. The author and semiotician, Walker Percy (see the discussion of Percy in this collection) notes that the tenets of science do not allow it to step outside of itself and examine how science articulates symbolic concepts. The mechanistic models that Barbieri advocates are symbolic maps; they are not the phenomena the scientists are studying. It may be up to scholars of the semiosphere to help scientists understand the non-physical nature of their mechanistic symbolic models. Scientists are members of the symbolic species; their models are sign systems that sometimes yield real facts about the world, but their mechanisms are products of their symbolic abilities the study of which are outside the scientists' purview. They need help, and that can come from the qualitative- interpretive work of semioticians.

Biosemiotics engages both the physical world and the nonphysical semiotic world, but when we get into the deep symbolic world (nonphysical abstract symbolic concepts), the relevance of the underlying physical biology and typical scientific methods become less relevant.

References

Brier, S. (2015). Can biosemiotics be a "science" if its purpose is to be a bridge between the natural, social and human sciences? *Progress in Biophysics and Molecular Biology*, ,