

Group Discussions in Biosemiotics

2011

Discussion of the paper

Origin and Evolution of the Brain

(DOI 10.1007/s12304-011-9125-1)

1

----- Original Message -----

From: [Marcello Barbieri](#)

To: [Alexei Sharov](#) ; [Almo Farina](#) ; [Anton Markos](#) ; [Argyris Arnellos](#) ; [Bruce Weber](#) ; [Catherine Cotton](#) ; [Charbel El-Hani](#) ; [Claus Emmeche](#) ; [Cliff Joslyn](#) ; [Daniel Mayer](#) ; [Dario Martinelli](#) ; [Don Favareau](#) ; [E liseo Fernandez](#) ; [Franco Giorgi](#) ; [Frederik Stjernfelt](#) ; [Gerald Ostdiek](#) ; [G rard Battail](#) ; [Guenther Witzany](#) ; [Hanyang Chang](#) ; [Howard Pattee](#) ; [Jannie Hofmeyr](#) ; [Jesper Hoffmeyer](#) ; [Joachim De Beule](#) ; [Joanna Raczaszek-Leonardi](#) ; [Jo o Carlos Major](#) ; [John Collier](#) ; [John Deely](#) ; [Kalevi Kull](#) ; [Karel Kleisner](#) ; [Liz Stillwaggon Swan](#) ; [Louis Goldberg](#) ; [Luis Emilio Bruni](#) ; [Marcel Danesi](#) ; [Marcello Barbieri](#) ; [Morten T nnessen](#) ; [Myrdene Anderson](#) ; [Natalia Abieva](#) ; [Paul Cogley](#) ; [Peter Harries-Jones](#) ; [Peter Wills](#) ; [Prisca Augustyn](#) ; [Sergey Chebanov](#) ; [S ren Brier](#) ; [Stanley Salthe](#) ; [Stefan Artmann](#) ; [Stephen J. Cowley](#) ; [Stephen Pain](#) ; [Terrence Deacon](#) ; [Timo Maran](#) ; [Victoria Alexander](#) ; [Vinicius Romanini](#) ; [Wendy Wheeler](#) ; [Winfried N th](#) ; [Yagmur Denizhan](#)

Sent: Wednesday, March 02, 2011 3:10 PM

Subject: A new paper for discussion

Dear Colleagues,

Please find in attachment a paper on the origin and evolution of the brain in the framework of the organic codes. I know that many of you do not accept this frame, but I hope that you find the arguments interesting anyway. The paper is a bit too long, but I had to deal with many points (coding, interpretation, first-person experiences, mind, Peirce, etc.) in order to give a realistic idea of Code biosemiotics.

I wanted to put my cards on the table, so to speak, and I hope that they are clear enough.

As in previous occasions, all comments that I receive from you will be taken into account in preparing the final version of the paper, so I wish to thank you in advance for them.

I look forward to a good discussion, many thanks.

All the best

Marcello

2

----- Original Message -----

From: "Kalevi Kull" <kalevi.kull@ut.ee>

To: "Marcello Barbieri" <brr@unife.it>

Cc: MAILING LIST

Sent: Wednesday, March 02, 2011 4:31 PM

Subject: Re: A new paper for discussion

Dear Marcello,

thank you very much for this interesting reading. The distinctions you are describing are certainly important to thoroughly think about.

Here, a point that is not very clear from the text.

You write, e.g.:

"The brain as we know it, in short, came into existence when the primitive brain split into instinctive brain and cybernetic brain, and these started producing the feelings and sensations that make up the primary modelling system of all animals."

In most cases in the text you seem to mean under the brain the vertebrate brain.

Majority of organisms who have brain are, of course, arthropods.

Is it so that you are speaking here ("the brain as we know it") about the vertebrate brain, and under primitive brain you mean the brains of invertebrates? You then seem to state that insects have no feelings nor instincts nor mind - if so, it would be good to make this explicit, in order to avoid misunderstanding.

And, or - do you mean here that the primary modelling system is a criterial feature of all animals in the sense of kingdom Animalia, or, in some other sense?

It seems to me quite obvious that major macroevolutionary steps - in the sense of appearance of new levels of organisation - can be connected with new types of codes.

This is also that you state about the origin of the vertebrate brain. Since the latter is the central point in your paper - it would be helpful for a reader to find a brief explicit description (just in order to grasp what you mean) of this code both in the conclusion and in the abstract.

With all best wishes, and thank you again,

Kalevi

3

----- Original Message -----

From: "Marcello Barbieri" <brr@unife.it>

To: "Kalevi Kull" <kalevi.kull@ut.ee>

Cc: MAILING LIST

Sent: Wednesday, March 02, 2011 5:31 PM

Subject: Re: A new paper for discussion

Dear Kalevi,

Many thanks for your questions.

(1) About the "brain as we know it" The brain as we know it is the brain "with feelings and instincts", and it is present in ALL animals, vertebrate and invertebrates. More precisely it is present in all triploblastic animals (I am not sure about monoblasts and diploblasts). The primary modelling system receives signals from all sense organs and produces models of the external world (Umwelt) and of the internal body (Innenwelt), so, again, all triploblastic animal (all bilateria) have this primary system.

(2) The split between vertebrates and invertebrates concerns not the primary but the secondary modelling system, the system that is capable of 'interpretation' (the 'interpretive' brain). Insects, in other words, have instincts and feelings, but little or no interpretative ability. This distinction however is not absolute. It comes from the fact that invertebrates have adopted a streamlining strategy, and vertebrates an exploring one. Which means that the interpretive brain (the secondary modelling system) is rudimentary in invertebrates, and its evolution really took off only in vertebrates.

I will try to make this point more clear in the final version of the paper.

Many thanks again for your comments. Very helpful! Best

Marcello

4

----- Original Message -----

From: [Marcello Barbieri](#)**To:** MAILING LIST**Sent:** Wednesday, March 23, 2011 10:51 AM**Subject:** Computers, coding and semiosis

Dear Kalevi,

I have received various emails from people who tell me that you keep repeating in public that “coding is NOT semiosis because codes exist in computers but these are not semiotic systems.”

They invariably end by saying “Do you think that he has a point there?”

Yesterday I have received the last of these emails, so I have decided to send the following collective reply.

“A semiotic system is a system that contains an “internal” codemaker, and from this it follows that a computer is NOT a semiotic system, whereas the cell is (the codemaker of the genetic code is an internal component of the cell).

At the same time, coding IS semiosis, because semiosis is, by definition, the production of signs and coding is always a correspondence between signs and meanings.

It is true therefore that a computer is not a semiotic system, but semiosis does go on in it because the codes of the computers come from a human codemaker. What goes on in the computer, in other words, is human semiosis transformed into automatic operations and performed by a machine.

What goes on in a cell is a correspondence between signs and meanings performed by the cell itself, not by an external codemaker, so it is a genuine production of signs, i.e., a genuine semiosis”.

The purpose of this letter is not to make you change your mind (I know that you will NOT do that), but to ask you a favour: when you mention the computer as an example that coding is not semiosis, PLEASE add that the computer does NOT have an internal codemaker whereas the cell does.

Thank you if you do.

Best

Marcello

5

----- Original Message -----

From: [Alexei Sharov](#)**To:** MAILING LIST**Sent:** Wednesday, March 23, 2011 2:52 PM**Subject:** Re: Computers, coding and semiosis

Dear Marcello and Kalevi,

We definitely need to develop a unified terminology in biosemiotics.

Marcello wrote: "A semiotic system is a system that contains an “internal” codemaker"

And "codemaker" is a machine that converts codes (e.g., coding DNA) into meanings (e.g., proteins), a ribosome as a major example.

According to Marcello, computer has no internal codemaker. Obviously, computers are not equipped with ribosomes. But they have other devices that convert codes into something entirely different (e.g., images on the screen). If proteins are "meanings" then why images on the screen are not "meanings"?

I have not seen a definition of "meaning" in Marcello's writings (may be he can help to find it?).

He may say that proteins are meanings because they have certain functions within the cell, whereas images on the screen have no function.

To remove this difference, let us equip our computer with a digital camera that captures the screen (and may be beyond the screen). Now we have a feedback, so that images on the screen affect computer processing.

Is this a semiotic system? Because we do not have a formal terminology we can continue bending the meaning of our terms. For example, we can say that images on the screen are not meanings because they do not affect the survival (and reproduction) of the computer.

Here we get into the domain of pragmatics, the area which Marcello tries to avoid.

My point is that there is nothing special in a ribosome that cannot be handled by a computer.

So the purpose of this letter is not to make Marcello change his mind (I know that he will NOT do that), but to ask him a favor: PLEASE, define your terms. "Copymakers" and "codemakers" are meaningless terms unless they are linked to the pragmatics of agents.

Converting one class of things into another class of things is not coding yet. It is coding only if it contributes to the functions of some agents (no matter natural or artificial).

And keep in mind that artificial agents may include "synthetic life".

-Alexei

6

----- Original Message -----

From: [Stanley N Salthe](#)

To: [Marcello Barbieri](#)

Cc: [MAILING LIST](#)

Sent: Wednesday, March 23, 2011 3:37 PM

Subject: Re: Computers, coding and semiosis

As a hierarchy theorist, I suggest that computers are not individuals at all. They are parts of a highly mechanized social system, and from this point of view they are parts of a semiotic system.

It would be the cell that is a semiotic system, not, e.g., the ribosome.

STAN

7

----- Original Message -----

From: [Vinicius Romanini](#)

To: [Stanley N Salthe](#)

Cc: [MAILING LIST](#)

Sent: Wednesday, March 23, 2011 4:11 PM

Subject: Re: Computers, coding and semiosis

This is a very good warm up for the upcoming gathering in NY!

As a Peircean, I would say that semiosis (as the subject matter of semiotics) should always be defined logically, that is, as a triadic relation among dynamic object, sign and interpretant - and never as dependent of concepts such as living or non-living, natural or artificial, material or mental etc.

Following this line of thought, a computer can participate in semiosis as much as anything else, such as pencils, blackboards or pieces of chalk. But also can cells, ribosomes, organisms and whole species.

Semiosis, as the action of signs, is producing the Umwelt of a species as much as the information of a genetic code.

That means that we are much more in signs than signs are in us.

At least that's how I see it...

best,

Vinicius

8

----- Original Message -----

From: [Liz Swan](#)**To:** [Marcello Barbieri](#)**Cc:** MAILING LIST**Sent:** Wednesday, March 23, 2011 4:38 PM**Subject:** Re: Computers, coding and semiosis

I think this is the key point:

"What goes on in the computer, in other words, is human semiosis transformed into automatic operations and performed by a machine." (Barbieri)

because it entails that a computer alone could never be a semiotic system (i.e., the computer's processing has no meaning for it); only a human using a computer who can interpret meaning in the images and text on the computer screen can instantiate a semiotic system as I see it.

Liz

9

----- Original Message -----

From: [Angelo Recchia Luciani](#)**To:** brr@unife.it**Cc:** MAILING LIST**Sent:** Wednesday, March 23, 2011 6:08 PM**Subject:** Re: Computers, coding and semiosis

Examining Shannon's theory of information, Heinz von Foerster (1980, p. 20-21) writes

"...when we look more closely at these theories, it becomes transparently clear that they are not really concerned with information but rather with signals and the reliable transmission of signals over unreliable channels..."

Computers work on electrical signals; they work on the results of transduction processes and *human* modeling processes, producing as a result electrical signals which must be transduced to build 'pictures' whose meaning attribution is a task performed by the observer.

"A crucial point is that information, unlike matter and energy, is a function of the observer. [von Foerster, 1974] For example, the same message may have different meanings for different people" (Umpleby 2007)

"Notions such as coding and transmission of information do not enter in the realization of a concrete autopoietic system because they do not refer to actual processes in it. (...) The notion of coding is a cognitive notion which represents the interactions of the observer, not a phenomenon operative in the observed domain." (Maturana and Varela 1980 p. 90, first published 1973).

Nonetheless, the notion of coding is a *cognitive notion* which we - as observer - can use to make a *description* of phenomena in autopoietic system.

Maturana, Humberto R. and Varela, Francisco J. (1980): Autopoiesis and Cognition. The Realization of the Living, Reidel Publishing Company, Dordrecht. (the book contains 's *Biology of Cognition* first published by H. Maturana in 1970 and Maturana's and Varela's *Autopoiesis. The Organization of the Living* first published by Humberto R. and Varela, Francisco J in 1973).

von Foerster, Heinz On Constructing a Reality. In: Environmental Design Research, Vol. 2, F. E. Preiser (Hg.), Dowden, Hutchinson & Ross, Stroudberg, pp. 35-46, 1973.

von Foerster, Heinz (1980) Epistemology of Communication. In: The Myths of Information: Technology and Postindustrial Culture, Kathleen Woodward (Hg.), Coda Press, Madison, pp. 18-27.

Umpleby Stuart A., Physical Relationships Among Matter, Energy and Information, Systems Research and Behavioral Science Vol. 24, No. 3, 2007, pp. 369-372.

10

----- Original Message -----

From: "Joachim De Beule" <joachim@arti.vub.ac.be>To: "Alexei Sharov" <sharoval@mail.nih.gov>

Cc: MAILING LIST

Sent: Wednesday, March 23, 2011 7:07 PM

Subject: Re: Computers, coding and semiosis

Dear All,

I have two questions, mainly aimed at Kalevi, but any comments are welcome.

1) What would it take to make a computer a semiotic system? It has been suggested that a camera is added so that it can perceive its surroundings. What if also 'arms' are added so that it can manipulate its surroundings? What if wheels or legs are added so that it can move? What if it can operate a power plant so that it can produce the energy that it requires to operate? And so forth... My question is: when does semiosis begin here?

2) We all agree (I presume) that a cat, being a higher form of life, performs semiosis. Now assume that we put a cat in a space suit and drop it at Mars. When does it stop performing semiosis? Surely when it dies. But what about the time when it was just using up its oxygen? Is there a real difference between a cat in a space suit on Mars using up its available oxygen and a flash light on Mars using up its battery power? My question is: is semiosis an absolute concept (it is or it is not) or something that depends on the circumstances, that is, the environment?

Let me state clear that whatever the answer to these questions, I think that it makes a very good starting point to define e.g. gene translation, that is code usage that is linked to metabolism (the householding of matter, energy and information), as semiosis: it involves an arbitrary code of which the application is crucial for the property of being alive.

Best, Joachim.

11

----- Original Message -----

From: [Alexei Sharov](#)To: [Joachim De Beule](#)

Cc: MAILING LIST

Sent: Wednesday, March 23, 2011 8:38 PM

Subject: Re: Computers, coding and semiosis

Dear Joachim,

Here is my attempt to answer your questions:

1) What would it take to make a computer a semiotic system? ... when does semiosis begin here?

Semiosis is not a "yes-no" quality but rather a quantity, measured by "depth" and time frame.

Computers perform some semiotic functions even without elaborate external devices but this is "induced" semiosis that comes from human users who define goals and methods (see the comment from Stan Salthe). Similarly, ribosomes perform induced semiotic functions in the cell. Computers have a very narrow range of "freedom" (e.g., in memory allocation, preference of message processing, etc.) however they are unable (so far) to learn how to perform their tasks better.

Computers are not autopoietic systems because they do not carry information and tools for self-repair and self-reproduction. If we make an autopoietic computer with learning abilities, then the depth of its semiosis will dramatically increase.

Treating induced semiosis as non-semiosis is not a good idea because all agents including organisms are heavily programmed (e.g., humans are pre-programmed genetically, behaviourally, and socially), and thus, induced semiosis is a very common thing.

2) *We all agree (I presume) that a cat, being a higher form of life, performs semiosis.... My question is: is semiosis an absolute concept (it is or it is not) or something that depends on the circumstances, that is, the environment?*

You try to define semiosis in terms of a single agent, but this approach is not sufficient. Single agents can do induced semiosis (as your cat breathing on Mars), in addition they can do some learning in the new environment. But all agents are made by other agents, and agents persist only via continuous agent production. Production of agents require much more depth of semiosis. Thus we should think not in terms of isolated agents but in terms of lineages of self-producing agents and populations of communicating agents. Without self-sustainable autopoietic agents semiosis has a short life.
-Alexei

12

----- Original Message -----

From: [Howard Pattee](#)

To: [Alexei Sharov](#) ; [Joachim De Beule](#)

Cc: MAILING LIST

Sent: Wednesday, March 23, 2011 10:05 PM

Subject: Re: Computers, coding and semiosis

I think Biosemiotics needs a dose of [Nominalism](#). If we want to converse with other scientists, we should stick with conventional (dictionary) meanings of words. Marcello says, “semiosis is, by definition, the production of signs and coding is always a correspondence between signs and meanings.”

That is one definition. Peirce said somewhere that semiotics is the study of “characters of all signs used by...an intelligence capable of learning by experience.”

Computers are now very good at learning by experience.

The conventional meanings of “code” are briefly (1) a set of coherent rules of behaviour, and (2) a mapping between two sets of symbols.

A code of rules usually implies an interpretation or meaning, but a code mapping between sets does not. The genetic code mapping has no more meaning than the ASCII code in a computer. Both are pure syntax.

I see a problem in defining semiotics as an exclusive subject. Must semiotic study always include syntax, semantics and pragmatics? For example, what is the problem if we allow the study of Shannon communication theory to be a branch of semiotics?

Shouldn't communication with computers (programming code) be a branch of semiotics?

Howard

13

----- Original Message -----

From: [Peter Wills](#)**To:** [Marcello Barbieri](#)**Cc:** [MAILING LIST](#)**Sent:** Thursday, March 24, 2011 5:08 AM**Subject:** Semiotics, organic codes and computers

Dear Marcello,

I will continue my conversation with you about organic codes and, simultaneously, the discussion about semiotics. I'll start with Howard's definition: semiosis is the production of signs. A sign is ordinarily expressed in symbols (from a limited set, the alphabet) and there must be a world of possibilities within which it signifies something. In the Shannon definition information consists of a specified pattern of symbols (an ordered sequence being the simplest example).

A code is an easily specifiable set of rules for mapping one lot of information onto another (Howard's second definition of code). The alphabets do not have to be different (cyphers often use the same alphabet), but may be (as in the case of the genetic code, nucleotide triplets and amino acids). The reason I say "easily specifiable" is that you can devise an algorithm to map any body of information 1:1 onto any other body of information and you may be able to see regularities in the algorithm that you are prepared to say are general enough rules to make up a "code" (as in Howard's first definition). But for two unrelated bodies of information the complexity of the algorithm (the mapping) will usually be about as large as the information content of the larger body of information (unless you are prepared to lose a lot of information in the process). So a code is a mapping of very low complexity and is normally expressible, for sequences (1D patterns) as a symbol-to-symbol mapping. Yes, the code is pure syntax.

The aspect of semantics that has always interested me is that the meaning of a word is defined by using other words and there is no way (that I know of) of writing a dictionary such that you start with some primitive words and bootstrap everything from there. Nevertheless, the specificity of words' meanings is maintained in a kind of stable fluid network, in spite of ambiguity, vagueness and partial redundancy. The relationships between the words of a language, between these objects are comprised of symbols, is formed by a network that cannot be expressed in an algorithm of complexity significantly less than the complexity of the network itself. That to me is the hallmark of a semiotic system or "language". It is an irreducibly complex network of relationships between objects made of symbols that provides a system for mapping information in one world (lists of symbols such as "I see the cat on the mat") onto information in another world (the pixelated image on my retina). In terms of the complexity of the mapping, a language is at the other end of the spectrum from a code.

The other feature of a semiotic system is that the network of relationships between the primitive symbolic objects (words) is far from a random conglomeration. Although the network is extremely complex, the relationships between objects (elementary signs) are extremely specific, allowing a huge amount of information about the second world to be expressed in just a few symbols in the first world. The network of relationships in the semiotic system forms an implicit context which allows a huge proportion of the information content of the second world to be ignored so that something can be represented with just a few first-world symbols (a short sentence) within an assumed context (which is information rich). [And of course, in building up the semiotic system differences in only some of the degrees of freedom end up being symbolically represented – not everything is relevant; but even the context is not fixed.]

Now, the only way I know of for such a system to come into being is through learning (c.f. Peirce's definition of semiotics). Some partial pattern in a physical system (the second world, the world to be represented) has the effect of causing some corresponding partial pattern to form in a different physical system (the world where the information making up the signs is recorded). At the start the mapping is not fixed and the transducer that makes the causative connection can be varied – the rules of the mapping can be changed. Then there must be feedback so that the states in the two worlds influence the selection of the connections – certain causative connections get reinforced and others get killed off. The processes governing

this feedback (the rules of survival of connections) are the structural determinants of the semiotic system that may finally evolve through the learning process.

Such a learning process is the only way to make the huge number of decisions needed to narrow the mapping between signs in the first world and the objects and events in the second ("real") world so that there is a mapping of manageable size (albeit still much much more complex than a code) between signs and what they represent. This is the way that computer learning takes place. Learning computers do not come up with compact "theories": general functions that specify, in algorithms that occupy just a few bits of memory, the entire mapping between input (signifiers) and output (signified) [or vice versa] – unless of course the world presented to the computer has been generated by using a compact function in the first place.

Now I come to the question concerning organic codes. In my initial response to you, Marcello, I think I was asking you to give explanations that you had already given elsewhere, some of which I have now looked up. I will drop the question of morphogenetic codes because it is probably too difficult an example to tackle. As outlined below, I think I can satisfy myself that you have, at least in the example that I have chosen (signal transduction code), already given definitions of sufficient rigour for me to accept the basic idea. I explore this below and comment on the meaning I want to give to the term "organic", relating it closely to my understanding of semiotics.

In your reply to me you describe one feature of an organic code that I had not mentioned – adaptors. I agree entirely on the necessity of having adaptors to serve as "assignment vehicles" to determine the meaning (in the second world) of signs (in the first world). I also agree that adaptors make non-deterministic assignments, non-deterministic in the sense that any other set of assignments is equally possible, a priori. In that regard, I see little importance in the structure of the genetic code, the way "similar" amino acids are assigned to similar codons, except as indicating the nature of the process and the pathway whereby the near-universal assignments were selected ("learned"). [I note that the similarity of amino acids is judged mostly on the basis of their chemistry, whereas the similarity of codons is judged mostly on an information theoretic basis – I'll return to this.] It is the fact that there is any mapping at all from codons to amino acids, not the choice of actual assignments, that bears on the idea of what an organic code is.

So far so good. But now I want to add something that comes from my interpretation of the word "organic". It is the fact that the assignments used by the code are intrinsic to the system, and can only be maintained as a result of their being executed. The system that creates the adaptors (the tRNAs) is itself a result of those assignments being made. I refer especially to the specific AARS proteins that attach the amino acids to the tRNAs with cognate codons and therefore execute the rules of the code-table. One can describe all the molecular details of protein synthesis down to whatever level of precision you like, but then the fundamental point about the operation of the genetic code in actual organisms will be missed – its organic integrity and origin, stretching from every currently living cell all the way back to things happening near the origin of life. Every cell inherits the code from its parent cell/s as a bundle of already functioning machinery – its organic inheritance, if you like. The DNA needed by the system to maintain the code (esp. for the AARSs, rRNA, tRNAs, ribosomal proteins etc.) is a kind of side issue, but one of a very interesting sort. That DNA is useless without the functioning cell, the whole integrated organic system, (esp. genetic code) that can give it a particular meaning. I'll return to this later too.

I want to be able to say that for there to be a code, the objects in the first world, the signs, must have some features which serve as information (in the simple Shannon sense) in relation to the processes that execute the relevant decoding (interpretation/ translation) operations. That is to say they have symbolic value. In the case of the genetic code you can take any arbitrary DNA sequence, specified as a choice of A, C, G or T at each position (2 bits of information), and determine its meaning (as putative protein) simply by applying the code-table rules. The sign consists of the sequence of the DNA and the sequence is made up of symbols: it can be written down, stored and transmitted electronically or optically; you can alter it and do whatever you like, but when you present the symbolic information to the functioning cell as a DNA sequence its meaning within that biological context will become apparent.

If I look at another of the organic codes to which you refer (I'll take the signal transduction code as an example), then do you find either of the two features I have described? In respect of the second feature (information aspect of first world molecules), I can adopt the crude approximation that any of N 1st-messengers for which there are cellular receptors is either present or absent outside the cell. In that case there are 2^N theoretically distinguishable signs (made up of the primitive first world symbol-objects – the 1st-messenger molecules) that can be presented to the cell. So indeed, the 1st-messenger state outside the cell contains information (N bits of input to the transducer system). Then I take it that a cell will have a code corresponding to the set of transducers (adaptors) that each links a 2nd-messenger to a 1st-messenger. In principle, any of the N 1st-messengers could be linked to any of the 4 possible 2nd-messengers; there are $4N$ possible types of adaptors. Once again taking the crude approximation that the production of any of the 4 2nd-messengers can be either "on" or "off", there are $2^4 = 16$ different states that can be made up of the second world objects (active 2nd-messenger producers). This would mean then that the signal transduction code for a given cell is represented by the subset of the 4^N possible transducers that are actually present in the cell membrane. It specifies a look-up table that tells you whether a particular 1st-messenger is linked to a particular 2nd-messenger, just like the genetic code is a table telling you whether a codon is linked to a particular amino acid or not. The first difference between this code and the genetic code is that a 1st-messenger may be linked to more than one 2nd-messenger (whereas codons are uniquely assigned). The second difference is that the 1st-messenger input system acts in a parallel rather than a DNA-sequential fashion, so it is much less information-rich. However, I have convinced myself that what you are talking about is a code that maps one alphabet of molecular objects to another; and that input information is processed by using adaptors to give a functional output (the 2nd-messenger population in the cell).

Now I want to ask whether this code is organic in the stronger sense that I have started to elaborate above. In the case of the genetic code, if the string of amino acids that you get by translating a DNA sequence was no more than that, just another sequence, then ribosomal translation would be of no more consequence than printing out, in the Greek alphabet, the text of what I am now writing. However, the protein chain folds up and produces a host of chemical features that can interact with chemical features of other molecules in the cell and thereby have a great variety of effects on what happens. I would be rather reluctant to talk about a code for protein folding because it is difficult to envisage how the process can be modularized in terms of a number of steps from a limited alphabet. Furthermore, what is important is the very detailed arrangement of the different chemical features that a protein molecule can have once it is folded. I doubt that there is any algorithm for getting to the folded state from the amino acid sequence (under whatever conditions prevail in a cell at any time) that is compact enough or modular enough to be thought of as a code.

Be that as it may, once the protein is produced, its interactions with other molecules can affect a broad range of processes in the very complex network of events that is taking place in the cell, participating in and perhaps changing the overall dynamic state of the cell. So, in this sense the protein acquires organic functions as a result of its folding – it affects and contributes to the overall operation of the cell. And that is what I take finally to be the biological meaning of the information in the DNA encoding the protein. The meaning is defined within the enormously complex context of the intracellular biochemical milieu that the folded protein encounters. The fact that the original input (the DNA sequence in the case of the genetic code, the 1st-messenger combination in the case of the signal transduction code) can be regarded as information means that the organic system constituting the cell can be regarded as a semiotic system; that is, if we look at it as a symbolic information-processing system rather than a physico-chemical system. [And I am inclined to say that protein folding can be regarded as a primitive semiotic sub-system – see my comments on neural network programs below.]

In this sense I see the function of the 2nd-messengers in the signal transduction system as organic. As a result of executing the rules of the code on the input you get from just a few bits of information (the 1st-messenger signal/sign interacting with a few types of receptors) to a population of 2nd-messenger molecules that diffuse around the cell having a multitude of effects, changing what the cell is doing and so on. There is far more to be considered than the 4-bit question that defines whether or not each of the four 2nd-messengers is currently being synthesized. The 2nd-messenger population acts as a kind of quasi-continuous modulator of internal cellular operations. I do not exclude describing some parts of this as the operation of some further code; that is a separate question. However, in terms of semiotics, I want to say that the meaning of the 1st-

messenger information is to be understood in relation to the integrated, organic state/functioning of the system as a whole. The term "organic" conveys the idea that a complete cell has far too many dynamic degrees of freedom for its operation to be easily (if at all) codified in terms of any compact algorithmic description. And the term "semiotic" conveys the fact that those many dynamic degrees of freedom are nevertheless connected and related to one another in a coherent integrated network capable of giving meaning to signs.

Thus, I have come as far as deciding that I am happy to call a code organic if it has the dual relationship with a biological system such that it is maintained as a part of the system and its operation contributes to the maintenance/functioning of the system.

What I particularly like about the genetic code is that this feature of being organic can be thought of as extending to the information-processing aspect (rather than chemical aspect) of the execution of the code. The molecules that synthesize/maintain the adaptors for the code (the AARSs) can only be got by executing the very code that they are primarily responsible for maintaining. And you have to have those molecules already present in order to interpret the DNA that encodes them. The sequence of the DNA encoding the AARSs has the special property that there is one decoding of it that creates the machinery for that very code. And that very special formal property, which is possessed by only an infinitesimal proportion of sequences of the required length, only exists because it is structurally induced by very fine details of the folding and chemistry of proteins, Ångströscopic molecular properties that themselves have nothing to do with DNA sequences; and because it has been historically induced by the prebiotic processes whereby protein sequences came to be collinear with nucleic acid sequences. Is there any better illustration of the relationship between physico-chemistry and information, between matter and symbol, than we see inherent in biological systems? Matter and symbol have a historically contingent relationship that is intrinsic to the origin of all living things. It was learned spontaneously at the origin of life and has been systemically "remembered" as "knowledge" ever since, such that without it, organisms would not exist nor could they evolve.

As far as I am concerned, to define "life", if that is possible, you have to explain how the organic, semiotic, matter-symbol relationship characteristic of and common to all biological systems emerged out of an otherwise inanimate world apparently devoid of non-thermal information and meaning.

A final word about computers. I am tentatively prepared to say that even a neural network program, adapted to learn a particular task, can operate as a very primitive semiotic system, able to interpret signs in a contextual, more-complex-than-code, but still structured, manner. What distinguishes organic systems from computers is that the molecular-level semiotic systems they operate are all the time being subject to immediate thermal decay that has to be "fought off" and they have an intrinsic way of using stored information to do this. In other words, organic systems are dependent, for their very existence, on being forever locked into interpreting information that represents (only in terms of their intrinsic semiotic systems) their own production in a Ångströscopically disordered environment.

Craig Venter's claims to have produced "synthetic life" will continue to be fatuous nonsense until he can produce an organic, semiotic system of the sort that I describe without stealing from living systems the knowledge entailed in having a collinear relationship between nucleic acids and proteins and the metabolically sustained machinery made out of those components supporting the code relationship. He must find a different example of information and self-sustaining interpretation, designed from scratch. How many years shall we give him before we judge him to have failed? The life that he currently calls "synthetic" actually belongs to the host cell into which he inserts a genome that is compatible with survival. That life, that organic semiotic system, has the remarkable capability of being able to survive by spontaneously transforming itself completely into the form that its interpreter says the invading genome represents. I regard this as a feat of cellular engineering orders of magnitude more impressive than anything I have seen any human accomplish.

My greetings to all in the biosemiotics community,
Peter

Peter R Wills, Associate Professor, Department of Physics,
University of Auckland, New Zealand

14

----- Original Message -----

From: [Marcello Barbieri](#)**To:** [Peter Wills](#)**Cc:** [Mailing LIST](#)**Sent:** Thursday, March 24, 2011 11:19 AM**Subject:** Re: Semiotics, organic codes and computers

Dear Peter,

.... welcome on board!

Not only you are a member of the biosemiotic community but in my opinion you rightly belong to what I call “code-biosemiotics”, the idea that it was organic codes that gave origin to semiosis on the primitive Earth. The genetic code was the key event in the origin of the Last Universal Common Ancestor (LUCA), but this was not a “modern” cell because it did not have a signal transduction code. Three distinct types of modern cells came into being with the Three Primary Kingdoms (Archea, Bacteria and Eukarya), i.e., with the origin of three distinct types of cell membrane that carry three types of signal transduction codes. After which, Archea and Bacteria did not evolve any new organic code and have remained substantially the same ever since. Only Eukarya went on exploring the coding space, and became increasingly complex cells. Note that their evolution went on for three thousand billion years, about 75% of the entire history of life! The result was a cell whose complexity is truly beyond imagination! We certainly cannot reduce all that to simple games of mapping rules, so how do we tackle the problem? Let me mention just a few points.

(1) First of all we need to distinguish between at least two different types of semiosis.

Protein synthesis is the prototype example of a manufacturing process that is based on a code (what I call “manufacturing” semiosis) whereas signal transduction is a semiosis (because it creates a correspondence between first and second messengers by means of adaptors), but it is not a manufacturing semiosis because the second messengers already exist in the cell and are not manufactured by the transduction process. Signal transduction creates a signalling association between first and second messengers and can therefore be referred to as “signalling” semiosis.

The point here is that we cannot expect all codes to be like the genetic code. There are important differences between them, and we must take them into account.

(2) The second point is to understand what happens when we put two or more codes together.

The association of the genetic code with a signal transduction code has the result that protein synthesis is regulated by signal transduction, and the cell acquires a “context-dependent” behaviour (no interpretation, here, just coding-decoding). But what happens when we add a third code, and then a fourth code? I suspect that the situation may be similar to the three-body problem. With two bodies there is a unique solution, but with three bodies the solutions become infinite!

(3) The third point is that people keep using different definitions of the organic codes, and this does create a “Tower of Babel” effect. As an example, please find in attachment an excellent paper on the ‘splicing code’. It is a marvellous work, the type that will convince the next generation of biologists of the reality of the organic codes (the present generation is lost, it will not change its mind). But it is yet another paper that goes its own way about defining the organic codes.

So, where do we go from here? I really don’t know, Peter. Even in our own community there are people who keep shooting at the organic codes idea and essentially say “yes, but...it is not enough!”

You too seemed one of those people in your first letter, remember?: “can you explain this? And can you explain that?” No, I can’t. I also put it in writing! In my last paper (Origin and Evolution of the Brain), if you remember, I wrote “The organic codes do not explain *everything*, far from it.... They just account for coding. ... they account only for the generative rules of life, not for the flesh and blood of history.”

Best

Marcello

15

----- Original Message -----

From: "Kalevi Kull" <kalevi.kull@ut.ee>

To: "Marcello Barbieri" <brr@unife.it> Cc: MAILING LIST

Sent: Thursday, March 24, 2011 11:22 AM

Subject: Re: Computers, coding and semiosis

Dear Marcello, dear colleagues,

I feel that, stepwise, our understandings are converging. Which is good, of course.

Some further steps in making our concepts more clear are also feasible.

Please consider the following formulations. First, it has been helpful to distinguish between

* semiotic - which refers to semiotics, and

* semiosic - which refers to semiosis.

The concept of CODE as defined in "The Organic Codes" is what I find valuable indeed.

In some details, still, it can be improved. Following Marcello's approach, we can define code as a regular correspondence or link between entities that would not form such regular correspondence on the basis of self-assembly (because there is immense number of possibilities to form alternative links).

As different from self-assembly, the creating or inheriting of codes requires work.

I.e., code is a regular correspondence or link that is created or inherited by semiosis (by life).

A code, always built by semiosis, may still persist some time without further activity of semiosis - like in many machines and automatons. Thus, code may exist (temporarily) without semiosis.

One can say that a code (and likewise, a grammar) is a frozen pragmatic, a frozen habit.

This is a general feature of artefacts - their pieces are put together that builds a code-relation into their body.

SEMIOSIS is what is capable of creating new code-relations.

Simultaneously, semiosis is also carrying on the existing codes, rebuilding and inheriting these.

Semiosis always includes some codes.

Thus, semiosis cannot exist without codes. Code is necessary but not sufficient condition for semiosis.

Semiosis always requires a previous semiosis

(omne semiosis ex semiosis; omne vivum e vivo - except at their initial origin at the origin of life).

Being capable of creating a new code, it implies that semiosis is also a unit of learning from experience.

This means that semiosis assumes and includes certain ambiguity, certain indeterminacy.

Living cell is a semiosic system. The translation process carried by ribosomes is a code-process, but it is only a part of semiosis. The adaptors (called code-makers by Marcello, like tRNAs in case of genetic code) are necessary in building the code-relation, however, yet insufficient for semiosis.

It seems reasonable to say that meaning-making is a feature of semiosis and not of code.

Meaning-making (and semiosis) appears when more than one code is involved, the codes that are mutually incompatible (i.e., code-plurality, at least code-duality). Because the latter is the condition where that piece of freedom appears that is necessary for the existence of search and primary intentionality.

IN COMPUTERS, at least in simple calculators, there are built-in codes, but no new codes are created, no code-makers in Marcello's sense, no semiosis by itself. (However, a calculator in a process of using it by a human is a part of semiosis.) In case of more advanced computers, I can imagine that a process equivalent to simple code-making in Marcello's sense can be simulated. Yet this is not semiosis.

In even a more advanced case, e.g., of independently moving and sensing robot-computers that would try to communicate with each other on the basis of non-identical codes, semiosis may temporarily appear.

There exists, certainly, a gray zone between semiosis and non-semiosis, at the lower semiotic threshold zone.

E.g., auto-cells (Terry Deacon's concept) would belong to that zone.

Improving the concepts is our work. :-)

With warm wishes

Kalevi

16

----- Original Message -----

From: "Joachim De Beule" <joachim@arti.vub.ac.be>To: "Alexei Sharov" <sharoval@mail.nih.gov>

Cc: MAILING LIST

Sent: Thursday, March 24, 2011 3:09 PM

Subject: Re: Computers, coding and semiosis

Dear Alexei,

Thank you for your answer, it is much appreciated!

Below I include some comments on your comments though...

All the best, Joachim.

(A) *".... Semiosis is not a "yes-no" quality but rather a quantity, measured by "depth" and time frame. Computers perform some semiotic functions even without" elaborate external devices but this is "induced" semiosis that comes from human users who define goals and methods (see the comment from Stan Salthe). Similarly, ribosomes perform induced semiotic functions in the cell."*

OK, but where does this lead us? I mean, defining semiosis as something graded such that where there is little it is induced by where there is plenty does not really help me much.

I think there are at least three factors why it is appropriate to speak of real semiosis (as opposed to induced or reduced or whatever semiosis) in case of translation by the ribosome:

(1) the genetic code is arbitrary

(2) it seems to be the result of three conflicting constraints on its evolution, of which two clearly have to do with coding (expressivity and precision) and one with metabolism (energy and resources):

(i) the constraint for robustness or precision (nearby codons map to the same amino acids, or to others with the most similar properties or function)

(ii) the constraint for expressivity (not all codons can map to the same amino acid) and

(iii) the constraint on available energy and resources.

(3) the ribosome is really manufacturing protein as required for its own survival (metabolism and reproduction), in the sense that it is actively producing (creating) protein according to the 'bauplans' captured in genes (mRNA) which it 'reads according to the genetic code'.

I am avoiding the word interpretation here, but this is what it could mean to me.

The notion of semiosis thus for me requires not more and no less than a code, that is an arbitrary correspondence between two worlds, and a codemaker or agent that applies or uses the code for self- and code-maintenance. Let me be clear about what all terms mean to me:

- Arbitrary means that the correspondence it is not predictable from first principles (minimal energy and maximum entropy). Like language, "it could have been otherwise".

It also entails that the code cannot appear through chance or 'self-assembly' as Kalevi put it, or at least not more than once or twice with high probability (e.g. because of the more than astronomical number of equally probable possibilities: there are roughly 10^{10000} proteins, but only 10^{80} atoms in the universe).

- Different modalities correspond to a priori independent spaces with different properties.

For example, sound waves and electrical impulses live in different modalities, and comply to their own physical laws and logic. Spoken language nevertheless induces a correspondence between them (from the ear to electrical pulses in the brain and nervous system to the mouth muscles to the ear etc).

Similarly, DNA and RNA can be copied, whereas protein can not; protein folds into a secondary structures through which it interacts in ways that are not predictable from its encoding mRNA sequence.

- The fact that the code is a correspondence between two modalities with different logics allows to combine the logics of one modality with that of the other, e.g. the copying capacity of the RNA world which is

needed to store information is made available to the protein world, and the metabolic capacity of the protein domain becomes available in the RNA and DNA world (because it requires protein to do the copying and coding). Meaning thus originates from the fact that something in one domain comes to stand for (i.e. comes to mean) something in another domain, which brings with it a whole new and a-priori unpredictable set of functionalities (the physics and logic of the other domain).

- The fact that the code is applied by an agent means that the agent uses it to encode information (inherited or environmental) that is expressed in one modality to produce (manufacture) information in the other modality.

But applying and maintaining an arbitrary code requires work, in the sense of thermodynamics. Coding also entails that it is the application of the code that is (partly) responsible for the maintenance of the agent, including the code (their survival, that is, what is needed to keep the agent and code in the specific energy and entropy state that allows coding. As mentioned, this state is not predictable from first principles).

What do you think?

(B) “... *You try to define semiosis in terms of a single agent, ...* “

Yes, I think that semiosis, or agency as I would perhaps call it, can occur in a single agent.

In fact, I really think that semiosis requires not more than what was stated above: a code and an agent that uses it to maintain it.

The thought experiment with the cat clearly shows that no other agent is required: the cat does not stop performing semiosis as long as it is alive, that is, as long as it is applying its codes, thereby inducing (reifying) a-priori unpredictable changes. The flash light is fully predictable from first principles.

All the best,
Joachim.

17

----- Original Message -----

From: "Kalevi Kull" <kalevi.kull@ut.ee>
To: "Joachim De Beule" <joachim@arti.vub.ac.be>
Cc: <sharoval@mail.nih.gov>; <brr@unife.it>
Sent: Thursday, March 24, 2011 5:24 PM
Subject: Re: Computers, coding and semiosis

Dear Joachim,

”... a single agent. In fact, I really think that semiosis requires not more than what was stated above: a code and an agent that uses it to maintain it. “

'an agent that can use something to maintain it' is a very strong requirement.

If to analyse this requirement, we can see, that this agent itself requires (includes) more than one code, it includes itself a semiosis, because only then there can be that sort of intentionality - 'using to maintain'.

Best
Kalevi

18

----- Original Message -----

From: [Marcello Barbieri](#)**To:** MAILING LIST**Sent:** Thursday, March 24, 2011 6:33 PM**Subject:** Re: Computers, coding and semiosis

Dear Kalevi,

I am sorry but you keep playing the same old trick. You change a word or two and that is enough to allow you to criticize the code view of life.

Now, let us start again: what was the issue in question?

The issue was "is CODING a form of semiosis?"

I have written "coding" in capital because that is where you play the trick.

Here is what you wrote: "Semiosis always includes some codes. Thus, semiosis cannot exist without codes.

Code is necessary but not sufficient condition for semiosis"

Have you noticed the change?

You have replaced CODING with CODE, and that is what allows you to say that "code is not sufficient for semiosis".

Your statement is correct, but is NOT what I was saying!

What I was saying is that "CODING (not code) is sufficient for semiosis".

This is not as trivial as it may appear at first sight, so let me elaborate a bit more.

CODING is the activity of a coding system, which is, in my opinion, a full semiotic system, a system that I have defined (many times) in the following way: *"a semiotic system is a triad of signs, meanings and code that are all produced by the same agent, i.e., by the same codemaker."*

A semiotic system, in other words, has 4 components: signs, meanings, code and codemaker.

CODING, therefore, is the production of correspondence between signs and meanings performed by a codemaker according to the rules of a code.

CODE is only ONE of those four components, and in this sense you are right.

But when you take ALL four components into account that is FULL SEMIOSIS.

Coding, in conclusion, is a full form of semiosis. It was the first semiosis that appeared on Earth and still is the most abundant form of semiosis that exists on our planet.

Best

Marcello

19

----- Original Message -----

From: [Günther Witzany](#)**To:** [Marcello Barbieri](#)**Cc:** MAILING LIST**Sent:** Thursday, March 24, 2011 7:09 PM**Subject:** Re: Computers, coding and semiosis

Dear Marcello!

May I suggest:

No natural code codes itself as no natural language speaks itself.

In natural codes there must be **living agents** which are competent to edit these codes.

Each natural code user follows **syntactic, semantic and pragmatic rules**.

Rule-following is inherently a kind of **consortial interaction**

Best Wishes

Guenther

20

----- Original Message -----

From: "Kalevi Kull" <kalevi.kull@ut.ee>To: "Marcello Barbieri" <brr@unife.it> Cc: MAILING LIST

Sent: Thursday, March 24, 2011 8:37 PM

Subject: Re: Computers, coding and semiosis

Dear Marcello, dear colleagues,

My aim, in my previous letter, was to try to find some minimum formulations that can be more widely agreeable in our biosemiotic community.

And I am glad indeed that these formulations were in a large part acceptable for you, Marcello.

Thus it is a good basis where to stand when trying to solve the further problems, those which were left out and which may require some further distinctions, including the one with the concept of CODING.

There are two forms of coding that are so different that should be certainly distinguished:

(a) coding as inheriting (rebuilding, conveying) an existing code.

This is what the codemaker as adaptor is commonly doing (in case of translation, this is tRNAs together with aminoacyl tRNA synthetases that actually convey the code). The translation process (making proteins on the basis of RNA) with its components is a process that transfers the genetic code, and together with replication and transcription processes also inherits it.

(b) coding as creating a new code.

I do not mean here a modification of an existing code due to an error in its inheriting (for instance, a mutation either in a tRNA gene or in an aminoacyl tRNA synthetase gene may, sometimes, lead to a change in the genetic code - and so has happened, which has resulted in a dozen of slightly different currently known versions of genetic code). What I mean under creating a new code is the process of finding a new relation and turning it into a rule. I expect this will require at least two interacting but incompatible codes in a system. We may hypothesise that a minimal living cell includes the necessary components for this.

Thus - coding in the sense (b) is making the new meaning, and it is certainly semiosis. Coding in the sense (a) is a part of semiosis, but itself not sufficient for semiosis. In other words - one code-maker is not enough for semiosis.

Semiosis, of course, does not create new meanings (new codes) in each step (in the level of cell it may do this quite seldom), but it should be potentially capable for this. The protein synthesis process (translation) alone is not capable for this - it may only change by error.

So let us try to progress in a positive joint efforts.

With all best wishes

Kalevi

21

----- Original Message -----

From: [Marcello Barbieri](#)**To:** MAILING LIST**Sent:** Friday, March 25, 2011 9:56 AM**Subject:** Re: Computers, coding and semiosis

Dear Kalevi,

I completely agree with your attempt to find a minimal common ground, and, believe me, I wish that we could! Remember that at the end of "A Short History of Biosemiotics" I launched a similar call for a minimal unity, and I made a specific proposal in that direction, but it was all in vain.

The minimal basis for unity, in my opinion, consists in two concepts:

- (1) Accept that the origin of the genetic code was the origin of semiosis on Earth. This means that organic coding is full semiosis (in your sense (b) coding as creating a new code).
- (2) Accept that Peircean semiosis (or interpretive semiosis), arose much later in evolution (stop with the trick of saying that coding is interpretation because this is only playing with words).

More precisely, we must stop with the attempt to impose a "cultural" model of semiosis to the cell, especially to the free living single cells of the first three billion years of the history of life.

In my opinion, the best way to honour Peirce is precisely to show that many of his ideas are still alive and kicking (as I have tried to do in my last paper). The fact that others can be safely buried does NOT detract in the least from his merits.

As for your distinction between two forms of Coding (only one of which is semiosis) I would put it in a different way. I do accept type "b" (coding as creating a new code), but about type "a" (coding as inheriting an existing code) I would say that USING an existing code is still a form of semiosis (when we use the fixed rules of language to communicate with other people we are doing semiosis).

In short, the use of signs and meanings (the two sides of coding) is always semiosis. This will probably remain a point of disagreement between us, but we can live with it!

Let me end by saying that I have very much appreciated your call for a minimal unity.

Many thanks for that!

Best

Marcello

22

----- Original Message -----

From: "Kalevi Kull" <kalevi.kull@ut.ee>

To: "Marcello Barbieri" <brr@unife.it> Cc: MAILING LIST

Sent: Friday, March 25, 2011 1:04 PM

Subject: Re: Computers, coding and semiosis

Dear Marcello, dear colleagues,

I am glad that we share so much in understanding the two meanings of coding, of which the coding as creating a new code is what always assumes semiosis.

"... As for your distinction between two forms of Coding ... I would say that USING an existing code is still a form of semiosis (when we use the fixed rules of language to communicate we are doing semiosis)."

Here, a small comment. "Using" assumes an agent that is using. Since, obviously, the agent is itself a semiotic system, therefore also the process of simple coding by an agent would be semiosis. I.e., type "a" coding is not itself semiosis, but can be semiosis together with a system with an agent that is using it. Let us now try to find more of common ground.

It is obvious that what can be the common ground for us, is where we cannot see any serious contra-arguments or logical contradictions.

Let us look at the candidate formulations.

(1) Accept that the origin of the genetic code was the origin of semiosis on Earth. This means that organic coding is full semiosis (in your sense (b) coding as creating a new code).

Here, the statement "coding as creating a new code assumes full semiosis" is well agreed.

The other statement that "the origin of the genetic code was the origin of semiosis on Earth" raises the following problems.

(1) An empirical problem. It is not yet well known which were the first codes at the origin of life on the Earth. For instance, it might well be that some signal transduction code appeared prior to the genetic code. Also, the genetic code may have appeared as a result of interaction of couple of simpler codes which were not yet genetic codes.

(2) A theoretical problem. The primary origin of semiosis is an exceptional case where the usual rules about the evolution of semiosis (e.g., the version of Redi's rule - omne semiosis ex semiosis) cannot hold. I.e., we cannot apply the model relationship between semiosis and coding as it occurs in living systems to the situation where there was no semiosis or coding yet and where these primarily start to appear.

(2) Accept that Peircean semiosis (or interpretive semiosis), arose much later in evolution (stop with the trick of saying that coding is interpretation because this is only playing with words).

Here is a problem with common definition of Peircean semiosis, which states that semiosis just assumes the irreducibly triadic relation. Since, logically, this is the same condition that you use when rightly defining code relation, it logically follows that coding in your sense (i.e., above b: coding that at least potentially can create new codes) assumes semiosis in Peircean sense.

I certainly think that we can progress in solving these problems and develop the formulations up to the point that makes these well argued and more widely acceptable.

With all best wishes

Kalevi

23

----- Original Message -----

From: "Joachim De Beule" <joachim@arti.vub.ac.be>
 To: "Marcello Barbieri" <brr@unife.it> Cc: MAILING LIST
 Sent: Friday, March 25, 2011 1:27 PM
 Subject: Re: Computers, coding and semiosis

Dear Kalevi,

On Thursday, March 24, 2011 05:24:05 pm Kalevi Kull wrote:

"... 'an agent that can use something to maintain it' is a very strong requirement. If to analyse this requirement, we can see, that this agent itself requires (includes) more than one code, it includes itself a semiosis, because only then there can be that sort of intentionality - 'using to maintain'."

I do not see why the usage of a code such that it is maintained requires an additional code, could you explain that please? I know that the cell uses additional codes, like signal transduction codes and splicing codes etc., but the modern cell in my view is already a pretty advanced system. I do not see why it should be so difficult to envision a simpler dynamical system that involves a code and an agent that uses it with the result that the code is maintained.

In fact, I think that my *Biosemiotics* paper on 'introducing dynamics in biosemiotics' (which I explained last week) gives an example of such a system, or at least comes close to it: the agent keeps a code that not only captures but also amplifies observed meaning-sign correlations, thereby introducing a feedback loop in the complete system that drives it towards one or the other coding system, that is, maintains an arbitrary code. I am very curious to learn what you think is still missing from it?

On Friday, March 25, 2011 10:05:23 am Kalevi Kull wrote:

"... Please define 'agent'. I expect that there cannot be an agent without a code."

In the model the agent is a cell membrane that is impermeable to adaptors (the code), so that it 'keeps' it. Within the membrane, adaptors react with meaning and sign molecules, which induces dynamics that support the code ('maintain it') ... there is no other code involved...

Thus, as a first definition of agent, I propose that it is any structure that introduces a separation between an 'inside' (the actual agent in which a code is kept and coding takes place) and an 'outside' (the environment that provides the agent with (molecular) information to which the code is applied as well as with the energy and molecular resources required to apply it.)

As for the origin of the 'first' semiosis, cell-membrane like lipid structures are known to form through self-assembly. If anything like a ribosome and a genetic code would co-evolve with such structures such that the production of proteins is promoted that amplify the formation (or sustaining) of such "membrane + primordial ribosome systems" through a positive feedback loop, then this would correspond to the emergence of semiosis.

I'm not enough a biologist to know in how far such a scenario is feasible, but at least in principle it is conceivable, and the mechanism is not restricted to the genetic code as we know it.

So I ask you again: what is missing?

Best,

Joachim

24

----- Original Message -----

From: [Vinicius Romanini](#)**To:** [Kalevi Kull](#)**Cc:** MAILING LIST**Sent:** Friday, March 25, 2011 1:46 PM**Subject:** Re: Computers, coding and semiosis

Dear Marcello and colleagues,

I must disagree with both assumptions launched by Marcello as a minimal basis for an unity of concepts.

I am afraid that such aprioristic statements might block the way of inquiry about physiosemosis and other possible contribution of semiotics to phenomena involving causation and teleological processes.

As an example, let me remember that it was a geneticist and statistician working with the genetic composition of populations (R.A. Fisher) that first gave up using probabilities as a way of distinguishing one population from another, and instead adopted the square roots or what we call probability amplitudes.

He found out that probabilities amplitudes measures distinguishability, and what we call Fisher Information is precisely our ability to know the probability law operating in a measurable parameter.

Schrodinger applied the same idea to quantum phenomena, and his wave function connects observer to reality through observation and the amount of Fisher Information available in the whole process.

The measured quantities of an electron might be conceived as the expression of a fact about an ongoing event or process in which uncertainty is ontologically conceived.

In other words, the readings of an instrument collecting information about reality are propositions, and so can be analysed semiotically.

The reading of the instrument is the subject while the Fisher Information is the predicate.

There is no thing in itself, but only registrations subject to semiotic interpretation.

So let's not draw sharp lines in science while nature keep telling us that it is a whole.

All the best, Vinicius

25

----- Original Message -----

From: [Marcello Barbieri](#)**To:** MAILING LIST**Sent:** Friday, March 25, 2011 5:07 PM**Subject:** Re: Computers, coding and semiosis

Dear Kalevi,

(1) Yes, it is true that there could have been some simpler code before the genetic code.

I have said that myself in the past, and I have also written that semiosis started not with coding but with "copying and coding". The copying of genes and the coding of proteins are both processes that depend upon templates - the difference is that copying does NOT require adaptors whereas coding does. Copying and coding are both performed by molecular machines, so semiosis came into being when the first molecular machines (which can arise by self-assembly) started producing the first molecular artifacts. That is what I was getting at, and I have repeated that concept so many times in my writings that I did not see the need to repeat it all over again.

(2) You say that coding assumes semiosis in the Peircean sense because it assumes a triadic relationship. It is indeed true that semiosis is always a triadic relationship, but it is NOT true that all triadic relationships are Peircean (interpretive). Organic coding is based on the ribotype model of the cell which is a triadic model (genotype, phenotype and ribotype) but not a Peircean model (the genetic code is a fixed set of rules, not subject to interpretation). By the way, the codemaker of the cell is the ribotype, not the ribosome alone or the adaptors alone.

At any rate, let us take stock of the fact that there is a tiny bit of agreement between us.

It is a small step, but it is better than nothing.

Best

Marcello

26

----- Original Message -----

From: [Marcello Barbieri](#)**To:** MAILING LIST**Sent:** Saturday, March 26, 2011 3:13 PM**Subject:** For a scientific biosemiotics

Dear Colleagues,

I must ask you to bear with me a little longer so that I can reply to Vinicius' claim that I have made two dogmatic, or "aprioristic", statements. I also want to rephrase them because they are much more than two "conditions for unity" in our field. In a slightly more general form, they are the pillars of a truly scientific biosemiotics. This is what is at stake here - the 'science' of biosemiotics - so please allow me to spend a few more words on this issue.

Vinicius has written that my statements "might block the way of inquiry about physiosemiosis and other possible contributions of semiotics to phenomena involving causation and teleological processes."

Let's keep our options open - he writes - "let's not draw sharp lines in science".

But science is precisely about drawing lines. Keeping our options open leads to nowhere.

We 'must' make precise hypotheses. More than that - we must make 'radical' hypotheses because trivial statements (such as "water is wet") may be true but are useless.

But when is a radical hypothesis also a scientific one? You already know the answer, of course.

An idea is scientific - and therefore NOT dogmatic - when it is testable. So this is the issue: do we have testable hypothesis that provide a scientific foundation for the field of biosemiotics?

(1) Let me start from 'Sebeok's principle', i.e. from the idea that "Life and semiosis are coextensive". Sebeok's argument was that life and semiosis are coextensive because they are both based on "interpretability". Is this a 'testable' statement? The answer, I am afraid, is NO, because interpretability is too vague, too variable, too subjective, etc. etc. That is why I proposed a different formulation: "Life and semiosis are coextensive because life is based on the molecular processes of copying and coding and these processes are organic semiosis because they are based on organic signs and organic meanings".

Now, is THIS a testable statement?

Yes, it is, because molecular copying and molecular coding are testable processes. Just find ONE example in which life is NOT based on copying and coding and the statement is falsified. Or, in a different way, just find one example in which copying and coding exist in inanimate matter and the statement is again falsified (in this case, physiosemiosis would be true).

So, this is my first argument. The hypothesis that the origin of life was also the origin of organic semiosis is testable and therefore scientific (It is testable exactly as the idea of evolution is - just find one fossil tooth in a Precambrian rock and the theory of evolution is falsified).

(2) The second pillar of a scientific biosemiotics is the idea that "Semiosis evolved".

Again, we can formulate this idea in many different ways, but they are not equivalent and, which is more important, not all of them are testable.

The formulation that I proposed is that semiosis evolved because different episodes of macroevolution gave origin to different types of semiosis in the history of life. The first was organic semiosis, then came interpretive semiosis, and finally cultural semiosis. Is this idea testable?

Yes, it is, because organic semiosis is based on copying and coding, whereas interpretive semiosis is based on abduction. Just find one example in which the behaviour of a free-living single cell cannot be explained by organic copying and coding and the idea is falsified.

A scientific biosemiotics, in conclusion, is possible, and it is based on a few testable principles.

(1) Life is coextensive with *organic* semiosis (copying and coding), not with interpretive semiosis.

(2) Interpretive (Peircean) semiosis came into existence much later, as a result of a new macroevolution that took place in nervous systems.

(3) Cultural semiosis was brought into existence by yet another macroevolution that took place in our species.

The philosophy of Peirce is the modern version of the ancient doctrine of hylozoism, the idea that the universe is alive, that an extended mind is perfusing it. It gives us the comfort of religion, the beauty of poetry, the unbounded possibilities of philosophy.

But it doesn't give us the truth. The bloody imperfect truth of science.

And that is the choice that we have before us today: what are we going to do with biosemiotics?

Are we building a new philosophy or a new science of life?

All the best

Marcello

27

----- Original Message -----

From: [Stanley N Salthé](#)**To:** [Marcello Barbieri](#)**Cc:** MAILING LIST**Sent:** Saturday, March 26, 2011 3:40 PM**Subject:** Re: For a scientific biosemiotics**Reacting to Marcello's --**2011/3/26 Marcello Barbieri <brr@unife.it>

Dear Colleagues,

I must ask you to bear with me a little longer so that I can reply to Vinicius' claim that I have made two dogmatic, or "aprioristic", statements. I also want to rephrase them because they are much more than two "conditions for unity" in our field. In a slightly more general form, they are the pillars of a truly scientific biosemiotics. This is what is at stake here - the 'science' of biosemiotics - so please allow me to spend a few more words on this issue.

Note that {semiotics {biosemiotics}}}

Vinicius has written that my statements "might block the way of inquiry about physiosemiosis and other possible contributions of semiotics to phenomena involving causation and teleological processes."

Let's keep our options open - he writes - "let's not draw sharp lines in science".

But science is precisely about drawing lines. Keeping our options open leads to nowhere.

Where must science "lead"? Technology.

We 'must' make precise hypotheses.

It has been pointed out that scientific modeling must choose between maximizing precision, generality and realism. If you maximize precision you must sacrifice the others.

More than that - we must make 'radical' hypotheses because trivial statements (such as "water is wet") may be true but are useless.

But when is a radical hypothesis also a scientific one? You already know the answer, of course.

An idea is scientific - and therefore NOT dogmatic - when it is testable.

Note the Duhem-Quine thesis. Because one must use ancillary hypotheses in order to test, a rejection of an hypothesis can always be avoided by rejection one of the ancillaries.

So this is the issue: do we have testable hypothesis that provide a scientific foundation for the field of biosemiotics?

(1) Let me start from 'Sebeok's principle', i.e. from the idea that "Life and semiosis are coextensive".

Sebeok's argument was that life and semiosis are coextensive because they are both based on "interpretability". Is this a 'testable' statement? The answer, I am afraid, is NO, because interpretability is too vague, too variable, too subjective, etc. etc.

That is why I proposed a different formulation: "Life and semiosis are coextensive because life is based on the molecular processes of copying and coding and these processes are organic semiosis because they are based on organic signs and organic meanings".

Now, is THIS a testable statement?

Yes, it is, because molecular copying and molecular coding are testable processes. Just find ONE example in which life is NOT based on copying and coding and the statement is falsified. Or, in a different way, just find one example in which copying and coding exist in inanimate matter and the statement is again falsified (in this case, physiosemiosis would be true).

Note the Cairns Smith work (book 'Genetic Takeover') on 'coding' in clays.

So, this is my first argument. The hypothesis that the origin of life was also the origin of organic semiosis is testable and therefore scientific (It is testable exactly as the idea of evolution is - just find one fossil tooth in a Precambrian rock and the theory of evolution is falsified).

It is not the "theory" (Darwinian selection theory) of evolution that is at stake here, but our understanding of its form. In any case, this observation would likely be rejected by noting various peculiarities of deposition.

(2) The second pillar of a scientific biosemiotics is the idea that "Semiosis evolved".

Again, we can formulate this idea in many different ways, but they are not equivalent and, which is more important, not all of them are testable.

The formulation that I proposed is that semiosis evolved because different episodes of macroevolution gave origin to different types of semiosis in the history of life. The first was organic semiosis, then came interpretive semiosis, and finally cultural semiosis. Is this idea testable?

Yes, it is, because organic semiosis is based on copying and coding, whereas interpretive semiosis is based on abduction. Just find one example in which the behaviour of a free-living single cell cannot be explained by organic copying and coding and the idea is falsified.

A scientific biosemiotics, in conclusion, is possible, and it is based on a few testable principles.

(1) Life is coextensive with *organic* semiosis (copying and coding), not with interpretive semiosis.

This rules out the principle of the origin of semiosis from an abiotic precursor situation, leaving that origin to result from the unknown origin of the biological genetic apparatus, which at present is being co-opted by Creationists.

(2) Interpretive (Peircean) semiosis came into existence much later, as a result of a new macroevolution that took place in nervous systems.

(3) Cultural semiosis was brought into existence by yet another macroevolution that took place in our species.

The philosophy of Peirce is the modern version of the ancient doctrine of hylozoism, the idea that the universe is alive, that an extended mind is perfusing it. It gives us the comfort of religion, the beauty of poetry, the unbounded possibilities of philosophy.

But, alas, no technological boost! You couldn't sell it.

But it doesn't give us the truth. The bloody imperfect truth of science.

Which is only one kind of truth. Semiotics has the opportunity of engaging other kinds.

And that is the choice that we have before us today: what are we going to do with biosemiotics?

Are we building a new philosophy or a new science of life?

Both.

STAN

28

----- Original Message -----

From: [Marcello Barbieri](#)**To:** [Stanley N Salthe](#)**Cc:** MAILING LIST**Sent:** Saturday, March 26, 2011 5:41 PM**Subject:** Re: For a scientific biosemiotics

Dear Stanley,

To my statement “(1) Life is coextensive with *organic* semiosis (copying and coding), not with interpretive semiosis.”, you have replied:

“This rules out the principle of the origin of semiosis from an abiotic precursor situation, leaving that origin to result from the unknown origin of the biological genetic apparatus, which at present is being co-opted by Creationists.”

I must underline that this conclusion of yours is totally groundless.

The origin of life by copying and coding means that life was brought into existence by molecular machines, more precisely by polymerases (copying) and by ribosomes plus adaptors (coding). Now it has been *proved* that even complex structures like ribosomes can arise by self-assembly from smaller components, and so they were as likely to appear spontaneously on the primitive Earth (*from abiotic precursors*, as you put it) as any other small and medium-size organic molecule. What I say does NOT in the least give in to Creationism, and I am surprised that you resort to this cheap accusation simply because I am against your Pansemiotic version of Peirce’s philosophy.

There were other cheap punches in your reply, but I am not going to reply to what I regard as a philosopher’s outburst of hate against science. And that does NOT prove that I am a technocrat.

If anything, guess what?, I believe that technology is actually killing science (more precisely, that is what is happening in Italy, today).

I am NOT wishing you a good afternoon because I really did not like your arbitrary insinuations!

Marcello

29

----- Original Message -----

From: [Marcello Barbieri](#)**To:** [Stanley N Salthe](#)**Cc:** MAILING LIST**Sent:** Sunday, March 27, 2011 4:22 PM**Subject:** Re: For a scientific biosemiotics

Dear Colleagues,

Despite my irritation at Stanley’s comments, I wish to acknowledge here that one of them deserves attention.

To my question “Are we building a new philosophy or a new science of life?”, Stanley has replied “Both”, and that of course is correct.

That is precisely what we SHOULD be doing.

There should be no opposition between science and philosophy, because they have largely complementary roles and both of them are important.

In our case, however, things have gone in a different way.

The concept of organic semiosis is a genuinely new contribution that Biosemiotics is giving to modern Biology. It explains why life is really coextensive with (organic) semiosis, and offers an entirely new explanation of the great events of macroevolution. And it is also a new contribution to Semiotics, because it reveals the existence of a new form of semiosis. Semiosis by molecular copying and molecular coding is in no way reducible to cultural copying and cultural coding.

In culture, for example, there is nothing similar to the phenomenon whereby a molecular machine writes the word “apple” and then the word wraps itself up and becomes a real apple:

In molecular biology, on the other hand, there is nothing similar to the abductive processes of interpretive semiosis nor to the generation of the unlimited sequence of signs described by Peirce.

But what has happened in practice?

Rather than rejoicing for the fact that we have a new and “testable” model of biosemiosis and start a new round of thinking, what has happened has been an attempt to reduce “biological” semiosis to “cultural” (Peircean) semiosis. To impose a Peircean model onto organic semiosis.

This is often justified by saying that Biosemiotics is a branch of Semiotics, and so it should derive its concepts from the mother discipline. But the truth is exactly the other way round. What we call “Semiotics” is nothing but “Cultural Semiotics” and that is the LAST form of semiosis that Nature has evolved on Earth. What we need, in conclusion, is a philosophy that helps us understanding the “way of Nature”.

Yes, Stanley is right on that point, and I wish to acknowledge it: we need both a new science and a new philosophy of life.

Best

Marcello

30

----- Original Message -----

From: [Paul Cobley](#)

To: br@unife.it ; ssalthe@binghamton.edu

Cc: MAILING LIST

Sent: Sunday, March 27, 2011 5:37 PM

Subject: Re: For a scientific biosemiotics

Dear Marcello,

I've found this recent round of debate interesting even if somewhat difficult to follow. I'm glad that a new science and a new philosophy is being built. Also, I'm keen to get to better grips with the notion of coding in biology, particularly if it “is in no way reducible to cultural copying and cultural coding”.

When you write that “What we call “Semiotics” is nothing but “Cultural Semiotics” and that is the LAST form of semiosis that Nature has evolved on Earth” you mean that cultural semiotics *is concerned with* the last form of semiosis that nature has evolved on earth, don't you?

But the main reason I'm responding is with reference to another issue. As a cultural semiotician (there are a number of us on the list), I'm not sure that it moves us forward to see people working in that area as merely “interpretative” in their bearing. Peirce's philosophy has numerous points which tend toward a view of coding (the formulation of types/tokens, for example). Closer to home, still, is the fact that Sebeok, from his linguistic years and even through his later, biosemiotic ‘modelling’ years, tarried with coding – the residues of it are to be found in his final publications. It's ambiguous in his writings on zoosemiotics, but it's clearly present there, too.

So, if a “new science and a new philosophy of life” is being built, let's bear in mind that our predecessors in cultural semiotics have already tried to employ ‘coding’ extensively and that we need to settle accounts with that tradition which is, after all, the tradition (derived from information theory, cybernetics and communication sciences) that put ‘codes’ on the agenda. In spite of your investment over the years, don't you ever feel inclined to abandon the term ‘code’ to cultural semioticians and plump for a fresh, unsullied term to describe how the molecular machine operates?

Best,

Paul

31

----- Original Message -----

From: [Stanley N Salthe](#)

To: MAILING LIST

Sent: Sunday, March 27, 2011 8:19 PM

Subject: Fwd: For a scientific biosemiotics

I'm sorry to irritate Marcello. However, I think we need to make one more statement: Until Biosemiotics discourse results in a new discovery in biology THAT COULD NOT HAVE BEEN MADE OUTSIDE OF A SEMIOTICS APPROACH, it will remain an interesting philosophy.

STAN

32

----- Original Message -----

From: "Søren Brier" <sb.ikk@cbs.dk>To: "Marcello Barbieri" <brr@unife.it>

Sent: Sunday, March 27, 2011 9:01 PM

Subject: RE: For a scientific biosemiotics

Dear Colleagues and especially Marcello

I am sorry to have been away from this interesting discussion, but I have been making and teaching an interdisciplinary philosophy of science Phd-course for the last two weeks and we are finishing a special double issue of *Cybernetics & Human Knowing* on Peirce's existential graphs.

I certainly like that we are trying to make bridges between the Peircean and the code semiotic views. At this time I just have to tell Marcello that his impression of Peirce's semiotics as being primarily a humanistic discipline is not very accurate. Remember he was a chemist and a logician and finally very inspired by Kant's architectural philosophy and metaphysics! But unlike Kant, Peirce spend a great part of his life as a practicing scientist. His paradigm is deeply transdisciplinary, but it is also true that biology might be the science that has develop most since his days and it was not an area that he was very profound in. The important work for Peirce was how to unite logic and meaning, mind and matter phenomenology and the special sciences, knowing and science in one paradigm that would be an alternative to Descartes dualistic vision and here he found that the mechanistic universalism was wrong as well as the view of mind. But he also found Hegel's as well as Husserl's interpretations of phenomenology to limited though he surely was an evolutionary philosopher.

Thus the two most recent research programs competing about making a transdisciplinary monistic framework for cognition and communication are Peircean based biosemiotics and pan-informational and -computational philosophy. As I have discussed many places, I think that the informational, the cybernetic and the systems philosophy lack to include a reflective phenomenological view on its epistemology.

When I try to understand code-semiotics it is a problem for me that it does not seem to belong to any of the two paradigms and that it is not yet developed enough to present a full alternative in order for us to see how it represent a new solution. Do we need such a full alternative. Yes, I think it is unavoidable. The problem we face is a general theory of life, consciousness, cognition, communication and meaning and it relation to matter, energy and information, in an evolutionary process view of knowledge and reality. Good discussion can be found here <http://www.idt.mdh.se/ECAP-2005/INFOCOMPBOOK/>

Further in my view we cannot just take the received view of science, social sciences and humanities for granted. We need to develop new views on the forms of sciences and humanities as for instance Kalevi has tried to do, though I still find Peirce's attempt more promising. The whole task is huge. Just to understand Peirce, information theory (in one of its unified paradigms) as well as modern biology (a huge field) and modern consciousness and communication research is personally bringing me to my knees in order to do a qualified job here. My first attempt is constructing Cybersemiotics. Short definition can be found here <http://glossarium.bitrum.unileon.es/glossary/cybersemiotics> . Especially the cybersemiotic star is an attempt to make a transdisciplinary framework for interdisciplinarity.

Venlig hilsen/best wishes
Søren Brier

33

----- Original Message -----

From: [Howard Pattee](#)**To:** MAILING LIST**Sent:** Sunday, March 27, 2011 10:27 PM**Subject:** Re: For a scientific biosemiotics

Dear Marcello,

I am not the one to defend Peirce and Sebeok, but how would you define *signs* and *symbols* without the concept of *interpretability*? You say interpretation is not testable, but copying and coding is testable. I think you left out the crucial requirement of *autonomy* (*self-copying* and *self-coding*). Copying and coding is all that a dead computer does. I think there are testable conditions for an autonomous agent as interpreter. Peirce, Sebeok, and von Neumann all effectively *define* sign and symbol by their interpretability. After all, the *interpretant* is one of Peirce's sign-defining triadic elements. Von Neumann's logic requires *self-interpretation* of *description* to execute *construction*. He requires that the description be self-interpretable two ways, as a structure to be copied, and as a specification for all the components necessary to copy the description and execute the *construction*. Furthermore, open-ended evolution requires that the "language" must be rich enough to maintain this *self-interpreted description* at all *naturally selected* hierarchical levels. That is why I say *life and language* are coextensive.

Long ago I called this life-defining *self-interpretation* requirement *semantic closure*. I now call it *semiotic closure* (at Luis Rocha's suggestion) because there are all three semiotic processes required here the genetic code is translation (*syntax*), protein folding, where the degeneracy of the *information* is removed and *laws* are harnessed, is the first level of interpretation (*semantics*), and so on to all higher functional levels (*pragmatics*).

Other than that, I think we agree.

Howard

34

----- Original Message -----

From: [Peter Wills](#)**To:** [Marcello Barbieri](#)**Cc:** MAILING LIST**Sent:** Monday, March 28, 2011 6:32 AM**Subject:** Re: For a scientific biosemiotics

Dear Marcello Paul, Stanley and Howard,

As a newcomer to this community, but not a complete newcomer to many of the ideas, I see the problem of new science and new philosophy as follows.

Science began by dealing with the question of what it is that stays the same as change occurs: the nature or substance of things. In the last 60 years, biology has become more and more reductionist in its espoused outlook: the causes of everything are molecular, (i.e., physical/material) in nature. Natural selection, whose mathematical description reduces more or less to tautology, is said by Dawkins and other members of his species to explain the semblance of immaterial meaning in the world (behaviour, language, culture) in terms of the outcome of molecular processes alone.

On the other hand, molecular biologists are forced, more and more, to use the language and methods of applied information theory. However, they do not acknowledge any cybernetic causes. Information doesn't cause anything. It is an ephemeral epiphenomenon, providing a useful shorthand for various descriptions, but of no fundamental reality. We may think of adenine (A), guanine (G), cytosine (C) or thymine (T) as letters of an alphabet for DNA sequences, but actually there is no such thing as a symbol in nature; symbols are all in our minds (and a mind is just another ephemeral epiphenomenon). A, G, C and T are molecules.

There is a strange inconsistency in the way in which evolution is explained in terms of genetic reductionism. We are supposed to believe that all the informatic language is being used is a shorthand for a much more complicated detailed material description, which uses the "true" language of quantum mechanics. I am more impressed by Socrates' discussion (attached) of the relationship between material mechanisms and intelligence as a cause of things than I am with the reductionistic accounts of modern biologists.

To my way of thinking biosemiotics rejects the reductionist claims and ascribes a reality to signs (as possible causes of things) in biology. However, the cosmological appearance of signs as causes is historic. No biological systems existed until the universe cooled down quite a bit from an initial super-hot state, so there were no biological signs for quite a long time, nor cultural signs for that matter. So I agree with Marcello that biosemiosis is coextensive with life and is therefore what I want to call "organic". But actually, most of the types of physical things now in the universe were also absent at the beginning, so they also have a genesis. Why should signs be any different? [I want to avoid arguments about the interpretation of "interpretation" for now.]

I think it is now possible to take up Stanley's challenge and make discoveries in biology that require a semiotic approach. I am currently trying to reconstruct the evolution of the genetic code without reference to genetic information. The bioinformatic method I am using assumes that the pathway of genetic code evolution was not driven by genetic mutation/selection processes, but by processes of progressive amino acid alphabet refinement. The analysis cannot be done without symbolically identifying an AARS enzyme with its amino acid substrate. [I think Howard's discarded term "semantic closure" appropriately describes what is being investigated - applying the coding rules to produce the adaptors that apply the coding rules. This is much less than the entire system maintaining itself by self-interpretation (Howard's term, which I take to include the control of metabolism and the possibility of reproduction), what he now calls "semiotic closure".] The physical process in which the each alphabet refinement takes place is a non-equilibrium phase transition in the dynamic system of enzyme turnover, all of which can be described and analysed in physico-chemical terms without any talk of alphabets and symbols; but such an approach would reveal nothing concerning the nature of a symbolic code at the end of it. So the semiotic character of the analysis is germane to it and I hope that it produces a clearer picture of what happened prior to the emergence of the complete genetic code and the Last Universal Common Ancestor (if such a thing ever existed as such) of all organisms.

In this way I hope to contribute to new science by taking a biosemiotic approach. What about a new philosophy? I guess the central question for me is whether systems of signs and their interpretation are somehow innate, preceding, at least in some formal sense, their emergence (first in biological systems); or are they somehow products of material processes? Are they integral to the substance/nature of the universe the way scientists would make such a claim in respect of space/time/energy? [This question is an absurdity to a reductionist scientist but not to a theist. What an awful bind!] Marcello and Stanley seem to give different answers to these questions. I hope the discussion continues and a new philosophical perspective emerges to give a clearer picture of causation in semiotic processes (for me, at least).

Marcello and I are not alone as scientists who decry the degradation of science by technology and its seemingly inevitable commercialism. Especially when the purpose of the technology is conceived with disregard for (or complete ignorance of) the semiotic integrity of biological systems. I find the general analysis of Paul Forman (in *Ber. Wissenschaftsgesch.* 33 (2010) 157 – 175, for example) helpful in understanding how the process is affecting scientists.

Best wishes,
Peter

35

----- Original Message -----

From: [Marcello Barbieri](#)**To:** NEW MAILING LIST**Sent:** Monday, March 28, 2011 9:07 AM**Subject:** For a scientific biosemiotics

Dear Colleagues,

As you can see from the letter below, Lucia Santaella Braga has asked to be included in our Mailing List, and I am of course happy to welcome her! Her address is already present above, so from now on, please reply to this email. In order to update Lucia on our discussion I am attaching a Collage of the letters that have circulated so far (with permission to Claus Emmeche to store it in his blog if he wants to). Thank you, Lucia, and welcome on board!

Best

Marcello

36

----- Original Message -----

From: [Marcello Barbieri](#)**To:** NEW MAILING LIST**Sent:** Monday, March 28, 2011 10:01 AM**Subject:** For a scientific biosemiotics

Dear Stanley,

You write "...I'm sorry to irritate Marcello. However, I think we need to make one more statement: Until Biosemiotics discourse results in a new discovery in biology THAT COULD NOT HAVE BEEN MADE OUTSIDE OF A SEMIOTICS APPROACH, it will remain an interesting philosophy. "

(1) First of all, I do NOT believe that you are sorry to irritate me. On the contrary, I am convinced that you are thoroughly enjoying it!

(2) Secondly, I have already answered your question in the past, and the answer is that Biosemiotics has ALREADY made a new discovery in biology that COULD NOT HAVE BEEN MADE outside the framework of CODE BIOSEMIOTICS.

It is the discovery that the presence of ADAPTORS reveals the existence of many organic codes in Nature in addition to the genetic code. Admittedly, there are also organic codes that have been discovered without the "adaptor-criterion", but that criterion has been crucial to PROVE the existence of the Signal Transduction code, the Splicing Code and of the Cytoskeleton code (to name just a few).

But there is more than that. The "adaptor-criterion", and therefore Code-biosemiotics (the idea that life is coextensive with *organic* semiosis) PREDICTS the existence of many other organic codes in Nature and represents therefore a new research field.

And even that is not all. If you have read my paper (Origin and Evolution of the Brain), you should have caught a glimpse that Code-biosemiotics does offer a new understanding of the history of life. Now, I know that you are totally insensitive to that kind of arguments, but to say that Code-biosemiotics remains "an interesting philosophy" means that you have no idea of what science is about. Believe it or not, science IS about making daring speculations, and there is no point in saying that they are just "interesting" speculations because they are not. They are "testable" speculations, and that makes all the difference!

I repeat: the idea that "life is coextensive with *organic* semiosis" is a "testable" hypothesis (copying and coding can be tested) and represents the very first principle of a scientific biosemiotics. It has already led to the discovery of a few organic codes and it predicts the existence of many more organic codes.

You may enjoy making sarcastic statements on all this, but look at your face in the mirror when you make them and ask yourself "do I really believe this?"

People never change their mind, but perhaps they may start wondering....

Have a good day!

Marcello

37

----- Original Message -----

From: [Marcello Barbieri](#)**To:** NEW MAILING LIST**Sent:** Monday, March 28, 2011 11:46 AM**Subject:** Re: For a scientific biosemiotics

Dear Søren

(First of all, please remember to push the "Reply-to-all" button when you want to send a message to all of us, as you clearly intended to in the letter that I paste below.)

Now for your main point.

You say that "code-biosemiotics does not seem to belong to any of the two paradigms.", and this is absolutely correct. But you also say that "...it is not yet developed enough to present a full alternative in order for us to see how it represents a new solution"

I am sorry, Søren, but this is NOT true. Code-biosemiotics is the idea that "Life is coextensive with *organic* semiosis (organic copying and organic coding), and this is (1) a testable hypothesis and (2) a fully general principle.

The problem, in my opinion, is that, being editor-in-chief of a Journal, you have been far too busy to follow the code-idea in any depth, and, believe me, I do understand that.

Let me give you just an example that proves what I am saying. You have insisted for years on the importance of explaining the "first-person experiences", and in my Brain paper I have described precisely such an explanation. Your reaction? None whatsoever. Again, I do NOT blame you for that because I do know what being editor-in-chief of a Journal means.

But the fact that you have not had the time to "read", let alone to "think", about code biosemiotics does not allow you to keep repeating - as you have been doing several times in the past few years - that code biosemiotics is "not yet developed enough...etc. etc."

It is true that code-biosemiotics is still at a very early stage of development, but the "first basic principles" are in place and they are bearing fruit. Look for example at the model of organic meaning just published by Joachim De Beule in *Biosemiotics*.

That is the PROOF that the approach is working!

But of course the journey has just started, and there is so much to be discovered!

You can certainly say that "we are not there yet", but you cannot say that the journey is not taking place.

Best

Marcello

38

----- Original Message -----

From: "Joachim De Beule" <joachim@arti.vub.ac.be>To: "Peter Wills" <p.wills@auckland.ac.nz>

Cc: Old MAILING LIST (without Santaella-Braga)

Sent: Monday, March 28, 2011 11:00 AM

Subject: Re: For a scientific biosemiotics

Dear Peter Wills,

This mail primarily concerns your first contribution, I did not have time yet to read your new contribution. I think that we are very much on the same line, but I still have some questions and comments:

"...A code is an easily specifiable set of rules for mapping one lot of information onto another (Howard's second definition of code). [...] The alphabets do not have to be different. [...] But for two unrelated bodies of information the complexity of the algorithm (the mapping) will usually be about as large as the information content of the larger body of information."

Perhaps I did not understand well, but I am not convinced that the complexity of a coding algorithm needs to be as large as the amount of information it can code for. For instance, the ASCII mapping from alphanumeric characters to numbers clearly has a finite 'complexity', but can be used to convey an infinite amount of information (any written text).

"...So a code is a mapping of very low complexity and is normally expressible, for sequences (1D patterns) as a symbol-to-symbol mapping. Yes, the code is pure syntax."

I am not sure what you mean by that a code (normally) is a one-to-one mapping between '1D sequences'? Does this include natural language even though it is multi-leveled and not one-to-one: it uses different modalities in parallel (speech, syntax, gesture, prosody, ...) and many phrases have several meanings. Furthermore, although the spoken utterances are 'sequential', I am not sure that their meanings are sequential (1D) structures...

"...The aspect of semantics that has always interested me is that the meaning of a word is defined by using other words and there is no way (that I know of) of writing a dictionary such that you start with some primitive words and bootstrap everything from there. "

I do not think that it is possible to define the meaning of words in terms of other words. It should include how they are linked to neuronal activation patterns corresponding to perceptual (e.g. visual) input and actions. These constitute the 'second body of information', not the entries in a dictionary (there is semiosis, and hence no meaning, in the usage of a dictionary, but not in the dictionary itself: coding is not the same as code, just as meaning is not the same as information).

"... Now, the only way I know of for such a system to come into being is through learning [...] At the start the mapping is not fixed and the transducer that makes the causative connection can be varied – the rules of the mapping can be changed. Then there must be feedback so that the states in the two worlds influence the selection of the connections – certain causative connections get reinforced and others get killed off. "

Do you mean selection in the sense of natural selection, that is, are you thinking of a process of reproduction+variation+selection here?

"... Now I come to the question concerning organic codes. [...] In your reply to me you describe one feature of an organic code that I had not mentioned – adaptors. I agree entirely on the necessity of having adaptors to serve as "assignment vehicles" to determine the meaning (in the second world) of signs (in the first world). I also agree that adaptors make non-deterministic assignments, non-deterministic in the sense that any other set of assignments is equally possible, a priori. I propose to refer to this property as 'arbitrary'?"

The structure of the genetic code does seem to be the result of the interaction between three conflicting forces (expressiveness, precision and energy [Tlusty T (Sept 2010). "A colorful origin for the genetic code:

Information theory, statistical mechanics and the emergence of molecular codes." Phys. Life. Rev. 7 (3): 362–376. doi:10.1016/j.plrev.2010.06.002. PMID 20558115.]

Nevertheless, I do agree with you that the main feature is its arbitrariness and what you say below:

"... The first difference between [the signal transduction code] and this code and the genetic code is that a 1st-messenger may be linked to more than one 2nd-messenger (whereas codons are uniquely assigned)."

But several codons map to the same amino acid, or is that fundamentally different?

"... The second difference is that the 1st-messenger input system acts in a parallel rather than a DNA-sequential fashion, so it is much less information-rich."

I do not understand this, I would think that with parallel information processing much more information can be processed per time unit? For instance, language normally works in parallel (words and syntax plus prosody, gesture, ...) and is generally much more informative than written text.

"... I would be rather reluctant to talk about a code for protein folding because it is difficult to envisage how the process can be modularized in terms of a number of steps from a limited alphabet."

I agree if you mean that the folding does not occur in an arbitrary fashion?

"... the protein acquires organic functions as a result of its folding – it affects and contributes to the overall operation of the cell. And that is what I take finally to be the biological meaning of the information in the DNA encoding the protein. [...] in terms of semiotics, I want to say that the meaning of the 1st-messenger information is to be understood in relation to the organic state/functioning of the system as a whole."

I totally agree, this is what I meant when I said that semiosis involves a code plus an agent that uses it to maintain it, that is a system (which includes the code) that is energetically and information-wise being maintained by the working of the code:

"... What distinguishes organic systems from computers is that the molecular-level semiotic systems they operate are all the time being subject to immediate thermal decay that has to be "fought off" and they have an intrinsic way of using stored information to do this. In other words, organic systems are dependent, for their very existence, on being forever locked into interpreting information that represents (only in terms of their intrinsic semiotic systems) their own production in a Ångströscopically disordered environment."

Again, I think we are on the same line here. So you would also say that for semiosis to occur in a computer, the computer somehow needs to maintain itself (and get the required energy and material resources for that) through the application of its code?

One problem I still have with this line of thinking is that it is not clear to me how to specify the border between a (semiotic) system and its environment. It is intuitively clear that a computer somehow is a separate entity, a "thing", but in interaction with humans it does 'maintain' itself by being useful and 'reproduced' by them. In the case of living systems, like humans for instance, the border is even far less obvious (the 'self/non-self' problem: are all the bacteria that we 'use' for digestion for instance part of us as semiotic systems?). Perhaps this is 'merely' a philosophical issue, but I think that it should receive some answer in order to free us from vague concepts like 'induced semiosis'...

"... Craig Venter's claims to have produced "synthetic life" will continue to be fatuous nonsense until he can produce an organic, semiotic system of the sort that I describe without stealing from living systems ..."

So do you think that it is nonsense to make models of semiotic systems? (a model, e.g. a mathematical formula or a computer program, will never perform self-maintenance in your sense I guess?)

All the best,
Joachim.

39

----- Original Message -----

From: [Marcello Barbieri](#)**To:** NEW MAILING LIST**Sent:** Monday, March 28, 2011 5:22 PM**Subject:** Re: For a scientific biosemiotics

Dear Paul,

(1) "... you mean that cultural semiotics *is concerned with the last form of semiosis that nature has evolved on earth, don't you?*"

Not exactly. What I mean is that "Semiotics" is often described as the discipline that deals with ALL sign-processes, including the biological ones, but in fact its basic reference model is the mind. This is why Peirce ended up by saying that there is "extended mind" throughout the universe.

Cultural semiosis, in short, is the form of semiosis where the human brain is the codemaker.

Organic semiosis is the form of semiosis where the cell is the codemaker.

Let me give you an example of the difference.

In cultural semiotics (or Semiotics *tout court* for most people) the model code is exemplified by the Morse code, i.e. by a relationships that (1) it is perfectly symmetrical, or invertible, (from dot-dashes to letters and viceversa) and (2) where the information of the first world is identical to that of the second world.

In the genetic code, instead, the relationship is NOT symmetrical (it goes from genes to proteins but not viceversa) and the information of the gene world is not identical to that of proteins world.

What I am getting at, is that we have to learn to deal with TWO codemakers in the universe.

The cell at the lower hand and the human brain at the upper one.

(2) You invite me to choose a different name for the organic codes, but why? Should we choose a different names for the proteins of the brain in order to distinguish them from those of the cell?

(3) You blame me for getting away from Peirce and Sebeok, thus showing how ungrateful I am to the people who gave us semiotics and biosemiotics. But who is really faithful to those great pioneers? Those who promise to repeat word by word what they said, or those who take their ideas a bit further and show that, in a new formulation, they are still alive?

Yes, I have changed Sebeok's first principle of biosemiotics, from "Life and semiosis are coextensive" to "Life is coextensive with *organic* semiosis (copying and coding)". But my formulation is "testable" and that is the only way to show that Sebeok's principle is still perfectly valid. Who, then, is continuing his work? And the same is true for Peirce. In my Brain paper I have shown that his concepts are still at the heart of the semiosis that goes on in some nervous systems. Why should we have to accept everything that he wrote in order to be true Peirceans? A historian has the duty to report faithfully what the master said, but a disciple is one who carries his teaching a bit further.

I am not at all sure that Peirce and Sebeok would agree with you if they were alive today.

Best

Marcello

40

----- Original Message -----

From: [Stanley N Salthé](#)**To:** [Marcello Barbieri](#)**Cc:** [New MAILING LIST](#)**Sent:** Monday, March 28, 2011 5:06 PM**Subject:** Re: For a scientific biosemiotics

Replying to both Howard and Peter --

My view can be put succinctly with a subsumptive hierarchy:

{physical world {chemical/material world {biological world}}}

This reflects history (or development) as well as modeling the synchronic structure of any locale.

The lower levels subsume everything found in the higher levels, while the higher levels integrate/harness all the lower level powers that occur locally under their emergent rules.

The levels emerged out of each other by way of historical discovery of pathways for energy flows -- thus:

Energy gradient instability --> search for the fastest dissipation routes (commanded by the Second Law of thermodynamics) generates dissipative structures (here arise proto-PRAGMATICS) --> generation of subsequent material informational tracks (different proto-SEMANTICS) as relatively stable configurations connected to renewable energy sources --> some dissipative structures harness more stable connectivities as local memory cues, generating proto-SYNTAX, by integrating the chemical level in more detail. The stage, as palimpsest, is set:

Then ! POW ! the unknown 'magical' origin of the early genetic apparatus allows reproducibility and spread of hungry protoliving fragments partout, tending to find more locales with renewable energy sources, leading to organic evolution and distinct ecologies.

STAN

41

----- Original Message -----

From: [Søren Brier](#)**To:** [MAILING LIST](#)**Sent:** Monday, March 28, 2011 5:24 PM**Subject:** SV: For a scientific biosemiotics

Dear Marcello

You are right I am behind with the papers for good reason that frustrates me, but I still think you misunderstand what I am saying. I am not saying that you do not have explanatory success on some areas. The code idea is good in many ways.

When you write: Code-biosemiotics is the idea that: Life is coextensive with *organic* semiosis (organic copying and organic coding), and this is (1) a testable hypothesis and (2) a fully general principle, you are talking about a scientific theory, which I think is what you aim at. It has a subject field as you mention and it may even include how it is possible for consciousness to arise in a brain.

But what ontology and epistemology and axiology is raised on?

Does it include a general idea of reality, knowing and values to set up a philosophy of science, everyday knowing and religion, ethics and aesthetics that makes transdisciplinary cooperation possible? Thus is the view of matter, energy, life, information, codes, mind, language and consciousness plus culture compatible over the whole spectrum? I think that the paninformation and –computation paradigm has a serious attempt to cover the whole range in theory in the form of a paradigm of that the world as well as the brain as a sort of computer.

When this is said I think their theory of consciousness, culture and communication is incomplete lacking a concept of meaning, qualia and feeling and therefore wrong in these areas because its understanding here is insufficient and therefore the theory breaks down in its attempt to be transdisciplinary.

Peircean biosemiotics do try to cover the same area too in an architectonic philosophy with a theory of natural and social sciences as well as humanities versus religion and ethics and aesthetics on a different ontology and epistemology based on the famous three categories combined with thycism, agapism and synechism.

Semiology is not able to cover such a vast territory as they cannot really include the living and non-living sciences in the paradigm as it start with language and culture as the subject area. Also the Peircean paradigm has its problems, as I mentioned and I do not think a merger with the code semiotics may be impossible.

But severe work on the basis of the foundational concepts would have to be done.

I do not see code-semiotics coming up at this level still, which is a huge task. But I still do not see how your code-semiotics without interpretation can do this transdisciplinary trick yet. It is also much to ask. But I do ask it as you seem unwilling to take departure in any of the other paradigms available and at the same time you base yourself on some kind of scientific worldview (a belief in the reality of scientific knowledge and scientific progress) without a base in phenomenology as a first “science”.

The ontology of code-semiotics going from physics to psychology over cultural sciences and linguistics is not for me, but it seems to be either some kind of realism that is more than a pure physicalism but still not an informationalism a la Floridi, which Gordana seems to base herself on or a general system organicist view combined with the a view of self-organizing systems as Wolfgang Hoffkirschner or you may lean towards some kind of instrumentalism? I will read your latest article and come back to that later.

Best wishes

Søren

42

----- Original Message -----

From: [Marcello Barbieri](#)

To: MAILING LIST

Sent: Monday, March 28, 2011 6:56 PM

Subject: Re: For a scientific biosemiotics

Dear Søren,

Yes, you are right, I AM talking about a scientific theory, and I have NOT been concerned in public with ontology, epistemology and phenomenology.

These issues are not essential to the building of the code view of life, and in no way I wish to impose my views on the researchers who have joined the approach of the organic codes.

My attitude is “let a thousand flowers bloom”, and that does not come from any great insight. It just follows from the belief that the future is unpredictable, including the future of code biosemiotics.

There is only one point that I want to bring to your attention.

You have written “... I still do not see how your code-semiotics without interpretation can do this transdisciplinary trick.”

To that, I can only underline once again that I am NOT ruling interpretation out. All I am saying is that interpretation was not there at the beginning. At a certain point, however, it did come into existence and we definitely need it to explain animal and human semiosis.

There is no hurry for your comments on my Brain paper. I mentioned it only to show you that I am not running away from issues such as feelings and first-person experiences.

Best

Marcello

43

----- Original Message -----

From: [Paul Cobley](#)

To: MAILING LIST

Sent: Monday, March 28, 2011 6:20 PM

Subject: Re: For a scientific biosemiotics

Dear Marcello,

Thanks for this. Here's my brief response on each point, with (3) being the crucial one:

(1) Pellucid and thought provoking.

(2) Strictly, I didn't invite you to choose a different name for the organic codes. I suppose my implicit question was whether you find the cultural baggage that goes with the term 'code' is sometimes a bit of a burden.

(3) You miss my point, here and, in fact, invert it. There's no 'blame'. On the contrary. Probably I have not made the point clear enough. And one of the reasons I haven't made it clear enough is because of my trepidation about stating it in a way that, likewise, might be misinterpreted. It's simply this: Peirce and Sebeok are not prophets of 'interpretability'; far from it, in the second case. Moreover, I think there's good reason to state, on the basis of the issue of coding that is currently being discussed, that you are the heir to Sebeok. I think that you recognize this in the fact that you treat Sebeok in these discussions as, on the one hand, someone whose work you take “a bit further” and, on the other, as an 'interpretative' whipping boy. I can see how the latter arises for you, but in my reading of Sebeok I incline towards the former.

Best,

Paul

44

----- Original Message -----

From: [Marcello Barbieri](#)**To:** MAILING LIST**Sent:** Tuesday, March 29, 2011 10:02 AM**Subject:** Re: For a scientific biosemiotics

Dear Paul,

I am glad that we agree about point (1).

As for point (2), no, I do not find that the cultural concept of the term “code” is a burden. I only point out that cultural people must become aware that there is a difference between organic codes and cultural codes. We must learn to talk to each other across the culture-nature divide.

Point (3) is, as you say, the crucial one. You write that

“Peirce and Sebeok are not prophets of ‘interpretability’; far from it, in the second case.”

You also say that you fear that your words might be misinterpreted, so I want to avoid the game of who is interpreting what. Let me just describe two facts that do not allow me to accept your point.

(A) The first fact consists in two crystal clear written statements.

[1] In the treatise of Semiotics edited by Posner, Robering and Sebeok (1997), semiosis is defined in this way: “The necessary and sufficient condition for something to be a semiosis is that A interprets B as representing C, where A is the interpretant, B is an object and C is the meaning that A assigns to B”

[2] In his last paper, Sebeok wrote “..there can be NO SEMIOSIS WITHOUT INTERPRETABILITY...etc. *Semiotica*, 134, 61-78 (the actual statement is at page 68).

(B) Whatever are the opinions actually expressed by Peirce and Sebeok (opinions that they did change in the course of their life) it is a fact that Interpretation is THE issue that today divides biosemiotics.

Let me just mention two documents that prove this point.

[1] In “Theses on Biosemiotics” (*Biological Theory* 4(2) 2009, 167–173) the representatives of the “Copenhagen-Tartu School” (Kalevi Kull, Terrence Deacon, Claus Emmeche, Jesper Hoffmeyer and Frederik Stjernfelt) write that their work is grounded “on a strongly Peircean framework” and in that paper semiosis is identified with Peircean semiosis from the origin of life onwards.

[2] Anton Markoš represents today the “Hermeneutic school”, an approach that is based not on Peirce but on Husserl, Heidegger, Gadamer and some Russians. In various publications he has denied that coding is semiosis, and has explicitly stated that semiosis is based on interpretation (see for example Anton Markoš and Jana Švorcová (2009). Recorded versus organic memory. *Biosemiotics*, 2(2), 131-149).

This, Paul, is the real situation, today.

Biosemiotics is divided precisely about the nature of semiosis, about the role of interpretation in it, and this is not just a problem of definitions or terminology.

What is at stake is the possibility of building Biosemiotics on “testable” or “non-testable” hypotheses. On “scientific” or on “philosophical” foundations.

And here comes the stab-in-the-back from Stanley Salthe. What he is insinuating is that the code view of life is just a philosophy like the others. That “testable” hypotheses are chicken feed for sophisticated people like himself. That organic semiosis is wrong because it plays in the hand of the Creationists, etc, etc.

Do you wonder that I felt like murdering him? But now I am ok again. Stanley can go to hell as far as I am concerned. What really matters is that there are so many young people who are still interested in a scientific approach to life and to culture. Let’s work for them, Paul!

All the best

Marcello

45

----- Original Message -----

From: [Marcello Barbieri](#)**To:** MAILING LIST**Sent:** Tuesday, March 29, 2011 4:57 PM**Subject:** Re: For a scientific biosemiotics

Dear Howard,

I wish to reply to the point that you have expressed in this way:

“...You say interpretation is not testable, but copying and coding is testable.”

I admit that I have not been clear enough here (mea culpa) so allow me to rectify.

As a matter of fact I do need to rectify in order to avoid a contradiction.

I said that interpretation was not there at the beginning, but at a certain point it did appear in the history of life, and when that happened it was a real (and therefore testable) property of some living systems. So this is what I need to explain: why can we say that interpretation is not real inside the cell but it is real (and testable) in some nervous systems.

(1) Inside the cell, when a ribosome is decoding a messenger RNA to make a protein, couldn't we say that the ribosome is “interpreting” that messenger?

What's wrong in saying that decoding is a form of interpretation?

Let's make another example. When our fridge is measuring the temperature of the room and decides that it is time to switch the cooling system on, couldn't we say that the fridge is “interpreting” room temperature?

Of course we could, but we are fully aware that we are using a metaphor, an expression that is completely redundant and that can be avoided without any loss.

The same is true for the ribosome. Yes, we could say that it is “interpreting” a messenger RNA, but it would be a redundant metaphorical expression. As metaphorical as saying, for example, that the ribosome is having sex with the messenger RNA, or that the ribosome is reading the poetry of a nucleic acid and translating it into the prose of a protein. Inside the cell, in conclusion, a process of interpretation is entirely metaphorical. The ribosome would perform a ‘real’ interpretation only if it could learn from experience and decide to change the decoding of a messenger RNA.

(2) In some animals, on the other hand, a ‘real’ process of interpretation does take place.

In my Brain paper, I have written:

“...Some animals (like snakes) stop chasing a prey when this disappears from sight, whereas others (like mammals) deduce that the prey has temporarily been hidden by an obstacle and continue chasing it. Some can even learn to follow the footsteps of a prey, which reveals a still higher degree of abstraction. “

This is ‘real’ interpretation, and it is a perfectly testable properties, so much so that we can set up tests that reveals that mammals and snakes have different interpretive abilities.

(3) We conclude that interpretation is a real process in nervous systems but a metaphorical one inside the cell, and this gives us the answer I was getting at. If we define both processes as interpretation, we have a concept that can be extended to all living creatures but which is no longer testable. You simply cannot test a metaphor.

So this is the correct formulation of my statement: “Interpretation is not testable at the molecular level, but it is perfectly testable in nervous systems. Copying and coding are always testable processes”.

On this last point. let me add just one thing. You wrote: “...Copying and coding is all that a dead computer does.”

Please think again. First of all, a computer is never dead because it has never been alive. Secondly a computer does not do any copying and any coding. All it does is switching states on and off. Remember that what goes on in a computer is human semiosis reduced to automatic operations. Copying and coding, in short, are always performed by living systems, at all levels.

All the best

Marcello

46

----- Original Message -----

From: "Søren Brier" <sb.ikk@cbs.dk> To: [NEW MAILING LIST](#)

Sent: Tuesday, March 29, 2011 11:18 AM

Subject: RE: For a scientific biosemiotics

Dear Marcello

I am glad I have the right understanding of your project. I do not quarrel with "All I am saying is that interpretation was not there at the beginning". My major interest is what kind of view of reality (ontology and epistemology) can make an explanatory framework for the amazing fact that interpretation and consciousness arise in the world in the cause of evolution? After moving into psychology from biology in studying brain and behavioural sciences, I realized that the scientific ontology that I carried with me lead to shipwreck on the shores of consciousness and meaningful interpretation. I realized that by studying Konrad Lorenz attempt to overcome this problem through a period of 30 years of research in developing models of cognition for animals to his and Tinbergen's paradigm of ethology. This is what lead me into a reflection on the prerequisites for doing science and for the possibility of transdisciplinarity crossing the borders between physics, biology, psychology and linguistics to mention the most important. I think this is necessary to solve the problems we are dealing with.

Venlig hilsen/best wishes

Søren Brier

47

----- Original Message -----

From: [Vinicius Romanini](#)To: [Marcello Barbieri](#)Cc: [MAILING LIST](#)

Sent: Tuesday, March 29, 2011 6:10 PM

Subject: Re: For a scientific biosemiotics

Dear Marcello

I admire your tenacity and recognize your authority on organic semiosis but, again, let's be careful not to through the baby with the bath water when we try to define concepts such as semiosis and interpretation. Truth is what a community of scientists would expect to reach at the end of their inquiry, and not what is put at the beginning of the road. Semiotics and biosemiotics are too much in their infancy to have lawful definitions.

When you rephrase Sebeok's dicto "[Life is coextensive with semiosis](#)" to "[Life and semiosis are coextensive because life is based on the molecular processes of copying and coding and these processes are organic semiosis because they are based on organic signs and organic meanings](#)" you are putting the threshold of semiosis where you think it should be.

Then you reason by *petitio principii* eliminating any phenomenon which does not fit you definition.

It is smart, but it is not scientific.

Science is not only about Popperian falsifiability, but also about an economy of assumptions.

In this sense, I think Sebeok's statement is better because is more general and inclusive.

If any hypothesis not immediately testable should be dropped a priori, then most of modern theoretical physics and cosmology must be taken as sheer nonsense. String theorists, for instance, have been working on their model for near 20 years now without being able to test any of their hypothesis so far.

Also, interpretability can be much more general than you are assuming. When a photon reaches a rock at any point of the universe, the rock heats and expands. Is it interpreting the photon? You put the bar of semiosis at a height as to deny this possibility. But if we think semiosis as a logical relation among correlates, then interpretation is almost a synonym of time.

Well, but maybe this is too much philosophy for your taste!

All the best,

Vinicius

48

----- Original Message -----

From: [Paul Cobley](#)**To:** NEW MAILING LIST**Sent:** Tuesday, March 29, 2011 6:44 PM**Subject:** Re: For a scientific biosemiotics

Dear Marcello,

Thanks for this. Just one point to make:

(A) The first fact consists in two crystal clear written statements.

[1] In the treatise of Semiotics edited by Posner, Robering and Sebeok (1997), semiosis is defined in this way: "The necessary and sufficient condition for something to be a semiosis is that A interprets B as representing C, where A is the interpretant, B is an object and C is the meaning that A assigns to B"

[2] In his last paper, Sebeok wrote "...there can be NO SEMIOSIS WITHOUT INTERPRETABILITY...etc. *Semiotica*, 134, 61-78 (the actual statement is at page 68).

It's possible that some on this mailing list will not know the English actor/comedian/writer, Ricky Gervaise. Well before he was famous, I got infuriated with him because he was on an indie radio station and took part in a debate over which was best: Led Zeppelin or Black Sabbath (the answer is Black Sabbath, for those who don't know). Gervaise came out in support of Zeppelin – that raised my ire. But his point was that when comparing Zeppelin and Sabbath, you have to take into account Sabbath in its entirety – not just the glory years, 1968-78 with Ozzy, but the years with Dio and Gillan, and then when Ozzy returned. This made me more angry because I knew his point was true (although it doesn't change the fact that Black Sabbath were better). I'm playing Gervaise in relation to Sebeok, now.

Incidentally, do leave me out of your fight with Stan. I'm certain he means well.

Best,

Paul

49

----- Original Message -----

From: [Marcello Barbieri](#)

To: [Alexei Sharov](#) ; [Almo Farina](#) ; [Angelo Recchia Luciani](#) ; [Anton Markos](#) ; [Argyris Arnellos](#) ; [Bruce Weber](#) ; [Catherine Cotton](#) ; [Charbel El-Hani](#) ; [Claus Emmeche](#) ; [Cliff Joslyn](#) ; [Daniel Mayer](#) ; [Dario Martinelli](#) ; [Don Favareau](#) ; [E liseo Fernandez](#) ; [Franco Giorgi](#) ; [Frederik Stjernfelt](#) ; [Gerald Ostdiek](#) ; [G rard Battail](#) ; [Guenther Witzany](#) ; [Han-liang Chang](#) ; [Howard Pattee](#) ; [Jannie Hofmeyr](#) ; [Jesper Hoffmeyer](#) ; [Joachim De Beule](#) ; [Joanna Raczaszek-Leonardi](#) ; [Jo o Carlos Major](#) ; [John Collier](#) ; [John Deely](#) ; [Kalevi Kull](#) ; [Karel Kleisner](#) ; [Liz Stillwaggon Swan](#) ; [Louis Goldberg](#) ; [Lucia Santaella Braga](#) ; [Luis Emilio Bruni](#) ; [Marcel Danesi](#) ; [Marcello Barbieri](#) ; [Morten T nnessen](#) ; [Myrdene Anderson](#) ; [Natalia Abieva](#) ; [Paul Cobley](#) ; [Peter Harries-Jones](#) ; [Peter Wills](#) ; [Prisca Augustyn](#) ; [Sergey Chebanov](#) ; [S ren Brier](#) ; [Stanley Salthe](#) ; [Stefan Artmann](#) ; [Stephen J. Cowley](#) ; [Stephen Pain](#) ; [Terrence Deacon](#) ; [Timo Maran](#) ; [Victoria Alexander](#) ; [Vinicius Romanini](#) ; [Wendy Wheeler](#) ; [Winfried N th](#) ; [Yagmur Denizhan](#)

Sent: Wednesday, March 30, 2011 9:52 AM**Subject:** Re: For a scientific biosemiotics

Dear Vinicius and Paul,

Let me reply to the two of you as representatives of the “humanities”, because it is imperative that we understand what is going on in biosemiotics today.

(1) Code biosemiotics has an extraordinary new idea to offer to modern biology: the idea that all great events of macroevolution were the result of new organic codes. That idea has been put on a sound experimental basis by proving that many organic codes exist in Nature by the presence of molecular adaptors. In the past ten years a variety of organic codes have been discovered even with other criteria, but the adaptor-criterion (the one that proved the existence of the genetic code) remains the king one (see in attachment a paper on a new code, as an example).

(2) In addition to (a) the relationship between codes and macroevolution, Code biosemiotics has proposed other two great concepts: (b) the idea that the cell is not a dualistic system but a trinity of genotype, phenotype and ribotype, and (c) the idea that evolution took place by natural selection and by natural conventions (copying and coding).

(3) In order to prove that all above ideas are “scientific”, I had to use the criterion that they are “testable”, and that is why I have been saying that even “interpretation” must be defined in such a way that tests are possible (which they are).

(4) The two major schools of Biosemiotics, today, are squarely based on “interpretation”, either in the Peircean sense (the Copenhagen-Tartu school) or in the Husserl-Heidegger sense (the Hermeneutic school of Prague). They have either attacked the organic codes idea or dismissed it by saying that it is “too narrow”, “too limited”, etc. etc. (first, it is not true; second it is true but not important; third, it is important but it is already included in our theory).

The result is that biosemiotics is still largely perceived as one of the many anti-science movements that are based either on “Peircean hylozoism” or on “continental obscurantism”.

Now, THIS is the reality, today, and in such a situation I repeat my appeal.

Code biosemiotics is not against philosophy, it is against an outdated philosophy.

It states that the first principle of biosemiotics is that “Life is coextensive with *organic* semiosis”, because it is only on this principle that the science of biosemiotics can be built.

But a new science of life is also bringing with itself a new philosophy of life, and THAT is what you should be doing. Look forward, for goodness sake!

All the best

Marcello

50

----- Original Message -----

From: [Paul Cobley](#)**To:** brr@unife.it**Sent:** Wednesday, March 30, 2011 11:07 AM**Subject:** Re: For a scientific biosemiotics

Dear Marcello,

“.... Look forward, for goodness sake! “

Correct.

Thanks for the article.

Best,

Paul

51

----- Original Message -----

From: [Howard Pattee](#)**To:** [Vinicius Romanini](#) ; [Marcello Barbieri](#)**Cc:** NEW MAILING LIST**Sent:** Wednesday, March 30, 2011 1:31 PM**Subject:** Re: For a scientific biosemiotics

Dear Marcello,

I think it is clear that we disagree primarily on our interpretations of how words are defined and interpreted.

I have *defined* what I have argued is the simplest system that would allow the objective use of epistemic concepts like *interpretation* and *agent*. Briefly, such a system is an organization with a *heritable symbolic description* that can *construct* the interpreting structures of its own symbols. This requirement I have called the *semiotic closure principle* which provides an objective, testable criterion for distinguishing *interpretation* from all other physical *interactions*. According to this *definition*, the cell is *observed* to be the simplest natural case of an interpreting system. (It does not exclude the possibility of an artificial autonomous agent.)

Definitions are neither true nor false, but they may be accepted or rejected on logical, pragmatic, or aesthetic grounds. Why do I think *semiotic closure* has a *useful* definition? First, it is based on the Peircean *irreducible* triadic definition of symbol as an arbitrary sign related to its referent by an interpreter. Second, it satisfies von Neumann's logical condition for *evolvable self-replication*. This requires two interpretations of the description one for copying and one for construction. Third, it conforms to definitions of an *autonomous agent* that allows the concept of a population distribution of unique individuals necessary for natural selection. Fourth, it is consistent with current facts of molecular biology.

I am a linguistic conservative. I have found communicating ideas is less ambiguous if I do not coin novel words or change the accepted meaning of words. Instead I rely on metaphors. Good metaphors become part of the language. For example, Schrödinger's use of *code script* was initially a metaphor, but as with all good metaphors *genetic code* is now literal and in many dictionaries under *code*, as is *computer code*. I think you are fighting a losing battle if you try to restrict natural language evolution of word meanings.

Respectfully,

Howard

52

----- Original Message -----

From: [Marcello Barbieri](#)**To:** [Vinicius Romanini](#) ; [Howard Pattee](#)**Cc:** NEW MAILING LIST**Sent:** Wednesday, March 30, 2011 3:23 PM**Subject:** Re: For a scientific biosemiotics

Dear Howard,

I hope you don't mind if I announce it in public, here and now, that some time ago I have asked Joanna Raczaszek-Leonardi to edit a volume in our Book Series of Biosemiotics that collects all your major essays. It is entitled:

“Howard Pattee’s physics of symbols: classic papers and contemporary comments”

The title that I had originally proposed was

“Physical Biosemiotics: the heritage of Howard Pattee”

which may be maintained as a subtitle of the book.

This is proof enough, I hope, of the importance that I attribute to your work.

It also explains why I am sad (but not surprised) that we disagree on interpretation.

You write “I am a linguistic conservative. I have found communicating ideas is less ambiguous if I do not coin novel words or change the accepted meaning of words.”

But you HAVE COINED novel words...and you HAVE CHANGED the accepted meanings of words.

This is why I see myself as continuing the work that you (and Sebeok) have started a long time ago. .

Despite your disagreement.

Yours, with the same respect as always

Marcello

53

----- Original Message -----

From: [Howard Pattee](#)**To:** [Marcello Barbieri](#) ; [Vinicius Romanini](#)**Cc:** NEW MAILING LIST**Sent:** Wednesday, March 30, 2011 5:07 PM**Subject:** Re: For a scientific biosemiotics

Dear Marcello,

Don't be sad if we disagree on some points! This discussion would not be interesting or productive if we agreed on everything. I also greatly appreciate your efforts to republish some of my old papers.

I clearly agree with you about the importance of codes. Here is the conclusion of my coding paper at Waddington's 1966 Bellagio meeting: *“the characteristic sign of biological activity at all levels [including brains] is the existence of efficient and reliable codes”* (Pattee, 1968. *The Physical Basis of Coding and Reliability in Biological Evolution*. In *Towards a Theoretical Biology, 1, Prolegomena*, C. H. Waddington (Ed.), Edinburgh University Press, p. 89).

Where I seem to not to agree with you is that Peirce's semiotics is outdated, or that he is perceived mainly as a hylozoist, any more than Newton is perceived mainly as an alchemist (which in fact he was). Peirce knew that while the reduction of networks to triadic relations was logically possible, it is often conceptually confusing to logically reduce natural structures of interpretative networks to triadic relations. In particular, we know that the structure of the brain forms some kind of distributed concurrent network. The interpretation of human language has turned out to be more effectively modeled as a network relating many nodes at several hierarchical levels. Many types of such *semantic networks* are now used in artificial intelligence, computational linguistics and knowledge representation. Network representation is also essential in studying genetic and protein interactions. Peirce would understand this because his later *existential graphs*, although never fully developed, were precursors of semantic networks (e.g., Sowa, J. F. 2000. *Knowledge Representation*. Pacific Grove, CA: Brooks/Cole)

Howard

54

----- Original Message -----

From: [Marcello Barbieri](#)
To: [Vinicius Romanini](#) ; [Howard Pattee](#) **Cc:** NEW MAILING LIST
Sent: Wednesday, March 30, 2011 6:03 PM
Subject: Re: For a scientific biosemiotics

Thank you, Howard!

Let me underline that I have fully accepted Peirce's model of semiosis in nervous systems (as you can see in my Brain paper). What is outdated, in my opinion, is the claim that Peirce's model (interpretive semiosis) applies to ALL forms of semiosis. It does NOT apply to the cell, in my opinion. The brain and the cell are the two great codemakers in the universe, and the Peirce model is valid only in the brain (mind).

You have said that it is valid also in the cell (hence our disagreement) but this is only because you have defined a self-description as a self-interpretation. And that, I am afraid, is not true.

But please let us not start another round of discussion on this point.

I am content of the fact that we both believe in a scientific biosemiotics, and that we are both working to bring it into existence. Have a good evening!

Marcello

55

----- Original Message -----

From: "Kalevi Kull" <kalevi.kull@ut.ee>
To: "Marcello Barbieri" <brr@unife.it> **Cc:** MAILING LIST
Sent: Wednesday, March 30, 2011 6:22 PM
Subject: Re: For a scientific biosemiotics

Dear Marcello,

does this mean that you do not agree with the following sentence (esp. the part in the brackets) as a general statement that also applies to the cell:

"A code, in other words, requires three entities: two independent worlds and a codemaker which belongs to a third world" (from a philosophical point of view this is equivalent to the triadic system proposed in semiotics by Charles Peirce)." Warm regards

Kalevi

56

----- Original Message -----

From: [Marcello Barbieri](#)
To: MAILING LIST
Sent: Thursday, March 31, 2011 9:06 AM
Subject: Re: For a scientific biosemiotics

Dear Kalevi,

Of course I agree with that statement! But what it means is that the cell is a triadic system (genotype, phenotype and ribotype) not that the cell is an "interpretive" triadic system! As I said before (but you don't listen) the Peircean model is triadic but not all triadic systems are Peircean. The cell is "decoding" the genome, but it is not "interpreting" it!

Decoding is when the translation of a message has always the same result. Interpretation is when it can have different results (or meanings). The translation of a messenger RNA can be regulated (by another code), but when it is done it is always done according to fixed rules.

In short, the context-dependent behaviour of the cell (and of some lower animals) is due to the combination of many organic codes, and it is substantially different from the context-dependent behaviour of higher animals that is due to genuine processes of interpretation (processes that can be tested).

If you do not distinguish between decoding and interpretation, you simply cannot describe what is taking place in Nature and what has happened during the evolution of animals! Best

Marcello

57

----- Original Message -----

From: [Vinicius Romanini](#)**To:** [Kalevi Kull](#) **Cc:** MAILING LIST**Sent:** Wednesday, March 30, 2011 10:19 PM**Subject:** Re: For a scientific biosemiotics

Dear Marcello,

Let me start by publicly thanking you for inviting me to participate in such an lively and interesting debate, even knowing that I would probably annoy you with my interventions.

Allowing representatives of the "humanites", as you say, into the arena proves that you are ultimately interested in fostering the debate and, considering the energy and tone of some of your own messages, stir the water as much as possible.

This is even more true since you invited me to edit a volume of the Book Series of Biosemiotics about "Peirce and Biosemiotics" knowing (at least I hope) that I try as much as possible to take Peirce's semeiotic as part of a systematic philosophy in which phenomenology and metaphysics cannot be separated.

I also thank you for your brief account, sent in your last message, of how Biosemiotics has been developed in the last years and the specific reference you gave about the tubulin code, although much of its content is beyond my competence.

That being said, I must protest against your tentative to patronize philosophy and to put it under what you call scientific biosemiotics. This is the kind of serpent's egg that has led to great mistakes and even tragedies. Moreover, I don't take Peirce's objective idealism (which can indeed be described as a sort of hylozoism) to be anti-scientific. It is just not compatible with many positivistic assumptions that still guide much of our science today.

I am not saying that it is to be taken as a creed. But neither must it be rejected by personal prejudice.

Bohm, Prigogine, Penrose, Smolin and dozens of others scientists have entertained the idea that a flow of information leading to synthesis of new properties - precisely what Peirce thought of a pervasive semiosis - is fundamental in nature.

This is not outdated nor anti-scientific. It continues to be a valid hypothesis until it is refuted scientifically.

You are much better than Torquemada! All the best,

Vinicius

58

----- Original Message -----

From: [Marcello Barbieri](#)**To:** [Vinicius Romanini](#) ; [Kalevi Kull](#) **Cc:** MAILING LIST**Sent:** Thursday, March 31, 2011 10:28 AM**Subject:** Re: For a scientific biosemiotics

Dear Vinicius,

The fact that I have proposed to dedicate a volume of our Book Series to Peirce should be proof enough that I am not against Peirce (I have used many of his concepts myself). What I am against is the Peircean "fundamentalism".

The fact that I have invited YOU to edit that volume, should prove, I hope, that I do accept pluralism. The fact that I have asked so many people from the "humanities" to join the Editorial Board of Biosemiotics should be proof enough that I do NOT patronize philosophy.

But yes, I am committed to a scientific biosemiotics. I also believe that a new science needs a new philosophy so I am genuinely looking for a real contribution from humanists. So far, what I have got is mostly slaps in the face and accusations of being an obtuse positivist. But not from everybody. Luckily, some young philosophers are beginning to see that the organic codes open up a new view of life, and that is enough for me.

Your book on Peirce will be published because it will be a document of what the present state of Peircean research actually is. That's all. It will certainly not be a book in favour of my views, but that does not bother me. I only hope that it is a good book. Best

Marcello

59

----- Original Message -----

From: "Kalevi Kull" <kalevi.kull@ut.ee>

To: "Marcello Barbieri" <brr@unife.it>

Cc: MAILING LIST

Sent: Thursday, March 31, 2011 11:22 AM

Subject: Re: For a scientific biosemiotics

Dear Marcello,

Thank you, I think we have got a step closer, at least potentially, again.

First, to those who want to find the sentence I quoted - ("A code ... is equivalent to the triadic system proposed in semiotics by Charles Peirce") - it has appeared in Barbieri, M. 2002. Organic codes: metaphors or realities? *Sign Systems Studies* 30(2): 743-754 (p. 747), and exactly in the same formulation in Barbieri, M. 2003. *The Organic Codes: An Introduction to Semantic Biology*. Cambridge: Cambridge University Press (p. 5).

But now, I indeed agree with your well formulated distinction:

**

Decoding is when the translation of a message has always the same result.

Interpretation is when it can have different results (or meanings).

**

I would add (and I expect you can agree with this) that interpretation is a process in which a new code can be established. Coding alone is not enough to create a new code, it just repeats the existing one.

Now, we have definitions that may allow us to investigate, whether on the cellular level it might be possible to have a mechanism that is more than coding, i.e. that would establish a new code.

When can we speak about a NEW code? Obviously, when the relation that will appear is not a deterministic result of (and thus, not deducible from) already existing one. Because if it is deducible, then there are no 'different results', there is just one, therefore it can be said to be a part of the same, already existing code. But if there are many possibilities from which one will be chosen by the cell then it can be a new code.

Let us leave out the situation of the origin of life and look at the system where we already have some living cells. How a new code may arise in this system?

This is clearly a problem that has not well studied yet. But let us try to tackle it.

Because if we shall find such a mechanism on a cellular level, then we can conclude that there is interpretation on a cellular level, and if we can demonstrate that there is no such mechanisms in cells, then we should conclude that there is no interpretation on the cellular level.

Before going on, let me ask, whether you accept this method to find the answer?

With best regards,

Kalevi

60

----- Original Message -----

From: [Marcello Barbieri](#)**To:** NEW MAILING LIST**Sent:** Thursday, March 31, 2011 3:59 PM**Subject:** Re: For a scientific biosemiotics

Dear Kalevi,

Let me repeat it again: when I wrote that “the triadic system of the cell is equivalent, from a philosophical point of view, to the triadic system proposed by Charles Peirce”, I meant that both systems have a triadic logic, NOT that the cell is an “interpreting” triadic system.

But I must immediately add that your letter has been a pleasant surprise to me.

I simply did NOT expect that you would accept the distinction between decoding and interpretation.

So, yes, we have indeed got a step closer, on that point.

I am afraid, however, that after that we depart again.

You say that “interpretation is a process in which a new code can be established. Coding alone is not enough to create a new code, it just repeats the existing one.”

The last part is true (“Coding does not create a new code”), but the first part is not. It is not true, in my opinion, that “interpretation is a process in which a new code can be established”.

And this brings us to the problem of problems: “What is it that brings a new code into existence?”

THIS, Kalevi, is the real new frontier of biosemiotics, and of biology as a whole.

But here we must be humble. It is an entirely new field of research, and we simply don’t know where it will take us. A beginning, however, has been made.

It has been made by Joachim De Beule in the paper that I am sending in attachment. And I am attaching also the Editorial where I have introduced Joachim’s paper.

Have a good read!

Marcello

61

----- Original Message -----

From: [Stanley N Salthe](#)**To:** [Marcello Barbieri](#)**Cc:** NEW MAILING LIST**Sent:** Thursday, March 31, 2011 4:21 PM**Subject:** Re: For a scientific biosemiotics

Folks -- I take note of:

“ 2011/3/31 Marcello Barbieri <brr@unife.it>

Dear Kalevi,

Let me repeat it again: when I wrote that “the triadic system of the cell is equivalent, from a philosophical point of view, to the triadic system proposed by Charles Peirce”, I meant that both systems have a triadic logic, NOT that the cell is an “interpreting” triadic system. “

This is the same reasoning I use in generalizing the Peircean perspective to physiosemiotic systems.

The triadic logic can be applied to abiotic locales, as I try to show in a forthcoming paper.

At its own scale the cell is also a physicochemical system.

STAN

62

----- Original Message -----

From: [Søren Brier](#)**To:** ['Marcello Barbieri'](#) ; [Vinicius Romanini](#) ; [Kalevi Kull](#)**Cc:** [MAILING LIST](#)**Sent:** Thursday, March 31, 2011 11:54 AM**Subject:** SV: For a scientific biosemiotics

Dear Marcello

You write

“...I also believe that a new science needs a new philosophy so I am genuinely looking for a real contribution from humanists.”

I think this is what our whole discussion is about.

Therefore we need to move in a broader area of the paradigm.

You write in one of your answers:

"Biosemiotics is divided precisely about the nature of semiosis, about the role of interpretation in it, and this is not just a problem of definitions or terminology. What is at stake is the possibility of building Biosemiotics on “testable” or “non-testable” hypotheses. On “scientific” or on “philosophical” foundations."

It seems that you are in a philosophical paradigm often called realistic scientism, which has the belief that their philosophy of science is not a philosophy but a science and that science can be done without philosophy or that it has a so obvious philosophy that we do not reflect much about it. Is this where we differ? For you philosophy seem to the same as "armchair philosophy" and has no connection to empirical science?

The view I have - and which I presume many of your opponents in this discussion matter have - is that science and philosophy have to be deeply integrated in a mutual developing process in order to produce any knowledge and understanding at all. But may be it is your view too. If so we can have a much more fruitful discussion.

You have the belief that interpretation is only in the brain, not in the cell.

Is that science and not philosophy? Is consciousness just a scientific fact, though its origin elude us?

As far as I am concerned there is no scientific explanation of consciousness in evolutionary theory and a reflection on what it means that consciousness is the prerequisite for any scientific explanation what so ever. Both the phenomenon of life and of consciousness influences our view of the scientific endeavor.

In my view this is an important part of what Peirce worked with.

He did by developing a phaneroscopic view of logic and science – and religion as well.

Venlig hilsen/best wishes

Søren Brier

63

----- Original Message -----

From: "Joachim De Beule" <joachim@arti.vub.ac.be>

To: MAILING LIST

Sent: Thursday, March 31, 2011 4:50 PM

Subject: Re: For a scientific biosemiotics

Dear Marcello and Kalevi.

Your previous contributions have confused me, so I hope that you can find the time to comment on an some issues, even though what follows has become much longer than planned, sorry for that.

1) Kalevi says that

"...[we can speak of a NEW code] when the relation that will appear is not a deterministic result of (and thus, not deducible from) already existing one. Because if it is deducible, then there are no 'different results', there is just one, therefore it can be said to be a part of the same, already existing code. But if there are many possibilities from which one will be chosen by the cell then it can be a new code."

I think you are asking how a new code can ever emerge if, on the one hand it must be arbitrary, and on the other hand it can not be the result of a deterministic process?

I think that this paradox appears merely because some distinctions are missing in the problem formulation.

In particular:

- Arbitrary vs deterministic.

I think that we agree that coding, by definition, is arbitrary. It is perfectly possible that a code is both arbitrary and deterministic. For example, I will always refer to Marcello as "Marcello", because that is his name. The genetic code is another example.

- Agent vs environment.

The fact that a code, by definition, is arbitrary, implies that its function (it's 'usefulness' in the sense of Howard Pattee's semantic closure or of what was said by Peter Wills), does not follow from the code itself, but always depends on the specific context in which it is applied. Thus, I think that it is crucial to distinguish between code-user (= agent) and environment (= context), and to always take both into account as separate (but interacting) entities in our models.

Thus, a child learning English is forming a new, private code, which is distinct from the communal code. The private code is new even though a communal code (English) already exists. After acquisition, the private code will be in accordance with the communal code, and hence deducible from it. Therefore, I do not agree when you say that "the relation that will appear is not a deterministic result of (and thus, not deducible from) already existing one."

- conventional vs non-conventional codes.

I refer to codes that are useful within a given ensemble of contexts as conventional codes.

Thus, conventionality is a property of a particular code in a particular type of context.

For example, in the context provided by England, the English code is conventional, but the French code is not. It is well known that language acquisition can influence the communal language (consider for instance creolization or the case of Nicaraguan sign language). Thus new code users, by adopting and applying their private codes, can change the environment and thereby have an effect on conventionality itself.

Furthermore, new conventional codes can even be formed from a situation in which no such codes exist.

For instance, many experiments have already illustrated how a new, deterministic, arbitrary language for naming objects can emerge among a group of robots, even though they all were initialized without a code, merely with the capacity to propose and adopt new codes and to align themselves during language games (cf. the work of Luc Steels).

So far I have given examples from natural language, but similar illustrations can readily be made for molecular coding. For instance, during development, the adaptive immune system is forming a code in interaction with the environment. The environment contains other organisms applying their own codes. As all organisms in the environment need to coordinate their codes in order to distinguish between beneficial and harmful 'communication partners', conventional codes will emerge. As the developing immune system tunes in to the actual environmental conditions that it experiences, it becomes more and more deterministic and conventional itself, etc.

The case of the genetic code is more restricted.

The cell does not seem to have any means to change the code during life-time, that is, as the result of learning. I think that this might have to do with the fact that the genetic code is one of the oldest codes on earth. As such, it will be more constrained by low-level physico-chemical considerations, as well as have become so conventional that it is the only code left. However, this would predict that mechanisms are at work that keep it from changing.

2) You both seem to agree that the fundamental difference between coding and interpretation is the way in which they depend on context. I would think that this is the wrong distinction.

Again, let me distinguish between agent and environment. This way, we can identify 'the context of semiosis' with any information that is coming from the environment.

Now consider 'coding semiosis': the molecular application of a fixed but arbitrary set of molecular 'rules' (adaptors) corresponding to the occurrence of chemical reactions within an agent that transform 'form' molecules to 'meaning' molecules (e.g. mRNAs to proteins).

Schematically this can be represented as follows:

$f_1 + c_1 \rightarrow m_1,$

$f_2 + c_2 \rightarrow m_2,$

...

Each line specifies a coding rule: a chemical reaction in which a 'form' molecule f_i reacts with an 'adaptor' molecule c_i to produce a 'meaning' molecule m_i . Reaction takes place within an agent (the code user) whenever the required reactants are available (an f and a c).

Adaptors (the c molecules) are part of the agent, whereas the forms could be provided by the environment. Then it will be the environment (i.e. the context) that determines which rules get applied, and it can be seen clearly how context may influence semiosis, although the coding itself "always has the same result."

Now Marcello says that

"... the context-dependent behavior of the cell (and of some lower animals) is due to the combination of many organic codes".

Adding additional codes to the picture makes it possible that the final result of coding depends on specific combinations of environmental inputs (forms), so that the decoding of a single form will be different depending on other availability of other 'contextual' forms. Is this what you mean when you say that context-dependent behavior can result from the combination of codes?

3) I may very well be ignorant on this issue, but I do not see how an additional context-dependence can be introduced besides through the mechanisms explained. This is why I do not agree with explaining the difference between pure coding and interpretation through their dependence on context.

I think that any difference between 'deterministic' and 'interpretative' behavior should be located within the agent. For instance, a new type of semiosis could occur when the code is adaptive, that is, when it can change during the life-time of the agent, for instance as the result of learning. This clearly is the case for a child learning a language, but not for a cell employing a fixed genetic code.

Being a newcomer to this field, I am sure that my terminology is not adequate and that my thinking contains many flaws, so I would appreciate it if you would enlighten me.

All the best,
Joachim.

64

----- Original Message -----

From: [Marcello Barbieri](#)

To: MAILING LIST

Sent: Thursday, March 31, 2011 5:58 PM

Subject: Re: For a scientific bisemiotics

Dear Joachim,

Quite frankly you have raised so many points that a whole Gathering would not be enough to deal with! Here, therefore, I will concentrate on just one of them. More precisely on the one point where there seems to have been some misunderstanding.

You write:

“... 2) You both seem to agree that the fundamental difference between coding and interpretation is the way in which they depend on context. I would think that this is the wrong distinction. ...”

and again:

”... This is why I do not agree with explaining the difference between pure coding and interpretation through their dependence on context.”

I must say, Joachim, that I never meant anything of the kind!

The difference between coding and interpretation comes from two different ways of processing the signals from the environment (context). It comes from within the system, not from without.

This seems to be your conclusion as well, so I do not see any disagreement on this issue.

As for the other points... perhaps you could organize a Gathering in Brussel, some day!

Or shall we discuss them in New York?

Best

Marcello

65

----- Original Message -----

From: "Kalevi Kull" <kalevi.kull@ut.ee>

To: "Marcello Barbieri" <brr@unife.it>

Cc: MAILING LIST

Sent: Thursday, March 31, 2011 7:22 PM

Subject: Re: For a scientific bisemiotics

Exactly so, as Marcello says, I agree:

”...The difference between coding and interpretation comes ... from within the system, not from without.”

But more precisely, of course, most of semiotics makes a useful distinction between environment and context, so that what is the context for a particular semiotic system depends also from the system (and its level) itself.

Best,

Kalevi

66

----- Original Message -----

From: [Paul Cobley](mailto:Paul.Cobley)**To:** joachim@arti.vub.ac.be ; brr@unife.it **Cc:** MAILING LIST**Sent:** Thursday, March 31, 2011 5:32 PM**Subject:** Re: For a scientific biosemiotics

Dear Joachim (and Marcello and Kalevi),

Thanks for this intervention. I'm also looking forward to reading your paper.

I'm learning from this exchange and I look to those of you who are more informed about biology and the practice of science because I'm simply not qualified to judge in that area.

However, in respect of your example of natural languages to base your observations, I do know that code models are dwindling into the minority in the study of communication. Few in the field operate as though there is such a thing as stable 'languages' characterized by fixed elements such as phonemes and called things like 'French'. The strongest and most cogent statement against the fixed-code tendency of some generativists, behaviourists and structuralists is to be found in the work of Roy Harris and his integrationist colleagues if you want to follow this up.

Similarly, there is an issue with 'interpretation' set against 'decoding' if we're relying on pointers from so-called 'cultural semiotics'. The distinction between fixed meanings that can be passed on and later interpreted and 'interpretation' has been a thorny issue in semiotics in the last 100 years, irrespective of what constitutes Peircean 'interpretability'. There has been a vested interest in the arts and humanities which has held that semioses are routinely decoded and then (sometimes aberrantly) interpreted. Increasingly, though, and stated a long time ago and quite clearly in the work of Roland Barthes, Umberto Eco and Stanley Fish (to name just a few), there has been a realization that there is no such thing as ideation before interpretation. Ideation is cotemporal with interpretation. There are important political consequences attendant on this realization.

Now, I'm merely stating the matter in respect of 'cultural semiotics' (some of which, it has to be said, still operates as if codes existed). If there are analogous circumstances to those I've described and these occur in the world of plants and animals or, conversely, if there are *no such* analogous circumstances, I look to you from the world of science to lead on that question. However, I and others will continue to be uncertain where to stand if your comparison of phenomena in *nature at large* and *that small part of nature known as culture* continue to be based on a very partial importing and, yes, interpretation, of concepts from the analysis of culture.

Best,
Paul

67

----- Original Message -----

From: <deacon@berkeley.edu>**To:** "Marcello Barbieri" <brr@unife.it>**Cc:** MAILING LIST**Sent:** Thursday, March 31, 2011 5:24 PM**Subject:** Re: For a scientific biosemiotics

"... a machine has solely motive power, whereas an organized being possesses inherent formative power, and such, moreover, as it can impart to material devoid of it — material which it organizes. This, therefore, is a self-propagating formative power ..."

— Kant, Critique of Teleological Judgment, 1790

Terry

68

----- Original Message -----

From: [Victoria N. Alexander](#)**To:** [Marcello Barbieri](#)**Cc:** [MAILING LIST](#)**Sent:** Thursday, March 31, 2011 10:49 PM**Subject:** Re: For a scientific biosemiotics

Marcello wrote to Kalevi:

"...I simply did NOT expect that you would accept the distinction between decoding and interpretation. So, yes, we have indeed got a step closer, on that point. I am afraid, however, that after that we depart again."

It sounds like we're starting to dance.

The idea, that "interpretation" must be potentially fallible or it is not an interpretive response at all but a reaction instead, is, I wager, fairly universal among Peirceans. T.L. Short makes this point repeatedly in his book. I think most of us probably understand that many semiotic processes go on fairly predictably, especially in more simple systems. A simple semiotic system may not have the capacity to respond to a sign in any other way than that for which it has been selected. However, sometimes responses can go wrong. The "wrong" ligand similar enough to the "right" ligand might provoke a response leading to a different type of effect, which might then be selected, initiating a change in the species. Thus, the interpretative act here may not occur at the individual level. It may occur at the level of the species. Human interpretation, likewise, does not occur at the level of a single neuron. It is the result of the effects of populations of neurons responding (and being "selected," reinforced, or not) over time. Thus I don't see how human interpretation can be categorically different than, say, chemotaxis. If you look at people in society they can certainly seem as mindless as bacteria.

A semiotic system usually (if not always) makes its own self-reproducing tools. This tool-making needs to be much less open to interpretation (error) than tool-using. But it is somewhat open (at some other level), otherwise evolution is impossible.

Understanding the genetic "code" (not sign) is surely valuable to all of us. (I admit I do not know enough, somehow I think it's only part of what it means to be a semiotic agent and thus I've bracketed it off for the moment in my own research.) Without it, we may not be able to say how the effective interpretive responses found in one generation are recorded (encoded) and passed onto the next. What gets passed on is the capacity to respond to signs in ways that are beneficial, i.e. meaningful. My question is, is tool-making or agent-making a semiotic process, when the tool or agent is pretty faithfully reproduced? Or is tool-using the essence of a semiotic process? Or maybe they both are, but we have to be careful that we indicate which part of the process we're talking about.

Do-se-do!

Victoria N. Alexander, Ph.D.

Dactyl Foundation

69

----- Original Message -----

From: "Peter Wills" <p.wills@auckland.ac.nz>To: "Joachim De Beule" <joachim@arti.vub.ac.be>

Cc: MAILING LIST

Sent: Friday, April 01, 2011 5:13 AM

Subject: Re: For a scientific biosemiotics

Dear Joachim,

You comments and questions are all very pertinent and helpful. In answering them I'll try and clarify what I meant and correct anything I think I was wrong about.

"...Perhaps I did not understand well, but I am not convinced that the complexity of a coding algorithm needs to be as large as the amount of information it can code for. For instance, the ASCII mapping from alpha-numeric characters to numbers clearly has a finite 'complexity', but can be used to convey an infinite amount of information (any written text)."

You are right and I did not mean that. Let me clarify. If I have two randomly generated sequences ("bodies of information", bits stored in a computer, not necessarily signifying anything) in two different alphabets, [0 1] and [a b], like

A = 10011000010110000010010110100111001100101110001010

and

B = aaaaabaabaababbbbababbbababaaaaaababbbbaabbabbbbaabb

then it will not generally be possible to devise an algorithm, to output B when the input is A, that is significantly less complex than 50 bits (the information content of either A or B, more or less, in this example). A simple example of an algorithm for getting from A to B is the algorithm:

XOR10011100110011110111100010100110010000110101111001

where XOR is the 2-bit "exclusive OR" rule "a if bits match; b otherwise".

The length of the algorithm is about 52 bits, depending on the particulars of the XOR implementation, typically by some Universal Turing Machine.

If you apply the algorithm to A you get B.[ASIDE: my algorithm actually consists of two parts, the XOR 2-bit "code" and a 50 bit "key", because I knew that was an easy way to find at least one algorithm for producing any sequence from any other.]

Gregory Chaitin's work implies that it is impossible to prove that there is NO very compact algorithm, what I want to call a "code", to get from any one sequence (like A) to any another (like B), and this is a consequence of Gödel's incompleteness theorem, but it is nevertheless almost always the case that there is no compact algorithm.

OK, now I want to compare this with how a code, a very short algorithm, works.

I apply the code 0→b, 1→a, which is an algorithm of only 2 bits (more or less), to map A onto

A' = abbaabbbbabaabbbbabbabaababbaaabbababaaabbbabab

and the algorithm can be applied to any sequence with a corresponding result.

Every sequence is uniquely paired with its "complement" in the [a b] alphabet by application of this extremely simple code rule.

Actually, you can apply the much more complex 52 bit algorithm (above) to any arbitrary sequence and get a unique result and you will also find that every unique A maps onto a unique B, just as you have with the simple code. And it has the interesting property of mapping similar sequences onto similar sequences (the Hamming distance taken as a metric of similarity).

Now, suppose the first sequence (A above) is a DNA sequence 25 letters long (you will have to use two bits for each letter, with, for example, 00=A, 01=C, 10=G, 11=T) and supposed we had a life-form that used only the four elementary amino acids alanine (a), asparagine (n), glycine (g) and valine (v) and we had a genetic code A→a, C→n, G→g, T→v.

Given the right molecular machinery, this extremely compact algorithm (of complexity 4 bits, more or less) would map the gene sequence

(A) = GCGACCGAAGCCGGCTATAGTGAGG onto the protein sequence

(B) = gnganngaaggnnggbvavagvagg, which we will presume folds up and has some function in the cell.

The code could be used to translate a host of 25-amino-acid-long functional proteins from 25-base-long portions of a genome. Let's say there are 1000 such proteins, so the information content of the protein-coding part of the genome would be 50,000 bits.

The main point I want to make about an "organic system" is that the process for getting the organism from the 50,000 bit genome cannot be described in so few bits. So the organic "algorithm" that uses the 50,000 bit "self-description" to maintain and reproduce the organism is more complex than its own compact description, so the whole organism must exist before it makes any sense to say that the genome encodes a symbolic description.

From my point of view genes were the first symbols that ever existed (probably elsewhere before on this planet), but they only came to exist as part of an organic process within which context they have an operationally defined "meaning/interpretation" (and I am using these terms only to signify the consequences of processes, not to imbue genetic information with some deep connection to something more intelligent than a computer).

"... I am not sure what you mean by that a code (normally) is a one-to-one mapping between '1D sequences'? Does this include natural language even though it is multi-leveled and not one-to-one: it uses different modalities in parallel (speech, syntax, gesture, prosody, ...) and many phrases have several meanings. Furthermore, although the spoken utterances are 'sequential', I am not sure that their meanings are sequential (1D) structures..."

I should have said "A code is normally a 1:1 mapping between letters from two alphabets and the information is very often arranged as a 1D sequence, preventing the need for a complicated algorithmic specification of where to find the next bit after the bit currently being translated".

I am definitely not trying to talk about anything like natural language here – just the purely syntactical business of symbol-by-symbol decoding.

At this stage I wanted to limit myself to the question of the syntax of translation using a code.

"... I do not think that it is possible to define the meaning of words in terms of other words. It should include how they are linked to neuronal activation patterns corresponding to perceptual (e.g. visual) input and actions. These constitute the 'second body of information', not the entries in a dictionary (there is semiosis, and hence no meaning, in the usage of a dictionary, but not in the dictionary itself: coding is not the same as code, just as meaning is not the same as information)."

Yes, a dictionary is useless unless there is a language and you can't have a language unless the words refer to something other than words. So dictionaries don't provide the "meanings" of words except through their references to reality, and I take it that your neuronal activation patterns are the first level of "reference" to the real world that you go through in order to find the reality corresponding to a word.

However, I was a step behind that and was saying "What if we think of the dictionary as a kind of code or algorithm to help us map sentences from the language onto reality?"

And I am suggesting that a dictionary doesn't work like a code, or even an algorithm whose complexity is as low as the list of words in it. I am suggesting that the way in which words are defined in terms of one another is very complex indeed such that any procedure or algorithm that you might think allows you to determine the meaning of a decent sized sentence, even within a limited context of reality, is likely to be of about the same size as the semantic complexity of the entire dictionary, i.e., in some sense you need the whole language, the entire meaning system, to get a proper measure of the complexity of a single sentence.

This is of course pure speculation and is my supposed measure of a dictionary's semantic complexity is probably no more than a metaphor for the scale of intricacy of the relationships between the meanings of words.

"...Do you mean selection in the sense of natural selection, that is, are you thinking of a process of reproduction+variation+selection here?"

Yes, I'm happy to describe learning in terms of "natural selection" but not in a purely Darwinian way where the only change influencing "success" occurs in the system's memory (information storage parts - genes). Lots of processes in biology involve a kind of selection that is non-Darwinian (epigenetic processes abound in biology) and I think that a lot of "learning" involves selection processes that are driven by the

"inheritance of acquired characteristics" rather than starting from variation (mutation) in the stored information (genetic memory).

"...I propose to refer to this property as 'arbitrary'?"

Yes, I am happy to call the non-deterministic nature of the connection between the two alphabets of a coding system "arbitrary".

"...The structure of the genetic code does seem to be the result of the interaction between three conflicting forces (expressiveness, precision and energy [Thrusty T (Sept 2010). "A colorful origin for the genetic code: Information theory, statistical mechanics and the emergence of molecular codes.".

Phys. Life. Rev. 7 (3): 362–376. doi:10.1016/j.plrev.2010.06.002. PMID 20558115.]"

Thank you for pointing this work out to me. I had not seen Thrusty's paper and I find this kind of approach to an explanation of the choice of codons for each amino acid very interesting.

This is the "non-arbitrary residue" that chemical factors have stamped onto the code.

The entries in the coding table are not entirely random, but the overall choice of one unique code from the 10^{65} theoretically possible codes (that map 61 codons onto 20 amino acids) is bound to be very arbitrary!

"...But several codons map to the same amino acid, or is that fundamentally different?"

The redundancy in the code (mapping more than one amino acid to the same codon) reduces the information content of a protein sequence relative to its corresponding RNA-base sequence, just as having only 4 second messengers onto which $N > 4$ receptor types are mapped reduces the information content of the 2^{nd} messenger population below that of the signal population.

"...I do not understand this, I would think that with parallel information processing much more information can be processed per time unit? For instance, language normally works in parallel (words and syntax plus prosody, gesture, ...) and is generally much more informative than written text."

The main difference between the signal transduction code (STC) and the genetic code (GC) is that the number of possible inputs to the STC is, in my simple model, 2^N where N is the number of receptor types, because each receptor type can be either "on" or "off" depending on whether the signal molecule that binds to it is present or not. The receptors are accessed in parallel.

However, the number of possible inputs to a ribosome for a sequence of length M is N^M where N is the number of codon types, because the codons in the message are read through sequentially.

In effect you get to choose M times which unique codon is "on" (a choice of 1 out of N) and use the adaptors (in this case tRNAs that effectively "carry" a GC table entry).

My main point was that generally speaking $N^M \gg 2^N$ where N in each case is the number of letters in the input alphabet.

Yes, parallel processing allows all the adaptors to work at once whereas in sequential processing you have to wait for one to finish before you let the next one in. Ribosomal translation is slow in molecular terms, but very very specific. Having only 2^N different inputs doesn't allow you much specificity in your control processes whereas nN^M (as in 64^{200} , that's an unbelievably huge number!) gives exquisite specificity (and so ultimately, "depth of meaning")

"...I agree if you mean that the folding does not occur in an arbitrary fashion?"

I do not want to talk about a "code" for protein folding because I want to reserve the word "code" for mappings whose complexity is very small, not comparable to the typical complexity (information content) of the input to whatever process the code is applied. I agree that protein folding is by no means arbitrary, but the process is hugely complicated. So I will allow that there is a "code" for protein folding in Howard's second sense – a set of rules (essentially of chemical interaction and polymer chain-link bending and rotation) that govern the behaviour of the process, but not a set of rules that is like a mapping between the letters of two reasonably small alphabets.

"...I totally agree, this is what I meant when I said that semiosis involves a code plus an agent that uses it to maintain it, that is a system (which includes the code) that is energetically and information-wise being maintained by the working of the code"

I like your description of an organism as "a system that is energetically and information-wise being maintained by the working of the code". I would like to make it a little more general and say "... maintained through information processing" to include processes like protein folding that cannot be described by a code.

When we look at a DNA sequence we only care about the distinctions between A, C, G and T and when we look at a protein sequence we only care about the fact that one of the 20 amino acids is different from all of the others and we know how to get from one to the other by using the genetic code table.

In this sense each amino acid can be represented by less than 5 bits of information (an amino acid specifying codon contains just less than 6 bits, because of the three stop codons and the information loss is a result of redundancy).

However, when we come to fold the protein we find first, that the playing field isn't even because some amino acids are more similar to some particular others, and second, that the properties relevant to the folding process cannot be specified in as few as 5 bits per sequence position. And what I strongly suspect is that the changes in the structure of the folded protein that are of biochemical significance are so fine that you could not give an account of them in fewer than $5M$ bits anyway (where M is the sequence length).

On top of the fact that you can't give any biochemically satisfactory list (compressed however you like) of the relevant properties (e.g., atomic structure) of a folded protein with fewer than nM bits (where $n > 5$ is the number of bits needed to specify the chemical properties of the amino acids that are relevant to the folding process), I have a further suspicion: that there is no compact algorithm (significantly shorter than nM bits) that can tell you how to find the folded structure of a protein given its $< 5M$ -bit specification as an amino acid sequence. So, that is why I do not want to talk about a protein folding "code", except in Howard's second sense, as in a code of behaviour.

Please note that I not saying that protein folding is anything like a random process. Far from it.

Given the right pH, ionic strength, temperature, pressure and the like, you get folding "for free" and (except for the intervention of chaperones etc) it happens without the help of any evolved process or the application of any process under the control of "biological specificity".

This is what Howard means (I think) by "harnessing the laws". So, by applying just a few bits of genetic information and harnessing the (information rich) laws of quantum mechanics you get a protein which can make differentiations of much greater specificity than can be defined through any algorithm of complexity as low as the original information input.

"...Again, I think we are on the same line here. So you would also say that for semiosis to occur in a computer, the computer somehow needs to maintain itself (and get the required energy and material resources for that) through the application of it's code?"

I think I would require more of an artificial system before I would admit that semiosis had occurred within it.

I really only want to say that a computer can operate as a semiotic system, that is, interpret signs, probably according to a system given to it. For me, "semiosis" implies the emergence of a semiotic system.

I can see that a computer could learn to interpret signs, even learn to make up signs in a way that are connected in more complex ways than people are able to arrange (and therefore useful to people who cannot fathom the connections, e.g., between prices in the stock market).

However, a computer will always be an "add on" to some human intention, and when it is not, it will not have an intention of its own, only meaningless behaviour – whatever happens will be whatever happens.

The computer will not have its "own world" to which the signs represented in it refer.

A computer that is programmed to find its own energy supply would not qualify as "organic" in my terms. Its physical being is not constituted through the internal processing of information, which is the case for organisms.

"...One problem I still have with this line of thinking is that it is not clear to me how to specify the border between a (semiotic) system and its environment. It is intuitively clear that a computer somehow is a separate entity, a "thing", but in interaction with humans it does 'maintain' itself by being useful and 'reproduced' by them. In the case of living systems, like humans for instance, the boarder is even far less obvious (the `self/non-self' problem: are all the bacteria that we 'use' for digestion for instance part of us as semiotic systems?). Perhaps this is 'merely' a philosophical issue, but I think that it should receive some answer in order to free us from vague concepts like 'induced semiosis'..".

Yes. Going back one stage. At what stage does molecule of glucose become part of a bacterium as it enters

through the cell membrane? And the atoms that I was made of 50 years ago are now strewn all over the earth, but I am still here. Physics is not very good at telling me who I am!

Although there are more bacterial cells in my body than there are cells of my own (which are on average much much bigger), my own cells are still easily identifiable in terms of their genealogy.

[The really weird stuff involving eukaryotic and prokaryotic cells is extremely rare.]

And although my own cells are mostly organised into this organism sitting here at a keyboard, think about poor Henrietta Lacks <<http://www.jhu.edu/jhumag/0400web/01.html>>.

There are now many more of her cells in the world than ever existed while she was alive.

More questions than answers ...

"... So do you think that it is nonsense to make models of semiotic systems? (a model, e.g. a mathematical formula or a computer program, will never perform self-maintenance in your sense I guess?)"

I think it's fine to make model systems, even think about artificial systems, but do so very very carefully and with the utmost respect for what they are. I expect the world to respect me. I attempt to do so in return, without getting too cock sure concerning what I know about it.

This is an attitude that I do not recognise much of among scientists. There are still far too many physicists willing to build bombs and far too many genetic engineers trying to turn a buck or do something smart without the slightest consciousness of the importance and potential fragility of the organic codes that underly, at a very deep level, the bits of the world they have decided to fiddle with.

Yes, I see most of it as irresponsible boyish fiddling. It is the sort of thing we are encouraged to do more and more so that our institutional rating improves. And there I will stop for now.

Best wishes,

Peter

p.s., Marcello has just sent us your new paper. It looks very interesting in the light of our discussion.

Geoff Hoffmann followed up a lot of Jerne's ideas and developed a dynamic model of the immune self/non-self distinction in about 1990 I think (see <<http://www.physics.ubc.ca/~hoffmann/pub2.html>>).

In the 1970s he had already considered the dynamic stability/origin of genetic coding, but without explicitly simulating the instabilities (which is what Bedian and then I did in the 1980s). Your Figure 2 presents a special problem in the case of the genetic code that Kay Nieselt and I treated in Fig 1 of our 1997 paper, which I'll send to you.

70

----- Original Message -----

From: [Marcello Barbieri](#)

To: MAILING LIST

Sent: Friday, April 01, 2011 10:18 AM

Subject: Re: For a scientific Biosemiotics

Dear Colleagues,

It is my duty, I am afraid, to set a limit to our consultation, and it seems to me that this is a good time to call it a day. I sincerely hope that nobody takes offence at this decision. It is in no way a limitation of freedom because anyone can clearly go on corresponding on a personal basis. It is simply due to practicalities. We all have other duties to carry on, and I cannot ask an indefinite amount of attention from the members of this discussion group.

This year the debate has been particularly intense, and I feel that now we need a pause of reflection. In order to encourage you to think things over, I am sending in attachment a Collage of all our emails, just in case. Many of us will meet in New York, and on that occasion we may have a new round of discussions. Let me warmly thank you all for your contribution.

All the best

Marcello

71

----- Original Message -----

From: "Kalevi Kull" <kalevi.kull@ut.ee>

To: "Marcello Barbieri" <brr@unife.it> Cc: MAILING LIST

Sent: Friday, April 01, 2011 10:56 AM

Subject: playfulness as a condition for creativity

Dear friends,

Let me say something that comes from the heart :-)

A good universal assumption to use is that my "significant other" is always more intelligent than myself. (This is a bit along the thoughts by Donna Haraway's chapter "Playing with strangers" from her book "When Species Meet" (2008) we happened to discuss in a recent seminar in Tartu).

A corollary to this thesis is this: what seems new is due to my restricted knowledge.

Which implies that it is illogical to call new anything except new for myself. Which means that it is reasonable to assume that there are thinkers who have already understood what I am still learning.

Let me bring an example from an article published in 1968.

(p. 168:) "... biosemiotic assumed the task of demonstrating in a controllable manner how the triadic relationship of communication and expressivity determines structure and function of intraorganismic communication systems."

(p. 174:) "... living systems are constituted from their very beginning as sign systems."

(p. 175:) "DNA molecules, together with the RNA and protein molecules, compose this triad of the inner communication system in the independently viable cell. The DNA molecules form the representatives of a subject, the proteins acting as receivers of communication from that subject as the RNA molecules fill the role of signs mediating between sender and receiver."

The paper is

Rothschild, F. S. 1968. Concepts and methods of biosemiotic. Scripta Hierosolimitana 20: 163-192.

This quite long paper includes much more.

This is before Sebeok's writings on the issue, not to speak about anybody's among us here.

The biosemiotic program is not new, in any case.

Now, the interesting question about the origin of new codes.

A common example of codes is reflexes of organisms. And it is pretty well understood how new reflexes - thus the new codes - come into being. This is not new.

Also, I do see some models existing in semiotics that explain how the new codes arise, and these models are applicable on the systems of cellular level.

More: a good model of code is the one that includes the explanation of its development.

In all cases, we have to be prepared that not only the terminology, but also a conceptual apparatus may be different than ours - nevertheless, the point what I am still searching may have been understood by some other scholar.

There is another corollary to the thesis above. It is this: it is deeply illogical to do anything about what I can expect that it will make harm to anybody, if it is possible to avoid this.

Which implies that it is deeply illogical to think about other minds as competitors.

An aim of these words (along with my previous letters) is to try to keep the warm atmosphere in our community, the friendly atmosphere that may allow us to use some playfulness - the major condition of creativity - so that everybody can feel the delight of the biosemiotic community.

I know you know more. And this cannot be otherwise :-))))))

Fond regards

Kalevi