also allows for writing systems, programs and, thus, very human ways of coming to know and believe.

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Codes: Necessary, but not Sufficient for Meaning-Making

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> Abstract • One of the main problems of biosemiotics, i.e., the distinction between code-based artifacts and (meaning-making) life itself, does not seem to be resolved yet. Semiosis requires codes but it cannot be based on a single code. I sketch a model that demonstrates the role of codes in semiosis and helps to see correspondences between the models of Peirce and Saussure.

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« 1 » Biosemiotics is the study of semiosis and its implications (among these, codes) in prelinguistic systems. Codes, obviously and traditionally, belong to the objects of semiotics (Eco 1976). Approached from the Peircean side, codes are habits, i.e., regularities produced by semiosis. Approached from the Saussurean side, codes are arbitrary correspondences, mutual mappings. In neither case are codes universal regularities like physical laws are. Both habits and mappings are acquired or constructed relations. An acquired relation cannot persist without being mediated, the mediator functioning as a constructor, mapping-master, or translator (Kull 1998: 303).

« 2 » The main question in Alexander Kravchenko's target article is whether code is sufficient for meaning-making, i.e., for semiosis. Indeed, "the bone of contention is the conception of semiosis," as Kravchenko writes in §8. Particularly as concerns the genetic code, its insufficiency for meaning-making has been strongly defended by Jesper Hoffmeyer and Claus Emmeche (1991), and others.

Can a single code produce meaning?

« 3 » The concept of code has been used by Roman Jakobson and other semioticians for language and language-like phenomena that assume the process of interpretation (see more about the history of the code concept in Sakellariou 2019). Erwin Schrödinger (1944) used the term "code" for the genetic process. Once formalized in information theory, however, code became identical with mapping. (For language this means that something in addition to code is required because language requires *parole*, the meaning-creation itself, the semiosis.)

« 4 » Georgij Gamow (1954) saw that the code concept could be applied to the inner working of biological cells as he started to use the term "translation" for protein synthesis. Later, this led to the question of whether the usage of the term "code" for the process of protein synthesis based on the sequential pattern of RNA (i.e., the "genetic code") is a mere metaphor or a genuine code in the following sense.

« 5 » Code is commonly defined as an arbitrary mapping. Arbitrariness is understood in the sense of Ferdinand de Saussure's Principle I: "The bond between the signifier and the signified is arbitrary" (Saussure 1959: 67). (Motivation, by contrast, should be understood as a constraint upon arbitrariness, i.e., motivation assumes arbitrariness; even the simplest perception is not just an imprint, it is mediated). In order to persist, mapping should have a mediator that functions as the map-master, i.e., that builds or constructs the mapping.

« 6 » Arbitrariness is a relation that is understood to be different from physical relationships in the sense of being physically indeterminate. Accordingly, code's being an arbitrary mapping can be defined as a relation that cannot be deduced from universal physical laws. Marcello Barbieri (2001) has helped to elaborate and specify the code concept. Code is historical, it is preserved due to the preservation of the specific mediator – map-master or "code-maker" (as Barbieri calls it) – by a self-reproducing system. Code is a correspondence that is made by a mediator that can link things that otherwise would not be linked (directly). The mediator in the case of code is also different from glue-like nonspecific compounds in that the mediator

- is context-independently preserved and restored, and
- has historicity.

« 7 » The genetic code is a code according to the above formalization – its code-makers being tRNAs together with ribosomes. In addition, there are several other

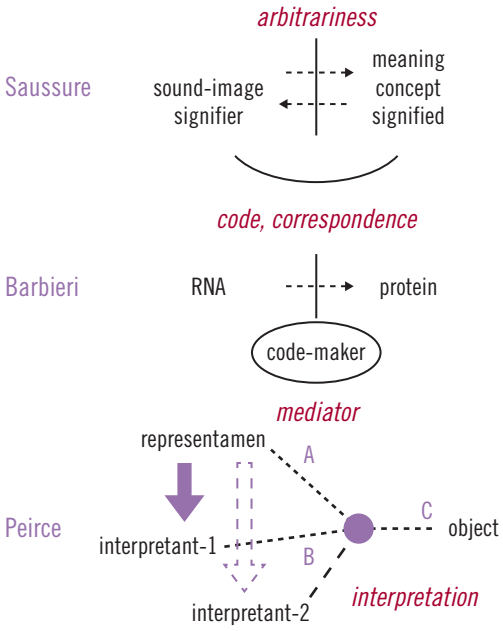

Figure 1 • Comparison between the models of Saussure and Peirce, and Barbieri's single-code model. Saussure's model claims arbitrary correspondence (including codes represented by dotted lines), to which Barbieri adds the description of code-maker that preserves this correspondence, while the reduction into a single code (one horizontal arrow) removes meaning-making. Peirce's model explicates the aspect of intepretation (vertical arrows) and emphasizes the irreducibility (represented by bullet) of the connection between codes in semiosis.

codes in cells (e.g., the signal transduction code) as well as in machines. Accepting the concept of code as defined by Barbieri (2001, 2015), however, does not yet imply that code is sufficient for meaning-making.

« 8 » The critique of the code model of semiosis already has a history, particularly in relation to Barbieri's work (Deely 2009; Champaign 2009; Markoš 2010; Cobley 2014, 2016: 75–90; Deacon 2015; Vega 2018; Rodríguez Higuera 2019; Gare 2019, etc.). Without delving into other aspects here, let me briefly analyse the code concept and the role of codes in semiosis to resolve an interesting fundamental issue: what is necessary for meaning-making in addition to a code?

« 9 » Umberto Eco (1986: 46ff) pointed out that the mappings that appear in semiotic systems are usually not one-to-one, but rather many-to-many, and they form networks (which is why he replaced "code" by "encyclopedia" in his later theory). Since semiosis (defined as the process of meaning-making) presupposes codes *and* interpretation, according to Eco, there cannot be meaning without interpretation.

« 10 » Juri Lotman (1990) repeatedly emphasized that a single code was insufficient for meaning-making. There should be at least two codes. A similar statement was made by Hoffmeyer and Emmeche (1991), introducing the concept of code duality. Indeed, Morse code has no meaning by itself, nor is the arbitrary relation established by the cogwheels between the spring and the speed of the arms of a mechanical clock itself a meaning-maker – meaning emerges as a result of interpretation.

« 11 » Interpretation (which is the same as primitive decision-making) assumes that there exists a choice between two or more options. The options can be described as different codes applicable simultaneously in the same situation. This brings about the inescapable indeterminacy of semiosis (Kull 2018).

Saussure, Peirce, and codes

« 12 » At the bottom of this discussion lies the big problem of finding the correspondence between the Saussurean and the Peircean models of meaning-making. Solving this problem is a challenge for biosemiotics. Below I shall describe briefly an approach to the solution, which will also clarify Barbieri's conundrum of the relationship between code and meaning.

« 13 » In Figure 1, I suggest a possible correspondence between Saussure's model of the sign, Barbieri's single-code model, and the model of semiosis on a certain reading of Peirce. In all three cases, as a first approximation, both left and right sides should be seen as intra-organismal. For Saussure, as well as for the genetic code, this is obvious, and as regards Peirce, this is the case at least in a phenomenological interpretation of his model. The left side represents "sign" in a narrow sense (representamen as sign in the case of Peirce), while the right side puts into correspondence the signified of Saussure and the object of Peirce. Of course, signified and object have rather different contents due to their relationship to their models as wholes but they can coincide in the case of minimal systems.

« 14 » We can see that Saussure represents the relation between signifier and signified in his scheme of the sign with two arrows in opposite directions: "The two elements are intimately united, and each recalls the other" (Saussure 1959: 66). In Barbieri's concept of the code, there is an obvious direction from RNA to protein when protein (which he calls "meaning") is fabricated by the code-maker. In this respect, code relation in Barbieri is simpler than the elementary sign relation in Saussure. Saussure's sign seems to include at least two opposite codes in Barbieri's sense.

« 15 » In presenting Peirce's model, I use here his definition:

> "[A] sign is something, *A*, which brings something, *B*, its *interpretant* sign determined or created by it, into the same sort of correspondence with something, *C*, its *object*, as that in which itself stands to *C*." (Peirce 1976: 20f)

Thus, both the representamen *A* and the interpretant *B* are "signs" in that narrower sense and thus belong to the left side in Fig-

ure 1. The "bringing something" is the emergence of a (triadic) relation that includes both *A*–*C* and *B*–*C*. If we identify the *A*–*C* and *B*–*C* as two different (i.e., incompatible in the sense that their sum would be contradictive, see Kull 2015) codes, then their identification into one (triad) is an internal interpretation, which is semiosis. Interpretation, in order to be different from physical determination, means (a primitive) choice. Figure 1 shows the choice between interpretant-1 and interpretant-2, but there can be more than two options, of course. If, during the habituation, the optionality completely disappears, then the triad may ultimately turn into a diad, i.e., into one code (still with a mediator, of course), and together with this the relationship will be fully automatic, with no meaning-making any more (Kull 2016).

« 16 » Thus, what I have presented with the scheme of the "Peircean model" here is an approach with the aim of naturalizing meaning-making, i.e., semiosis. Also, I assumed that semiosis requires agency. The core aspect of agency is interpretation, not code. Semiosis as sign action is a code-transfer, not just code-making. Barbieri emphasizes the role of code-maker as the third element in code, while the triadicity of semiosis is based on the coexistence of more than one code in the process.

« 17 » A single code does not include a source of its own change. The code-maker preserves a code; it does not actively change it, because it is not an agent. A new or a changed code is a result of learning or choice, or interpretation. However, this does not imply that the code itself carries meaning. Meaning as a phenomenon appears only due to the choice-like (also called abductive) element in semiosis, i.e., in interpretation. Codes are commonly products of interpretation, or semiosis.

« 18 » It is difficult to distinguish between semiosis and code because during the process of habituation, the sign relation gradually loses its choice-making or interpretive aspect, ultimately turning into pure code. This is because the choice in a familiar situation gets solved in an increasingly more predictable way, so the choice becomes hardly noticeable and happens momentarily, before it completely disappears in entirely automatic code.

« 19 » In conclusion, accepting Barbieri's definitions of code and arbitrariness, I have shown that code is insufficient for meaning-making. The main source of arbitrariness is interpretation, while the arbitrary-relation is afterwards preserved by a code. A code alone is insufficient for semantics. A code is not semiosis.

« 20 » Thus, we arrive at an agreement with Barbieri in that genetic code is a genuine code, and at an agreement with Kravchenko that coding is not semiosis. These two statements can be compatible. Barbieri's role in explicating the description of code-maker should be acknowledged, while understanding that meaning-making requires an additional process of choice.

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