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PRAGMATICS BEYOND COGNITION: A PERSPECTIVE OF CHARLES PEIRCE'S UNFINISHED CONCEPTION FOR (BIO-)SEMIOTICS[1]

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The development of artificial intelligence and the new understanding of biomolecular processes for transmitting genetic information have emphasized the necessity to consider semiotic activity, that may operate autonomously from human cognition. In this regard, Charles Peirce's latest conception of semiosis is of particular interest. For Peirce, semiosis is an interpretation that doesn't necessitate an external interpreter. A sign is viewed as a quasi-mind, and semiotic processes are carried out by these signs, specifically through the quasi-minds that are embedded within them: a quasi-utterer and a quasi-interpreter. Semiosis can thus be viewed as an ongoing, personalized interaction of structural semiotic entities (quasi-minds). The latest findings in molecular genetics and their implications in biosemiotics shed light on a unique aspect of interpretation: it can occur without an external interpreter owing to its mechanism of self-organization. By studying communication and information processes at the biomolecular level, we can redefine pragmatics as operations intricately linked with systemic self-regulation and interaction with the environment.

Keywords*: non-cognizant semiotic agents, Charles Peirce, pragmatics, sign, interpreter, interpretant, sign as a quasi-mind, semiopoiesis, semiosis, biosemiotics, code biology*

1. Introduction

Different versions of pragmatics are based on the assumption that pragmatics is a relation between some human (or anthropomorphic) subject and a sign system. This notion was introduced by Charles Morris, who essentially contributed to accommodating Peirce's semiotic theory. This has possibly led to the misconception that Morris borrowed this idea from Peircean semiotic theory and coined the term in alignment with Peircean philosophical pragmatism. In our paper, we intend to demonstrate the following:

1. Charles Morris introduced the contemporary notion of pragmatics, and this conception is not a development of Peircean ideas but directly opposed to them. In the original Peircean notion, interpretation produces an interpretant, but this does not presuppose the existence of the cognizant interpreter.

[1] The article summarizes and expands upon the findings that were partially introduced in: (Zolyan 2023a; 2023b; 2024).

2. In his semiotic theory, Peirce intentionally excluded the notion of a cognizant subject. According to him, a sign is endowed with semiotic operative capacities, acting as a quasi-mind. Peirce realized that his conception might not be readily accepted by his contemporaries and did not elaborate on it in a systematic way. However, his draft notes make it possible to reconstruct his holistic vision of semiosis as a self-emerging and self-regulated process.

3. The recent advancements in biosemiotics, code biology, and AI presuppose the possibility of semiotic operations independent of any mind or cognition. In Piercean terms, semiotic entities can act as quasi-utterers and quasi-interpreters to perform regulatory or performative functions. Based on this understanding, pragmatics can be redefined as a facet of semiotics focused on the interaction between the environment and the system — or, in semiotic terms, between the sign system and the contexts of its actualization. In this way, a sign system may act as a speaking and interpreting agent, or *a quasi-mind*.

2. Charles Morris on pragmatics

While discussing interpretation and interpretants, Peirce does not mention interpreters, which may seem like a gap that Morris addressed. Consequently, the following definition became widely accepted:

> "The subject of study may be the relation of signs to interpreters. This relation will be called the *pragmatical dimension of semiosis,* and the study of this dimension will be named *pragmatics"* (Morris 1938, p. 30).

Meanwhile, Morris proposed different definitions of an interpreter. In this regard, he refers to Aristotle rather than Peirce. At least three approaches can be identified:

> "The interpreter of the sign is the mind; the interpretant is a thought or concept; these thoughts or concepts are common to all men and arise from the apprehension by mind of objects and their properties" (Ibid.).

It implies the existence of a universal human mind — akin to Kant's transcendental subject — which serves as an interpreter of signs. However, Morris did not anchor himself on mentalistic notions and made an attempt to eliminate them: «The interpreter of a sign is an organism; the interpretant is the habit of the organism to respond» (Ibid., p. 31). This definition does not imply the presence of a mind but only the capacity to respond correctly to a sign-vehicle: «Pragmatics itself would attempt to develop terms appropriate to the study of the relation of signs to their users» (Ibid., p. 33). However, this most general notion of *users* says nothing, as it does not specify any mode of usage. It is still unclear who these users are, but it is obvious that Morris tried to distance himself from mentalistic associations. This approach aims to define this concept in a manner that is entirely pure and free from subjective or contextual connotations. Rather than involving a hu-

man interpreter, this view presupposes an operator embedded within the semiotic system that transforms structural relationships into behavioral patterns. The use of signs is restricted by the syntactic structures of language (sentences) instead of being influenced by thought or context: "Considered from the point of view of pragmatics, a linguistic structure is a system of behavior" (Ibid., p. 32).

Looking ahead, it is worth noting that this is similar to how genetic information's regulatory mechanisms can be described at the molecular level. Morris relied on Peirce's published work and realized that Peirce's definition of a sign did not include the concept of an interpreter. Morris may not have been aware of Peirce's unpublished manuscripts and letters, so he could not have assumed that the absence of an external agent to the sign was fundamental to Peirce's understanding of semiosis. In all cases, it should be noted that when referring to a human user of signs, Morris is not specifically talking about a particular speaker within a specific speech act. Instead, he is referring to a universal human thought expressed through the rules of language, although the sounds carrying these thoughts vary in different languages (Ibid., p. 30). However, Morris's successors, despite having the opportunity to study Peirce's drafts, and possibly being influenced by pragmatics of natural language, developed this aspect of semiotics as sign operations performed by a cognizant (or human) subject.

3. Sign as a quasi-mind

One of the key concepts in Peirce's semiotic theory is the idea of interpretive semiosis, which does not presuppose any specific subject to have a mind or brain. Throughout his career, Peirce realized the complexities of signs, offering various definitions (at least 76; cf.: Marty n. d.). However, he consistently avoided introducing or mentioning the notion of an interpreter within interpretative processes. According to Jürgen Habermas, in his semiotics both the mind and interpreter are integrated into the structure of the sign: "because it consists of nothing other than that three-placed relation of representation in general; it is absorbed by the structure of the sign" (Habermas 1995, p. 247). Peirce understood sign relations as algebraic, making the notion of an interpreter (*human thought*) redundant:

> "A sign is something, A, which brings something, B, its interpretant sign, determined or created by it, into the same sort of correspondence (or a lower implied sort) with something, C, its object, as that in which itself stands to C. This definition no more involves any reference to human thought than does the definition of a line as the place within which a particle lies during a lapse of time" (Peirce, 1976, p. 54).

Peirce ultimately rejected the concept of an interpreter in his latest version of semiotics, which is primarily found in his handwritten sketches titled "Pragmatism — Notes and Drafts" (Peirce 1907). His aversion to the notion

of a person using a sign is evident in his comments. After reiterating his definition of a sign, he acknowledges that including a person in that definition is a reluctant concession — a *sop to Cerberus* — made in response to the desire to be understood:

> "I define a Sign as anything which is so determined by something else, called its Object, and so determines an effect upon a person, which effect I call its Interpretant, that the latter is thereby mediately determined by the former. My insertion of "upon a person" is a sop to Cerberus, because I despair of making my own broader conception understood" (Peirce 1977, p. 80—81).

In his draft notes, the concept of a "person" is absent; it was eliminated from the definition of a sign and substituted with an indefinite pronoun, that is, "something capable of somehow 'catching on'" (Peirce 1907, p. 318). As Peirce pointed out, semiotic relations do not necessarily require an intelligent agent; they can function through a kind of "quasi-mind" or "quasi-intelligence" that is involved in the operations on signs and is inherent in the sign and sign system. In this context, the sign itself acts as an agent in these operations. Therefore, according to Peirce, a sign can be considered a (quasi-) thinking entity or a *quasi-mind*:

> "…as every thinking requires a mind, so every sign even if external to all minds must be a determination of a quasi-mind. The quasi-mind is itself a sign, a determinable sign" (Peirce 1977, p. 195).

Peirce defines a sign not in terms of its paradigmatic and syntagmatic relations with other signs, as is typical in Saussurean semiotics, but through interactions within the chain of signs both generating it and generated by it. First, these are the sign's closest "neighbors" in this sequence: the quasi-utterer and the quasi-interpreter. A sign manifests in three hypostases, and the interpreter is not seen as external to the sign; rather, the interpreter emerges as the result—or, more precisely, as the process—of a bifurcation of the quasi-mind, becoming an integral part of the sign itself, as something welded into a sign.

To concretize this understanding, one can deduce the following stages of the semiotic process, which unfolds through and around the sign. A thought-sign, representing the initial implied quasi-utterer, generates and establishes a meaningful connection between signs and objects. In Peirce's semiotic framework, both the object and the thought-sign combine and transform into what Peirce calls the (sign-as-a-) quasi-utterer. The object is transformed into a sign-as-an-utterer, which then assumes the new function of a sign-as-an-interpreter, generating its interpretant. Then, this newly formed interpretant becomes a sign-object, and the process of secondary semiosis restarts when this already semiotized sign correlates with the implied secondary quasi-utterer. Through the implied second quasi-interpreter, this gives rise to a second interpretant. In the first stage, these quasi-minds act as utterers and interpreters of thought; in the next stage, they act as utterers and inter-

preters of sign. At each stage, new signs and interpetants emerge[2]. A thought-sign replaces an articulated sign and thereby receives a recognizable form (literally: *a moulded sign*), which in turn evolves into a mental entity, and it will be replaced by the new inferring semiotic entities — thus the process continues indefinitely. This conception, known as infinite semiosis, was further developed by Umberto Eco (1983; 1990). Semiosis is understood as a self-generating process carried out by signs that function as quasi-minds. It can be described without necessarily relying on human thinking. However, according to Peirce's later thoughts, semiosis may (if not should) have its limits:

> "The next step toward our definition is the consideration that a chain of signs that conveys a given meaning can in many cases, at any rate, be neither beginningless nor endless. Still, it must be of a mental nature. There must then be some other mental element than a sign that can endow a sign with a meaning; and someone upon which the meaning can ultimately be expended" (Pierce 1907, p. 318).

There was no apparent further development, so one can only speculate how Peirce might have clarified the interpretation that Umberto Eco later provided for his theory (and which was challenged by Emile Benveniste)[3]. However, it is evident that, according to Peirce, if a definitive final point were to be found, it would not be a physical object but a mental element, specifically a new thought-sign. This, in turn, may (or have to) initiate a new process of semiosis, leading to the emergence of new semiotic quasi-utterers and quasi-interpreters. Following this line of reasoning, a strange hybrid of machine and reaction emerges: the mind can be conceptualized as a sign-maker, connected to a reaction machine that responds to mild stimuli:

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[2] This is our understanding of Peirce's handwritten sketch (see also the commentary on this passage in (Gorlee 1994, p. 217—218): "A sign is whatever there may be whose intent is to mediate between an utterer of it and an interpreter of it, for being repositories of thought or quasi-mind by conveying a meaning from the former to the latter. We may say that the sign is moulded to the meaning in the quasi-mind that utters it, where it was, virtually at least, (i.e. if not in fact, yet the moulding of the sign took place as if it has been there,) already an ingredient of thought. But thought being itself a sign the meaning must have been conveyed to that quasi-mind, from same anterior utterer of the thought, of which the utterer of the moulded sign had been the interpreter. The meaning of the moulded sign being conveyed to its interpreter, became the meaning of a thought in that quasi-mind; and as there conveyed in a thought-sign required an interpreter, the interpreter of the moulded sign becoming the utterer of this new thought-sign" (Peirce 1907, p. 318).

[3] One might get the impression that Pearce was trying to answer the question posed half a century later: "Man himself is a sign; his thought is a sign; his every emotion is a sign. But finally, since these signs are all signs for each other, for what could they be a sign that is not a sign itself? Where could we find a fixed point to anchor the first signifying relationship? The semiotic edifice that Peirce constructs is not self-inclusive in its own definition. In order to keep the notion of sign from disappearing completely amidst this proliferation *ad infinitum,* we must recognize a difference, somewhere in this universe, between sign and signified" (Benveniste 1981, p. 6).

> "…a mind may, with advantage, the roughly defined as a sign creator in connection with a reaction-machine. A reaction-machine is very delicately susceptible… to physical forces" (Ibid.).

It is unclear whether Peirce's idea foreshadows the behaviorist concept of meaning as a stimulus-response or suggests neural interactions, as he did not continue this line of reasoning. In his quest to identify a mental element other than the sign, Peirce introduced a new semiotic entity: the concept of permanent *sign-creation.* Habermas's remark mentioned earlier suggests that Peirce reduced a mind to the triadic relation of representation entirely absorbed by the structure of a sign. However, this is a sign with creative capacities, and in this respect, it may function as a mind. Dundee Gorley also considered Peirce's draft notes and arrived at a similar conclusion (Gorlee 1994).

Peirce's theory raises the question of whether there is a mental element other than a sign. Peirce attempted to incorporate the role of the subject in his semiotic theory by providing an ostensive definition: *someone upon which the meaning can ultimately be expended* (Pierce 1907, p. 318), and the choice of the animate pronoun *someone* is notable. However, identifying who this person is seems either impossible or unnecessary. Modern researchers generally prefer to overlook Peirce's hesitations, likely owing to their inconsistencies. Let us recall the mythological plot that Pearce alludes at. Sibyl volunteered to help Aeneas pass Cerberus in order to reach the kingdom of the dead. She soothed the dog with a honey cake mixed with a sleeping potion. Cerberus fell asleep, allowing Aeneas to enter the kingdom of the dead. Peirce invokes this figure as a metaphor for a participant in semiotic processes — one who seeks to lull the vigilance of the philosophical community. However, Peirce's stance is not entirely consistent; while he rejects the idea of a personalized mind, he introduces hybrid terms such as "quasi-mind" and "mental elements" and creates hybrid personages like "quasi-utterer" and "quasi-interpreter". In Peirce's time, neither artificial intelligence nor molecular genetics were known, which could have influenced Peirce's development of his concept. He attributes the ability to perform semiotic operations not only to humans but also to crystals, plants and even natural phenomena. This is why Morris consistently speaks about the biotic nature of pragmatics[4]. It's worth noting that Morris was unaware of Peirce's more radical conception, which was not widely known at the time.

At the same time, Peirce only outlined these concepts in a preliminary way. In his later work, he focused on the semantic aspects of semiosis as a dynamic process. Instead of quasi-pragmatic elements, he differentiated between two types of objects (Immediate and Dynamic Objects) and three types

[4] Nevertheless, Morris understood the idea of "biotic" very broadly, extending it to social relations as well: "it is a sufficiently accurate characterization of pragmatics to say that it deals with the biotic aspects of semiosis, that is, with all the psychological, biological, and sociological phenomena which occur in the functioning of signs" (Morris 1938, p. 30).

of interpretants (Dynamic, Immediate, and Final)[5]. Combined with his previous ten-member classification, this allowed him to identify 66 types of signs (Atkin 2008; 2023). Of course, this detailed classification is too complicated to use. It is evident that the two types of objects and the three types of interpretants may relate to characteristics like the thought-sign, sign-quasi-mind, sign-utterer, and sign-interpreter. However, Peirce did not indicate that possibility, so we prefer not to speculate on it but to consider developing them in the light of new data.[6]

4. The new life of Peirce's unfinished conception

Thirty years ago, one of the most significant philosophers of the twentieth century foresaw that advancements in genetics and artificial intelligence would revive Peirce's previously overlooked ideas:

> "Peirce spoke of quasi-minds, because he wanted to conceptualize the interpretation of signs abstractly, detached from the model of linguistic communication between a speaker and a hearer, detached even from the basis of the human brain. Today this makes us think of the operations of artificial intelligence, or the mode of functioning of the genetic code" (Habermas 1995, p. 245).

Peirce's hesitation stemmed from the need to associate the concept of interpreter with two quasi-interlocutors — the addressee and the addressant, some quasi-persons sending and receiving messages. Morris later formalized these aspects as the pragmatic dimension of the sign, but he replaced fictious quasi-interlocutors with observable organisms. Subsequent developments in pragmatics continued this approach by reintroducing personified agents—such as cognizant interlocitors — as autonomous entities, independent of the sign system itself.

Meanwhile, the perspective can be reversed: molecular genetics suggests that sign operations can occur without involving such concepts as consciousness, mind, or brain. Erwin Schrödinger (1944) and George Gamow (1954) used analogies with sign operations to predict the principles of genetic code

[5] The main attention of researchers is attracted by this typology; cf.: (Nesher 1983; 1990; 2018; Atkin 2008; Švantner 2014; Pape 2015; Jappy 2016; 2019; Aames 2018; Sørensen et al. 2019; Hilpinen 2019; Schmidt 2022; Haase 2022, Olteanu, Ongstad 2024).

[6] One can find some evidence that Peirce considered the possibility of combining semantic and communicative approaches in another triad of interpretants, which was outlined but not further developed: "There is the Intentional Interpretant, which is a determination of the mind of the utterer; the Effectual Interpretant, which is a determination of the mind of the interpreter; and the Communicational Interpretant, or say the Cominterpretant, which is a determination of that mind into which the minds of utterer and interpreter have to be fused in order that any communication should take place. This mind may be called the commens. It consists of all that is, and must be, well understood between utterer and interpreter, at the outset, in order that the sign in question should fulfill its function" (Peirce 1977, p. 196—197).

organization. Then Francis Crick compared the genetic code to "a small dictionary which relates the four-letter language of nucleic acids to the twenty-letter language of the proteins" (Crick 1981, p. 170). Nucleotides were likened to letters, and genes to texts (for more details, see: Raible 2001; Zolyan 2021; Zolyan, Zdanov 2018).

The genetic code has both biochemical and stereochemical aspects that form the basis for representing information in symbolic forms. Unlike typical biochemical phenomena, genetic information is not a random combination of elements; rather, it is regulated by their location, linear order, and context.

> "Genes are not the germs of biological structures, but resemble linear texts written under certain rules and carrying genetic information about molecular structures and functions … Both genes and non-coding areas are segments of DNA molecules, i.e., they are constructed from the same alphabet of four nucleotides. Therefore, the differences between such texts are not in their physical nature, but exclusively in the succession of symbol-monomers. This is the key to the information-linguistic approach. Hence, genes are not physical but informational units of heredity" (Rutner 2000, p. 23, my translation).

Terence Deacon recently echoed this thesis:

> "The structural characteristics of these molecules have provided semiotic affordances that the interpretive dynamics of viruses and cells have taken advantage of. These molecules are not the source of biological information but are instead semiotic artifacts" (Deacon 2021, p. 537).

However, the competence to manipulate semiotic entities does not imply that a molecule has consciousness. If one refers to pragmatic regulations in the biomolecular world, it may only be in the Peircean sense, as something melded into the sign. Without referencing Peirce's reflections on the quasi-interpreter and the quasi-utterer, Deacon explores the conditions under which a molecule becomes a semiotic system, thereby re-addressing a problem that Peirce posed but did not clarify:

> "In Peircean terms, this amounts to asking what sort of molecular system is competent to produce the interpretants that can bring this re-presented property into useful relation with that system? In an age when neuroscience was in its early infancy and molecular biology was not even imaginable, it is not surprising that he avoided speculating about what sorts of dynamical systems were competent to be interpreters… There are reasons to be more hopeful that insights into the physical implementation of interpretation might be obtained within molecular biology" (Ibid., 540; see also: Pattee 2012; Küppers 2023).

Of course, new insights can greatly enhance and solidify our understanding of the material *implementation of interpretation;* however, some preliminary concepts are already in place—they allow us to grasp, if in a general sense, how interpretation can occur through self-initiated and self-controlled processes, without relying on an external interpreter. In the 1980s, the solution was found to a puzzling question: how can the outcome of an activity

(like interpreting genetic information) exist without an agent taking this action? Italian microbiologist Giorgio Prodi (1928—1987) suggested that the interpreter and the interpretant are one and the same, arising from self-sustaining protein synthesis reactions. While borrowing Peirce's definition of the interpretant, Prodi presented his own consideration of sign-creation:

> "The general system outlined by Peirce may also be non-human, since the process of semiosis occurs wherever there is a mediation between an interpreter and a thing by means of an interpretant. But in Peirce's framework, and broadly speaking in Morris's too, the only possible domain for this kind of semiosis is the human one; at least, they both conceive interpretation in an anthropomorphic and anthropocentric manner. Unlike the De Saussure's demarcation, Peirce's does not need to postulate either intentionality or conventionality (i.e. the artificial nature of semiosis). Nevertheless, in his approach to the problems of semiosis, the sign is something already given as a mediator. It is already inserted in a semiotic function whose origins thus remain totally obscure. What we must do is to go a step further and eliminate not only intentionality but also mediation in the most elementary stage of meaning. A sign is not something that officially represents something else. It is a natural object that corresponds to (and is a function of) something else." (Prodi 2021, p. 117—118).

In contrast to Prodi's work in semiotics, another Italian microbiologist, Marcello Barbieri, took a different approach and focused on developing a semiotics-influenced branch of biology. For him, the genetic code comprises two distinct molecular 'worlds': nucleotides and amino acids. A specialized system of adapters is essential for maintaining fidelity to the rules of molecular correspondence, which are based on coding convention rather than the chemical or biochemical properties of the interacting elements. This set of adapters establishes a mapping between these two domains, serving as an intermediary or "codemaker", rather than an "interpreter." [7] Barbieri argues against the term "interpretation" and emphasizes the role of an intermediary or transductor. He suggested to include the third component, the ribotype: a ribonucleoprotein system serves as the cell's codemaker, converting the cell into a semantic system by producing proteins based on the rules of the genetic code (Barbieri 2008, p. 27).

The experimental data made it possible to concretize Peirce's speculative concept. Peirce's model involved signs alternating roles as both speaker and interpreter, creating corresponding meanings, or interpretants. This process mirrors the way genetic information is processed. According to Peter Wills and Charles Parker, self-organization processes lead to the emergence of an

[7] Barbieri prefers to distinguish between coding and interpretation, which he believes to involve abduction and presupposes the presence of higher brain activity (Barbieri 2019). However, for Peirce, thinking can be reduced to semiotic interpretative operations: "Thought is not necessarily connected with a brain. It appears in the work of bees, of crystals, and throughout the purely physical world… Not only is thought in the organic world, but it develops there. But as there cannot be a General without Instances embodying it, so there cannot be thought without Signs. Admitting that connected Signs must have a Quasi-mind, it may further be declared that there can be no isolated sign" (Peirce 1906, 523).

interpreter even before the primordial genetic code itself. They argue that language and interpreter are systems of recursive operations, and the reciprocal transformations of causes and effects give rise to a *Hofstadter's strange loop* (Carter and Wills 2021). The sequence of signs conveying a specific meaning cannot be both beginningless and infinite, despite Peircean conception implying an infinite sequence of interpretations. There are various signals that mark the start and end of genetic processes. At the most basic level, the standard genetic code includes three stop codons and one start codon, in order to delimitate boundaries of linear sequences. These markers of segmentation also highlight the textual nature of genetic coding.

Peirce developed an incomplete concept about a machine reaction triggered by a delicate stimulus, resulting in the creation of quasi-subjects of semiosis. This concept may be compared with the relationship between code and code-maker (M. Barbieri). Prodi describes a similar pattern; however, this is not a speculative construction but a description of the process of protein synthesis in semiotic terms:

> "The enzyme <*enzymes are proteins that act as biological catalysts* — S.Z.> comes into contact with all the indifferent elements present in the system in a purely statistical, thermodynamic way, and enters into relationship only when it encounters its own substrate and no other. The substrate is thus the referent sign for the reading machine, or interpreter, and the 'reading' — that is, the signaling phenomenon — consists of the destruction and utilization of the substrate. Here an interpreter is 'one who interprets', a synonym of interpretant, and the two terms, though quite distinct at a higher level of semiotic analysis, are equivalent at this level" (Prodi, 1988, p. 207).

The semiotic nature of genetic information creates an image of a (quasi-)anthropomorphic subject capable of generating and interpreting genetic texts, such as a genome or a gene. In Peirce's terms, there is a transition from something that can "catch on" to someone upon whom meaning can ultimately be conferred. These processes assume the ability to recognize an invariant "meaning" that takes on different forms depending on context. For example, during genetic transcription and translation, a single entity (such as the amino acid *methionine*) is encoded differently depending on its location within a particular DNA or RNA strand: "ATG (in the context of a non-transcribed DNA strand) = > TAC (in the context of a transcribed DNA strand), = > AUG (in the context of mRNA) = > UAC (in the context of tRNA) = > Methionine"[8].

This chain of biochemical transformations can be rethought according to Peirce's general scheme of semiosis: "*The interpretant of a sign becomes in turn a sign, and so on ad infinitum*". But in this case, one may notice some significant clarifications: firstly, the process is completed when there is a transition to a certain new level (in this case, it is a transition from nucleotides to amino acids), and secondly, it presupposes the differentiation of contexts and splitting of the sign into an expressive sign (quasi-utterer) and an interpre-

[8] Abbreviations: G — Guanine; cytosine — C; Adenine — A; U - Uracil, T — Thymine.

tive sign (quasi-interpreter). The DNA and RNA strands with such an extrapolative function act as a field for creation of quasi-interlocutors: the sign-utterer *ATG* is transformed into the interpreter sign *TAC*. In its turn, the *TAC* acts as an utterer in relation to the next sign-interpreter *AUG*. At the next stage (the new strand), this sign *AUG* acts as an utterer for the final sign interpreter *UAC*, which is immediately connected (in its literal sense, through the loop of RNA) with the signified of all these signs, namely *Methionine*. In Peirce's terms, such a (re-)interpretation can be described as a 'dialogue' between sign-quasi-utterers and sign-quasi-interpreters, who, at any new stage, alternate roles and simultaneously function as the interpretant of the preceding member of the chain.

The genome and genes appear in the form of a text, and, naturally, the question arises about its "author" and "readers". In this role, either an inanimate something (nature, organism, evolution) or God appears. Interestingly, Collins, the head of the genome sequencing program, used both options for the titles of his popular books: one is called *The language of God* (Collins 2006), the other *The language of life* (Collins 2009). Other metaphorical subjects also appear, which affect the terminology of molecular genetics[9]. The genome is often likened to a book without an author; however, it has an editor, as editing is one of the fundamental processes. Additionally, there is a proofreader responsible for the genome's evolution. This concept was put forth by François Jacob, the discoverer of messenger RNA:

> "The genetic message, the program of the present-day organism, therefore, resembles a text without an author, that a proof-reader has been correcting for more than two billion years, continually improving, refining and completing it, gradually eliminating all imperfections. What is copied and transmitted today to ensure the stability of the species is this text, is ceaselessly modified by time" (Jacob 1973, p. 287).

The operations as they described by biologists closely resemble proofreading, and making it difficult to find more suitable terms, as Maynard Smith notes:

> "In "proofreading," the sequence of the four bases in a newly synthesized DNA strand is compared with the corresponding sequence of the old strand, which acted as a template for its synthesis. If there is a "mismatch" (that is, if the base in the new strand is not complementary to that in the old strand according to the pairing rules, A-T and G-C), then it is removed and replaced by the correct base. The similarity of this process to that in which the letters in a copy are compared — in principle, one by one — with those in the original, and corrected if they differ, is obvious. It is also relevant that in describing molecular proofreading, I found it hard to avoid using the words "rule" and "correct"" (Smith 2000, p. 178).

[9] Cf.:" The colloquial use of informational terms is all-pervasive in molecular biology. Transcription, translation, code, redundancy, synonymy, messenger, editing, proofreading, library — these are all technical terms in biology ... In fact, the similarities between their meanings when referring to human communication and genetics are surprisingly close" (Smith 2000, p. 178).

Considering the genome and genes as texts raises questions about their readers and interpreters. Kalevi Küll (1998) proposed the concept of the organism as a text that reads and translates itself. This idea can be further developed and explored. A new agent has emerged: the reader with hermeneutic abilities. Just as a text creates itself, it also generates its own reader and interpreter, who is capable of assigning new meanings to the text. Anton Markos, in his monograph *Readers of the Book of Life*, questions this belief: "the genome is often viewed as *sui ipsius interpres* (or self-interpreting text). According to this view, the 'interpretation' of a genetic script would mean simply decoding according to a known key" (Markoš 2002, p. 34). The opposite of mechanical decoding is hermeneutical reading, "which is not merely a matter of deciphering meaning — as such a method would simply reveal what is already pre-existing — but rather, it is the very act of acquiring knowledge […] and creating meaning, as both knowledge and meaning will arise in the very process [of the reading]" (Ibid., p. 35).

As we can see, Peirce's characters—in his terms, the quasi-speaker and quasi-interpreter (*those upon whom the meaning can ultimately be expended*) — can take on different manifestations in modern descriptions in molecular biology. In this discussion, we are referring to the personification of certain semiotic functions of signs and texts, rather than to beings possessing minds and brains. However, there is another pragmatic aspect that Peirce could not have anticipated, and it serves as an additional argument in support of his conception. This aspect involves the regulatory mechanisms of genetic coding. Each cell contains the same genome, and at the same time performs its own specific functions. A specialized system of commands is necessary to activate or suppress particular genes that are responsible for specific processes associated with each type of cell. Essentially, its functioning is governed by specific gene programs. These regulatory codes can be likened to performatives. In addition to the author and the reader of genetic information, there must also be an entity that issues commands about when and what should be "written" and "read". François Jacob compared this situation to a jukebox:

> "The only instruction that can be received from the environment through regulatory proteins is a 'go' or 'stop' signal. Reading the genetic message, therefore, is like getting music from a juke-box in a cafe. By pressing one of the buttons, one can choose the desired record from those in the machine. But in no case can one modify the recorded music or its execution. Likewise, a segment of the genetic text contained in the bacterial chromosome may or may not be transcribed, depending on the chemical signals received from the environment; but the signals cannot modify its sequence, and therefore, its function" (Jacob 1973, p. 293).

Recent discoveries have significantly expanded the repertoire of regulatory functions in genetics. A gene is composed of various entities that control its behavior and activity. This regulation determines which genes should be active, at what times, in which embryonic cells, how intensively they function, and for how long. There are specific mechanisms (or "languages")

that involve agents, such as receptors and neurotransmitters that mediate immune and nervous regulation. Additionally, remote biochemical regulators like growth factors and hormones play a role, along with interactions between genes themselves, leading to gene regulatory networks (cf. Spirov 2024). Beyond the standard genetic code that correlates nucleotides with amino acids, 237 additional codes have been identified (a complete list can be found on the website: http://www. codebiology. org/database. pdf), most of which are associated with regulatory functions. This type of communicative interaction can correspond to the theory of speech acts and performatives. Semiotic operations are carried out by various components of the system, where some complex signs (or texts) function as illocutionary or perlocutionary agents. This includes entities that receive signals, those that issue commands, and those that execute them, thereby actualizing the information encoded in DNA. Semiosis is no longer confined to the boundaries of the sign itself—it interacts with context. This results in quasi-pragmatics evolving into full-fledged pragmatics.

5. Instead of a conclusion — what might come next?

Discoveries in molecular genetics do not simply validate Peirce's intuitive insights. The identification of various regulatory codes requires further investigation to differentiate between those that are semiotic in nature and those that represent biochemical or stereochemical phenomena. However, there is already compelling evidence supporting the need to expand the concept of the sign to include both Peirce's understanding and the Saussurean structuralist perspective. Peirce's semiotic conception starts and ends with a sign as a self-sufficient—albeit dynamic—yet enclosed and self-contained entity; it doesn't take into consideration the role of text, system, or context (external environment). Certainly, semiotic operations are limited to internal operations within a system. In order to control external processes, external entities must first be transformed into internal ones; only then can Peirce's semiotic concept be meaningfully applied.

Considering both theoretical and potential applied dimensions of biosemiotics and code biology, we suggest reformulating the scope of pragmatics—not as a relationship between a sign system and a subject but as a distinct hypostasis of a sign system itself. As can be seen, semiotic operators (or agents) emerge already at the basic stage of genetic coding. Therefore, instead of Morris's definition of pragmatics as a relationship between a sign system and an organism or subject, we can suggest a more general one — a relationship between a sign object system and a meta-system regulating its actualization.

The meta-system functions as a type of semiotic "I" that controls the generation (as a quasi-utterer) and interpretation (as a quasi-interpreter) processes. This meta-system can either be embedded within the text—much like how the genome contains not only genetic information but also instructions that regulate the gene expression—or personified in an external object (for instance, the semiotic "I-speaker" may be represented in an actual speaker and vice versa).

Pragmatics, as defined by Morris, corresponds to the latter case and thus represents a specific instance. A cognizant subject appears at the medial level, while at the micro level (molecule) and macro level (language, culture, semiosphere) this concept is no longer applicable. Instead, quasi-minds or super-minds emerge (the latter could be referred to as nation, society, humanity, transcendental subject, etc.)[10]

In addition to proper sign processes, challenges arise in managing signs themselves—issues that are already well recognized in pragmatics (performatives, the theory of speech acts). However, in molecular genetics, the 'speakers' are not individuals with specific functions—they are texts and regulatory codes that act as communication agents. In each cell, the selection of genes depends on its specialization. Most genes are destined to remain "silent," while some are activated and expressed. Sequences of identical nucleotides, though regulated differently, function as operators that provide and execute commands, creating the necessary conditions for protein synthesis. The genomic DNA also contains instructions for its own activation in preparation for its new incarnation in protein forms.

This situation highlights the sign system's role as both a subject and an object, reviving Peirce's concept of the sign as a quasi-mind. An examination of the main regulatory mechanisms reveals that regulatory codes a) establish specific conditions for coding, b) govern coding processes, and c) consist of the same elements as the coding sequences but are interpreted differently: their interpretants are not amino acids or proteins, but rather operations of activation or repression. Understanding the communication and information processes at the biomolecular level allows us to better grasp pragmatics as semiotic operations. These operations are connected to the self-regulation within the system and its interactions with the context (internal and external environment).

By exploring communication and information processes at the biomolecular level, one can redefine pragmatics not as an interaction involving an agent external to the system, but as a domain of semiotic operations intrinsically connected to intra-systemic self-regulation and systemic interaction with the external environment. The unfolding of intra-systemic information also creates contexts and interfaces for interaction, challenging and potentially transforming our understanding of semiosis. The systematic extension of Peirce's sign conception can be aligned with the theories of codepoiesis (Barbieri 2012) or semiopoiesis (Zolyan 2022a; 2022b). From this perspective, semiosis can be viewed as a semiotic manifestation of autopoietic processes. The emergence of life involves complex processes that control the flow of in-

[10] According to Yuri Lotman, complexly organized semiotic objects (i.e., text, culture, semiosphere) acquire the characteristics of both an organism and an intellectual device and are capable of autonomous activity: "The individual human intellect does not have a monopoly in the work of thinking. Semiotic systems, both separately and together as the integrated unity of the semiosphere, both synchronically and in all the depths of historical memory, carry out intellectual operations, preserve, rework, and increase the store of information" (Lotman 1990, p. 273).

formation, ultimately leading to the development of the primordial sign relationships expressed through genetic coding. The functioning of both the semiosphere and the biosphere relies on certain semiotic relationships, which arise and act as mutually binding and determining factors. The Peircean concept of semiotic quasi-minds may clarify the characteristics of semiosis as an intrinsic dynamic process of self-organization and self-development. However, it is important to recognize that a sign acquires its abilities and capacities not independently, but as part of a system. This occurs through its interactions — both syntagmatic and paradigmatic — with other signs. Charles Peirce did not sufficiently consider this aspect. Therefore, it would be misleading to position Peirce's semiotics in direct opposition with Saussure's systemic approach. It is through such relations and interactions that the rules that determine the operational characteristics of an individual sign are formed. By incorporating systemic elements into the analysis, it will be possible to expand the theory to the point where semiotic systems—like monads or selfes—can also be viewed as quasi-minds.

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ПРАГМАТИКА ВНЕ СОЗНАНИЯ: НЕЗАВЕРШЕННАЯ КОНЦЕПЦИЯ Ч. ПИРСА ПРИМЕНИТЕЛЬНО К (БИО-)СЕМИОТИКЕ

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Интенсивное развитие искусственного интеллекта и понимание биомолекулярных процессов передачи генетической информации выявили необходимость рассмотрения семиотической деятельности, не предполагающей наличия человеческого сознания или разума. В этой связи особый интерес представляет позднейшая концепция семиозиса Чарльза Пирса. В ней семиозис рассматривается как такая интерпретация, которая не требует внешнего по отношению к системе интерпретатора. Знак понимается как квази-разум, а семиотические процессы осуществляются посредством знаков, а точнее, слитыми в них квази-разумами: квази-говорящим и квази-интерпретатором. Тем самым семиозис определяется как устойчивое персонализированное взаимодействие структурных конституент знака (квази-разумов). Последние открытия в области молекулярной генетики и их применение в биосемиотике проливают свет на уникальный аспект интерпретации: она может происходить без внешнего интерпретатора благодаря феномену самоорганизации. Изучая коммуникационные и информационные процессы на биомолекулярном уровне, мы можем переопределить прагматику как операции, неразрывно связанные с саморегуляцией внутри системы и взаимодействием с окружающей средой.

Ключевые слова: *некогнитизантные семиотические агенты, Чарльз Пирс, прагматика, знак, интерпретатор, интерпретатор, знак как квази-разум, семиопоэзис*

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