

GATHERINGS IN BIOSEMIOTICS — 2022



Palacký University
Olomouc



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Introduction

After the global circumstances that forced us to organize the *Gatherings in Biosemiotics 2020* as the first fully-online Gatherings, we are back in Olomouc, finally meeting face to face in our city. This year, our offering comes as strong as before, with a large number of presentations displaying a renewed interest in the problems of organic meaning, animal communication and the implications of biosemiotics for understanding culture.

One of the common grounds of the *Gatherings* is the openness of the community to consider new ideas, and as new faces join in to share their research, so do we expect to give something in return: A critical perspective to further develop and refine biosemiotic theories. That meaning is a crucial part of biological systems seems, from the perspective of biosemiotics, only natural, but it is in the construction of robust theories that meaning becomes crucial for scientific practice.

We hope that this visit to our city results in the emergence of new ideas, the building of new friendships and the development of cooperation in the different areas where biosemiotics is active. We also invite you to enjoy what the city has to give in terms of culture, entertainment and cuisine. We are happy that you are here with us!

Claudio J. Rodríguez Higuera

PALACKÝ UNIVERSITY IN OLOMOUC, CZECHIA

Biosemiotics, 2022

As Anton Markoš has succinctly defined it: “biosemiotics is about how semiosis is performed by other critters” (18). This brief account is well compatible with several other attempts to describe the scope and tasks of biosemiotics:

- “Biosemiotics is the study of the myriad forms of communication and signification observable both within and between living systems. It is thus the study of representation, meaning, sense, and the biological significance of sign processes” (Favareau 2010: v);
- the aim of biosemiotics is to understand the ways of meaning-making in the realm of life;
- “bio-semiotics can be generally defined as the study of qualitative diversity found in and by living systems” (Kull et al. 2008: 44);
- “biosemiotics, or semiotic biology, is the study of qualitative semiotic processes that are considered to exist in a variety of forms down to the simplest living organisms and to the lowest levels of biological organization” (Maran 2016: 29);
- “physics focuses on all those universal regularities of nature over which organisms and observers have no control. [...] By contrast, the study of biology focuses on those specific events over which the organisms and observers have local control” (Pattee 2007: 116);
- “in short, the province of biosemiotics coincides in its entirety with that of the biosphere, which, in this context, is tantamount to the ‘semiosphere’” (Sebeok 2001: 63);
- “biosemiotics is engaged in developing conceptual tools for theoretical biology (and thereby also, indirectly, for experimental biology) — while on the other hand, the conceptual understandings made evident by biosemiotics contribute to the development of a general semiotics” (Hoffmeyer 2008: xvii);
- “part of the peculiarity of biosemiotics as a field of research is that

it seems to be permanently “parasitic” on two other fields, viz. biology for empirical cases and semiotics for conceptual tools. Furthermore, one can observe a high variety of theoretical styles that its contributors bring in, coming from both the natural sciences (e.g., evolutionary and molecular biology, ecology, biochemistry, embryology, ethology, robotics, computer science) and the humanities (e.g., psychology, linguistics, semiotics, anthropology, philosophy)” (Emmeche 2011: 369).

In the XXI century, the biosemiotic work is represented already in 25 volumes of the book series *Biosemiotics*, in 14 volumes of the journal *Biosemiotics*, and in a large number of other publications.

The annual *Gatherings in Biosemiotics* have been occurring since 2001. Two published review volumes have recorded brief accounts of what has been achieved in these two decades.¹ And this is already the fifth time when the *Gatherings in Biosemiotics* has taken place in Czechia: in 2004, 2009, and 2016 in Prague; in 2020, and 2022 in Olomouc.

Czech biosemiotics has developed in the context of an intellectual culture, where have worked, for instance, such biologists as Jan Evangelista Purkyně, who coined the term ‘protoplasm’ in 1839; Gregor Mendel, who established many of the rules of heredity in the 1860s; Emanuel Rádl, who wrote an important review on the history of biological theories in 1909; Zdeněk Neubauer, who taught and inspired the current generation of biosemioticians; etc². And concurrently, Czechia is also a country with very rich traditions in semiotics research, including, among others, the Prague Semiotic Circle.³

Thus, we are glad to welcome biosemioticians from many countries of the world to the biosemiotics centre of Olomouc, in June 2022, for creative discussions and mutual help to better understand the workings of life itself.

Kalevi Kull

PRESIDENT OF THE INTERNATIONAL SOCIETY FOR BIOSEMIOTIC STUDIES

¹(1) Rattasepp and Bennett (2012), and (2) Lacková, Rodríguez Higuera and Kull (2020).

²Notably, Markoš et al. (2009).

³See Gvoždiak (2016).

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Olomouc at a glance

Olomouc is a historied, colorful city, and this visit is a perfect chance to visit a place off the beaten path with much to give. Mainly served by the airports in **Prague** and **Vienna**, the city is at reach by train and bus. With around 100.000 inhabitants, Olomouc counts with important architectural and archeological sites worth exploring.

As you settle in, we have some recommendations for your culinary needs close to the venue. No matter if you are out looking for lunch, a cup of coffee or a beer, Olomouc offers a wide variety of options, and we hope you enjoy these while visiting us for the *Gatherings 2022*.

Lunch

There are multiple options around the university building, and we recommend you visit these ones in particular. Remember to have Czech crowns with you in case of places without card readers, as euros are not regularly accepted in shops and restaurants.

Bystro U pana Lilka [vegan friendly]: Hanáckého pluku 1021, Tuesday to Friday, 11 AM to 2 PM.



U Kristýna [Italian]: Wurmova 1208/6, Monday to Sunday, 11 AM to 10 PM.



Fresh Up [vegan friendly]: Křížkovského 10, Monday to Friday, 7:30 AM to 6 PM.



Coffee Library: 1 Biskupské náměstí 842, Monday to Sunday, 8 AM to 7 PM.

Koza zůstala celá [vegan friendly]: Mlýnská 952, Monday to Friday, 11 AM to 4 PM.

Green Bar [vegan friendly]: 3 Ztracená, Monday to Friday, 11 AM to 5 PM.

Drápal: Havlíčkova 637/1, Monday to Sunday, 11 AM to 12 AM.

Bistro Konvikt [vegan friendly]: Univerzitní 3, Monday to Friday, 8:30 AM to 10 PM.

Local breweries



Svatováclavský pivovar: Mariánská 845, Monday to Sunday, 11 AM to 10 PM.

Hostinský pivovar Moritz: Nešverova 2, Monday to Sunday, 11 AM to 10 PM.

Letní kino: Pekárni 26, Monday to Saturday, 4 PM to 10 PM.

Coffee

Pikola Espressoobar [takeaway]: Ostružnická 337/30, Monday to Sunday, 7 AM to 5 PM.

V Lese: Žerotínovo náměstí 152, Monday to Sunday, 9 AM to 7 PM.

P I K O L A

Café na cucky: Dolní náměstí 23, Monday to Sunday, 8 AM to 8 PM.



27 Monday

Univerzitní 3 — Konvikt, Corpus Christi Chapel

09:00 - 10:00 REGISTRATION & MORNING COFFEE

10:00 - 10:20 WELCOME WORDS

10:20 - 10:40 Claudio Rodríguez Higuera

10:40 - 11:00 Morten Tønnessen

11:00 - 11:20 Timo Maran

11:20 - 11:40 BREAK

11:40 - 12:00 Don Favareau

12:00 - 12:20 Josh Bacigalupi

12:20 - 12:40 Yagmur Denizhan & Vefa Karatay

12:40- 13:00 Victoria Alexander

13:00 - 15:00 LUNCH

15:00 - 15:20 Márcia Pinheiro Ohlson

15:20 - 15:40 Daria Arkhipova

15:40 - 16:00 Elize Bisanz

16:00 - 16:20 Joanna Rączaszek-Leonardi

16:20 - 16:40 BREAK

16:40 -17:00 Robert Bohat

17:00 - 17:20 Israel Chávez

17:20 - 17:40 Filip Jaroš & Carlo Brentari

17:40 - 18:00 Silver Rattasepp

19:00 - 23:00 RECEPTION PARTY

28 Tuesday

Křížkovského 10 — Velká Aula

09:00 - 10:00 REGISTRATION & MORNING COFFEE

10:00 - 10:20 Kalevi Kull

10:20 - 10:40 Anton Markoš & Jana Švorcová

10:40 - 11:00 L'udmila Lacková & Vinicius Romanini

11:00 - 11:20 Alexei Sharov & Morten Tønnesen

11:20 - 11:40 BREAK

11:40 - 12:00 Phillip Guddemi (online)

12:00 - 12:20 Carl Estrada

12:20 - 12:40 Remo Gramigna

12:40- 13:00 Massimo Leone

13:00 - 15:00 LUNCH | EDITORIAL BOARD MEETING

15:00 - 15:20 Anton Sukhoverkhov (online)

15:20 - 15:40 Anastasia Zavorotishcheva (online)

15:40 - 16:00 Nicola Zengiaro

16:00 - 16:20 Ekaterina Velymezova

16:20 - 16:40 BREAK

16:40 - 17:00 Jaime Cardenas-Garcia (online)

17:00 - 17:20 Óscar Miyamoto

17:20 - 17:40 Mikhail Iljin

17:40 - 18:00 Ivan Fomim

18:30 - 20:30 **GUIDED CITY TOUR**

29 Wednesday

Křížkovského 10 — Velká Aula

09:00 - 10:00 REGISTRATION & MORNING COFFEE

10:00 - 10:20 Sigmund Ongstad

10:20 - 10:40 Vinicius Romanini & Renata Vicentini Mielli

10:40 - 11:00 Arran Gare

11:00 - 11:20 Jamin Pelkey

11:20 - 11:40 **BREAK**

11:40 - 12:00 Prisca Augustyn (online)

12:00 - 12:20 **Malcolm Evans & Gareth Lewis**

12:20 - 12:40 Nicholas Hemann

12:20- 12:40 **Nicolas Niemann**
12:40- 13:00 **Pauline Delahaye**

13:00 - 15:00 LUNCH

14:30 **BUS DEPARTURE**

14:30 - 22:00 EXCURSION TO BOUZOV CASTLE

30 Thursday

Křížkovského 10 — Velká Aula

09:00 - 10:00

MORNING COFFEE

10:00 - 10:20

Jeremy Sherman (online)

10:20 - 10:40

Yogi Hendlin & Matthew Slayton

10:40 - 11:00

Alin Olteanu

11:00 - 11:20

Martin Švantner

11:20 - 11:40

BREAK

11:40 - 12:00

Julian Zubek & Stanisław Butowski

12:00 - 12:20

Karel Kleisner, Petr Tureček & Jindřich Brejcha

12:20 - 12:40

Borys Jastrzebski

12:40 - 13:00

Jan Toman

13:00 - 15:00

LUNCH

15:00 - 15:20

Inna Livytska

15:20 - 15:40

David Suárez-Pascal

15:40 - 16:00

Óscar Castro & Rebeca Méndez

16:00 - 16:20

Leo Kennedy

16:20 - 16:40

BREAK

16:40 - 17:00

Ali Tareq Abdul Hasan (online)

17:00 - 17:20

Theodor Sperlea and Matthias Labrenz

17:20 - 17:40

Chiara Schumann

17:40 - 18:00

Alberto Bastard

18:00 - 18:30

ROUNDTABLE DISCUSSION

01 Friday

Křížkovského 10 — Velká Aula

09:00 - 10:00	MORNING COFFEE
10:00 - 10:20	Caleb José Tardío (online)
10:20 - 10:40	Paolo Tabacchini
10:40 - 11:00	Denys Sultanhaliev
11:00 - 11:20	Veronika Sellner
11:20 - 11:40	BREAK
11:40 - 12:00	Sergei Chebanov (online)
12:00 - 12:20	Amelia Lewis (online)
12:20 - 12:40	Alina Therese Lettner (online)
12:40 - 13:00	Auli Viidalepp & Tyler James Bennett
13:00 - 13:20	John Schumann (online)
13:20 - 13:40	CLOSING WORDS
19:00 - 21:30	AFTER-PARTY

ABSTRACTS

(UN)CREATIVE PATHOLOGIES: MASS HYSTERIA, UNHEALTHY ADDICTIONS AND AUTO-IMMUNE DISEASE

V. N. Alexander

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My research has long been focused on trying to understand creativity from a biosemiotic perspective. According to my theory of biosemiosis, a system is capable of intentional behavior insofar as the effect of its response to a sign tends to reinforce that type of response to that type of sign. This entrains the system to achieve its goal (it's always sort of backward looking), but due to the flexible nature of signs, room for creative improvement exists insofar as chance structures can be harnessed as signs to achieve new goals (or the same goals via new means). Significantly, the kind of chance I am looking at is not random; it is constrained by the relative similarity and relative proximity of the biological signs.

The other side of creativity by such biosemiotic means is pathology, e.g., mass hysteria, auto-immune disease, and unhealthy addictions. Óscar Castro García, J. Augustus Bacigalupi and I (2021) recently looked at the biosemiotic mechanisms underlying what could be called the *learned pathological behavior* of slime mold. The world has lately witnessed similar kinds of pathology in the “mass formation” behavior, noted by psychologist Mattias Desmet (2022), that has arisen from propaganda related to the pandemic. Desmet’s theory is supported, I believe, by Alexander and Grimes (2017), a biosemiotic reading of subconscious information processing and the etiology of unhealthy addictions. I’ll also look at James Lyons-Weiler’s theory of *pathogenic priming* in relation to acquired auto-immune diseases. I believe there are similar semiotic processes behind these three different kinds of pathologies.

Although pathologies may arise from the same kind of biosemiosis that gives rise to healthy and productive creative actions, it seems to me that pathological actions may be much more regular. I will be exploring the nature of this regularity in view of some of Yagmur Denizhan’s recent comments/lectures on cybernetic systems. Systems that are not open to new information may impose self-harmful constraints through the too-strict application of filters without regard to context.

References

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Alexander, Victoria N., Bacigalupi, Joshua A., and Castro García, Óscar 2021. Living systems are smarter bots: Slime mold semiosis versus AI symbol manipulation. *BioSystems* 206: 104430.

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MODELLING OF SEMIOSIS IN ARTIFICIAL INTELLIGENCE MEDIATED COMMUNICATION: BETWEEN NEUROSCIENCE AND BIOSEMIOTICS IN RESEARCH ON HUMAN COGNITION

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This paper focuses on digitally mediated communication, in particular within social media platforms using artificial intelligence recommendation systems. Artificial intelligence recommendations play a crucial role aiming to provide a user with a constant stream of non-physical stimuli encouraging online interactions. Digital communication largely increased during last years due to various changes in interpersonal communication, including COVID-19 restrictions and requests for self-isolation, leading to less face-to-face communication and augmentation of interactions on digital platforms such as social media.

We presume that the extensive use of social media networks as media in communication can affect users' perception of audio-visual stimuli, such as text, image and video contents, and their interpretations (Kramer et al, 2014). In particular, it can systematically lead to stress as a reaction to non-physical stimuli provided by artificial intelligence recommendations used on social media.

Stress reactions of humans on stimuli within artificial intelligence recommendations in social media platforms is chosen as a case study of digital burnout. Digital burnout is a relatively new challenge in modern societies, and the reasons for it and its impact on human cognition is yet to be fully described. This phenomena is recognised in individuals experiencing strong effects of stress in situations when their physical self remains outside the communication process but they are largely exposed to non-physical stimuli.

The revision of the impact that social media networks have over human cognitive functions is done by constructing the connections between data-driven neuroscience methodologies and the interpretive tools of biosemi-

otics. In both neuroscience and biosemiotics, one of the main focuses is how organisms react to stimuli through interpretation. This research aims to create a bridge between neuroscience and biosemiotics to provide valuable tools for better understanding of stress among humans in communication within social networks. Finally, this paper would like to create a bridge between the methodological findings and connect them to a semiotic perspective on human cognition and interpretation processes.

References

Kramer, A. D., Guillory, J. E., and Hancock, J. T. 2014. Experimental evidence of massive-scale emotional contagion through social networks. *Proceedings of the National Academy of Sciences* 111(24): 8788-8790.

FUNKTIONSKREIS, GESTALTKREIS, AND SITUATIONSKREIS IN THURE VON UEXKÜLL'S INTEGRATED MEDICINE

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This paper explains Viktor von Weizsäcker's *Gestaltkreis* as a reinterpretation of Jakob von Uexküll's *Funktionskreis*, "the primary mechanism of meaning-making" (Kull 2020), in the context of philosophical anthropology and medicine. Viktor von Weizsäcker translated Jakob von Uexküll's *Funktionskreis* components *Merken* and *Wirken* into *Wahrnehmen* and *Bewegen* for his human *Gestaltkreis* model. The translation into English could be perception and action for both models. The *Gestaltkreis* model is central to a philosophical-anthropological approach to medicine that laid the foundation for psychosomatic medicine in Germany. Weizsäcker's *Gestaltkreis* (1940) and the associated definition of health as actively created by the subject informed Thure von Uexküll's model of *Situationskreis* that completes his psychosomatic medicine as an emergent system. Just like Jakob von Uexküll introduced the subject in biology, Thure von Uexküll introduced the subject in medicine by applying *Gestalt* and *Situation* as emergent levels of the basic *Umwelt* to integrate human cognitive and social aspects of life. Based on Jakob von Uexküll's *Funktionskreis* as a general model of semiosis, *Gestaltkreis* and *Situationskreis* characterize Thure von Uexküll's psychosomatic medicine not merely as a method or approach to medicine, but as a general model of life and health that stands in stark contrast with mainstream medicine. Thure von Uexküll laid out the complexity of the emergent systems, explaining the development and interdependence of the separate levels; and proposed the individual "biographical" physiologies of particular organs and functions as the result of an individual's personal experience in the same way that 'the immune system can only be understood as an organ with a biographical physiology, following Thure von Uexküll. Uexküll defined the term *disease* [Krankheit] as an unsolved problem situation or its consequences, on several or all levels of the system. Thure von Uexküll's idea of "biographical physiology" can be substantiated by recent concepts in cognitive science, neuroscience, and psychology. An important aspect of integrated medicine is the ability to articulate feelings and emotions

with language. Research on positive emotional granularity and psychological resilience has shown that our abilities to identify and label our emotions can have far-reaching effects for coping and health, thus validating Thure von Uexküll's understanding of meaning as a fundamental concept of integrative thinking.

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SEMOGENESIS: GROUNDING PEIRCEAN SIGNS VIA VIRTUAL RELEVANT NOISE AND ACTUAL METASTABLE STRUCTURES

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This presentation is in response to Don Favareau's suggestion that my heuristic model for semiogenesis presented at last year's gathering could elucidate Peirce's triadic signs: How they emerge, stabilize and complexify themselves in vital systems. The system theoretic frame and motivations for this investigation will be illustrated by the questions raised when trying to conceive of a synthetic system able to realize semiosis, as in animal behavior. The intuition that emerged from these questions is the basis upon which the heuristic model introduced last year will be reviewed. This review will then serve as a theoretically and physically grounded lens through which the Peircean irreducible triadic sign process will be elucidated.

A Question and an Intuition

In 2003, I designed an interactive sculpture for the World Trade Center Memorial competition. Its interactive intent was that visitors could see the patterns of both themselves and others reflected in an interactive sculpture: synthesized impressions of people present and absent. This design proposal raised many more questions than it answered: how could an inanimate sculpture absorb immense amounts of pattern information about people coming and going, recognize them when they returned and then display an abstract, yet distinct, pattern that was both relevant to that person and simultaneously about others? Animals exhibit these types of behaviors as part of their intrinsic nature; what are our machines missing? To fill this void, I initially imagined waves of patterned energy washing over circuits. The waves mold the circuits, while the circuits simultaneously mold the waves; each in-form the other. This intuition will be the basis upon which Peirce's triadic sign process will be elucidated via the heuristic model below.

The Heuristic Model

As introduced at last year's gathering, the circuits are populations of diversely tuned nodes that rewire themselves via sparse higher dimensional interference within the superposed relevant noise of their shared common medium. These virtual patterns mold and are molded by each nodes' local behavior, *simultaneously*. And through a self-regulatory annealing habit, ever more complex and contextually relevant patterns emerge. This theory argues that the emergent metastable patterns of this model are both irreducible to abstract formalisms and irreversible to previous states. This continuous actual evolution of circuit behavior is possible because of the maintenance of a virtual terrain replete with an infinity of circuit generated superposed signals: relevant noise.

Peircean Semiosis Through the Lens of the Model

After select literature is reviewed highlighting common confusions surrounding Peirce's triadic sign, the above heuristic model will serve as a lens through which Peirce's similarly irreducible and irreversible process of sign generation can be more rigorously elucidated. This will set the stage for future explorations into other projects, such as Gilbert Simondon's *individuation*; Kalevi Kull's *free choice*; Don Favareau's *relevant next*; and Cecile Malaspina's *cultivated noise*.

THE RELEVANCE OF THE UEXKÜLLIAN CONCEPT OF UMWELT FOR A PROCESS ONTOLOGY FOR BIOLOGY

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In the last decades, as part of a critique of the mechanical understanding of biology, a series of new biological and philosophical approaches have emerged in an attempt to contest the biological discourse rooted in the Modern Evolutionary Synthesis (MES). As the name suggests, the MES is the integration of the Darwinian evolutionary theory and the Mendelian genetic theory formulated in the first half of the 20th century. Although at the time the MES paradigm was theoretically and technologically successful, for a while now it has been shown to be inadequate for understanding what a living organism is. In this respect, some biologists and philosophers like John Dupré, Daniel J. Nicholson, and Spyridon A. Koutrofinis, following Carl Woese's work, have criticized the understanding of living beings drawn from the machine metaphor. Instead, they have suggested that a process flow metaphor is more appropriate, which has led them to demand a process flow ontology for biology as a discipline. This ontology asserts that processes are the most ontologically fundamental factors as a means to understand every entity; particularly, it leads to the comprehension of the living organisms as a set of individualized processes. The aforementioned authors have established that there are already precedents for this ontology in the philosophy and biology of the 20th century, such as Dewey, Whitehead, Waddington, Bertalanffy, Levins, Lewontin, etc. In particular, Koutrofinis considers the theoretical biologists of the early 20th century as precursors, highlighting the figure of Jakob von Uexküll and his Umwelt doctrine (the Umweltlehre).

Taking this into consideration, I argue that the uexküllian concept of Umwelt is relevant for understanding the discourse of biology from a process ontology that seeks to overcome the mechanism and reductionism of MES paradigm. Particularly, I want to show three things in this regard: 1) that the concept of Umwelt—the way it emerges in uexküllian biology as opposed to mechanistic biology—, may help reinforce the critique of the machine metaphor; 2) that the concept of Umwelt may help think

the living organisms as a set of processes, drawing from the concept of a functional cycle (Funktionskreis), which is essential in the uexküllian doctrine; and 3) that the concept of Umwelt—as it has been understood since Uexküll himself and within biosemiotics (especially in Kalevi Kull and Jesper Hoffmeyer)—provides us a philosophically fundamental approach to the understanding of living organisms from a process ontology perspective, namely, the idea of the subjectivity or agency of the very living beings. To sum up, I argue that the concept of Umwelt can help us to comprehend biological processes as semiotic processes (i.e. semiosis).

ENTANGLEMENTS BETWEEN THE BIOSPHERE AND THE SEMIOSPHERE. A RELATIONAL APPROACH TO THE CONCEPT OF INTELLIGENCE

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In his article *Questions Concerning Certain Faculties Claimed for Man* Charles Peirce brilliantly leads the reader to the epicenter of his logic, to the 5th question in the text: *Whether we can think without signs*. The answer follows promptly and unmistakeably, confirming that "The only thought, then, which can possibly be cognized is thought in signs. But thought which cannot be cognized does not exist. All thought, therefore, must necessarily be in signs." The reciprocal relativity and conditionality of the mind and the physical world we witness in Peirce's logic of signs prevail in current scientific investigations in cognitive sciences and fields as diverse as biology and physics. In recent discussions in quantum physics, new discoveries challenge the old concepts of spacetime as parameters of reality, envisioning new spheres of entanglements beyond space and time. For instance, current quantum physics explains the physical world as a web of correlations called *relative information*, meaning being released in continuity between the mental, biological life and the physical world. The approach also relates to the biosphere as perceived in structures and processes essential for the continuation of life, understood as a biochemical process that unfolds in relation to the laws of nature.

Studying these pathways, the paper discusses core features of the biosphere and the semiosphere as entanglements of sign processes that ensure continuity and embody harnessed intelligence. The investigation will naturally and ultimately reflect on the existence of comparable processes in the technosphere of artificial intelligence.

AN ODE TO THE CODE: "JUST" A METAPHOR? THE GENETIC CODE BETWEEN METAPHOR AND METAPHYSICS

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If semiosis is a necessary, criterial attribute of life according to Sebeok, then the nature of genetic biosemiosis and its code is one of the key questions in biology. Yet, decades after the discovery of DNA and its code, controversy among biologists (as well as linguists) prevails – ranging from calling the genetic code 'just' a 'metaphor carried too far' all the way to it being 'literally true' and 'more than a metaphor'. This confusion could be eliminated if biologists understood the profound complexity of conceptual metaphors and linguists appreciated that the codon-to-amino-acid correspondence rules are not 'just another chemical reaction' (or worse still, a type of crystallization). Hence, in this study I present the results of a trans-disciplinary analysis using *Conceptual Metaphor Theory* (CMT) to systematize *what is literal, what is metonymic and what is metaphorical* in the biological discourse about gene expression processes. Metaphors were identified using the MIPVU method based on empirical corpus-linguistic research with good inter-coder reliability.

Preliminary results of this CMT-based analysis lead to these conclusions: genetic *information* is *literal* information measurable in bits, storable and retrievable as well as transcodable. The genetic *code* is a *literal* code – an arbitrary (not determined by physical or chemical necessity) correspondence between triplets of nucleotides and amino acids. Is DNA a *language*? *Not literally*; although DNA and human language share the properties of linearity, arbitrariness, dual articulation and combinatorial productivity, there is empirical evidence indicating that DNA 'may not follow Zipf's law,' which is typical for natural human languages (Faltýnek 2011; Tsonis et al. 1997). If that is the case – and given the contiguity (but non-literal identification) of the two – calling the genetic code "a language" seems to be a *metonymy*. Calling a sequence of genetic information a *literal text* seems to be justified by Sebeok's definition of text as a 'string of signs transmitted from a source to a destination'. DNA has also been called a *book*; given the basic definition this would not be

a metaphor, but a *metonymy*. Similarly, these CMT approaches can be used to analyze the parallels (or lack thereof) between codons and letters, genes and words (or sentences), genomes and books, as well as understand protein functions as the ‘meaning of the code,’ etc. (cf. Matlach and Faltýnek 2016) Hence, the widespread habit of dismissing the genetic code and information as ‘just a metaphor’ when faced with its metaphysical implications (such as ‘Who wrote the book of life?’, etc.) is *not justified* in terms of bioinformatics, biosemiotics and cognitive linguistics. In other words, evidence shows that genetic information is literal information and the genetic code is a literal code – confirming Prodi’s proposal, whereby instead of thinking whether cells speak like us, the question should be asked whether we speak like cells.

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THE CENTRAL DOGMA OF INFORMATION

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The central dogma of molecular biology deals with the detailed residue-by-residue transfer of sequential information, such that information cannot be transferred from protein to either protein or nucleic acid. More formally, the central dogma of molecular biology states “once (sequential) information has passed into protein it cannot get out again” (Crick 1970: 562).

Info-autopoiesis, based on Bateson’s *difference which makes a difference*, is the self-referenced, recursive process of information self-production that engages all living beings in their efforts to satisfy their physiological and/or social needs. This allows the discovery not only that information is not an absolute quantity, but rather a derived quantity, useful to living beings, from the sensorially detected motion of matter and/or energy in the universe. All living beings have this unique capability of detecting spatial/temporal differences or information that allows its use to derive meaning as active manipulators/observers of their environment. For the human-organism, the process of info-autopoiesis is found to be triadic in nature and incorporates the simultaneity of a quantitative/objective perspective with a qualitative/subjective perspective. These perspectives develop from the endogenous interaction of Impersonal/Objective/Absolute Information and Personal/Subjective/Relative Information, which results in exogeneous Shannon/Distilled Information. In interacting with its environment, the human-organism develops from a state in which its knowledge of the human-organism-in-its-environment is almost non-existent, to a state in which the human-organism not only recognizes the existence of the environment but also sees itself as part of the human-organism-in-its-environment system. This allows a human-organism not only to self-referentially and meaningfully engage with the environment and navigate through it, but to even transform it in its own image and likeness (Cárdenas-García 2020; Cárdenas-García and Ireland 2019).

In this process of meaningful engagement with the environment, humans create and transform endogenous semantic information into many expressions of exogeneous syntactic information. Exogeneous syntac-

tic information is synonymous with ordered material structure and artificial creation, including analogue and digital information. Other humans can interpret exogenous syntactic information and uniquely transform it into semantic information, which can take multifarious forms. This asymmetrical process is the basis upon which to postulate the central dogma of information, and state that 'info-autopoiesis results in endogenous semantic information that irreversibly becomes exogenous syntactic information'. In other words, once endogenous info-autopoietically created semantic information becomes exogenous syntactic information it cannot be internalized again. The artificial world created by humans, including machines, is syntactic in nature. These syntactic creations become embodied as exogenous artificial syntactic ordered structures. At best they can only recognize, extract, create, transmit, preserve, store, and utilize syntactic information, being unable to transform syntactic information into semantic information. In short, this resourceful capacity for syntactic creation does not allow us to create artificial beings with capabilities for meaning making comparable to our own. It suggests that our dreams for artificial intelligence and beyond are misguided.

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ON ARBITRARINESS AND ARTICULATION: THE MECHANISM OF SIGN SYSTEMS

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In semiotics, it is often assumed that signs are never isolated, thus, if there is a sign, it can be safely assumed that there are some other signs to which the first one relates, and this results, seemingly, in that if there is a sign then there is a sign system. Yet, one can always ask, how is it that two or more signs form a system? In what sense are sign systems "systems"? Where does their systemacity come from? This paper will aim to give an answer to this question. We will begin with the assertion that all meaning is arbitrariness. This assertion is rooted on a definition of meaning as fundamentally relational and plural. The plurality of meaning is due to its relationality. We take it that a concrete meaning can only be so in relation to a concrete practice wherein said meaning is deemed relevant (or pertinent). The concrete practice in which a given concrete meaning is recognized is tantamount to K. Kull's characterization of a logical conflict; *id est*, in a concrete practice, the executant of the practice is simultaneously faced with multiple incompatible options. The executant's choosing amounts to a movement by virtue of which the plurality of meaning is temporarily and relatively determined. This *choosing* movement, at its core, is a *relating* movement and it consists in linking together what does not, by itself, need to be linked. Because of the relationality of meaning, choosing enables both "sign" and "interpreter" (and "object" in the Peircean sense) to be constituted, and for a "standing for" relation to be established. Thus, in a concrete practice, an executant is (also) an interpreter to the extent that "standing for" relations are precisely established in concrete practices. If we think of a choosing movement that was the first in a series of choices, we can aptly characterize it as an illustration of "absolute arbitrariness." Now, if the "standing for" relation were to be always completely arbitrary, systematicity would not exist. It is thus needed to assume either that (a) in concrete practices, more than one "standing for" relation has to be at play (as in L. Prieto's proposal of double pertinence on the content plane), or that (b) different concrete practices in which different "standing for" relations are involved, are intrinsically linked with each other (as in an *Umwelt*). In both cases, what becomes evident is that there are more movements involved

in concrete practices than a “first movement.” And thus, there is something else than pure arbitrariness. Indeed, to our view, the first movement necessitates a second movement that limits its reach. All the subsequent choices following one that is guided by absolute arbitrariness are done in relation to the first: their aim is precisely to limit the arbitrariness inaugurated by the first choice. These subsequent movements can be aptly called “relative arbitrariness.” Notice that because all the subsequent choices are limiting the reach of the arbitrariness opened by the first choice, they are all related to one another. Since these choices create “standing for” relations, the signs being informed by these choices can create a system. The delimitation of arbitrariness is in this view tantamount to what J. Hoffmeyer called *scaffolding*. But notice that the notion of “absolute arbitrariness” emphasizes the fact that some signs are articulated: indeed, our main hypothesis would be that because the mechanism of a sign system is the delimitation of arbitrariness, the recurrence of some choices in a given direction creates identifiable patterns within sign systems. The paper will show the applicability of this view by tackling the problem of syntax in some non-human sign systems.

INTERDISCIPLINARY COURSE OF LECTURES ON BIOSEMIOTICS FOR PROFESSIONALS

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In order to summarize the author's work in semiotically aware biology (SAB) since the 1970s the author has been giving three blocks of lectures on biosemiotics (since October 2021, available on YouTube).

The 1st block (4 lectures) describes the (pre)history of biosemiotics as a biological discipline. Consideration begins from mythological and fabulous ideas about the language of animals, judgments about the imitation of animals by Aristotle, the idea of two covenants – the Bible and Nature – in the Judaic and medieval Christian traditions. Borocco allegorics and medical semiotics are important sources for biosemiotics. In the conditions of the excision of anthropomorphism (19th century), the study of the sign of the living being remains in neurophysiological reflexology, and in the first half of the 20th century it appears in the semiotics of Ch. Morris and in ethology. The middle of the 20th century was marked by the realization of the universal semiotic status of the genetic apparatus of all living organisms, the second half of the 20th – the beginning of the 21st century was marked by discoveries in animal cognitive ethology, zoosemiotics and zoopsychology, which revealed a huge variety of semiotic processes in animal behavior. Semiotic processes have been found in immune phenomena, ecological interactions, reproductive mechanisms, etc. As a result, modern biosemiotics was formed by T.A. Sebeok, J. Hoffmeyer, K. Kull, A.A. Sharov, A. Markoš, G. Witzany, P. Cobley, D. Favareau, etc.

The consideration of SAB as a subject for biologists reveals the presence of significant defects in their ideas about sign (language). Therefore, the 2nd block (6 lectures) is devoted to the discussion of the significant issues of semiotics: the concept of sign (starting with Plato's "Cratylus"), the problem of motivation and (in)arbitrariness of the sign, the typology of signs, the relationship of indices and symptoms, the status of the signal and its relationship to the sign, etc. In particular, the existence of five concepts of signs (hermeneutics, philology, linguistics, semiotics, pragmalinguistics) and their potential as a basis for creating a SAB are

discussed.

The 3rd block (15 lectures) is devoted to the author's version of biohermeneutics, which is developing as a branch of theoretical biology close to H. Pattee's interpretation. The starting point here is the idea of a reflexive experiment as a dialogue between a community of empirical biologists and a seminar of theoretical biologists. The empiricist enters into a quasi-dialogical interaction (enlogue) with a living being, and the theoretician enters into an enlogue with a generic (speculative) being. Then the body of an organism, studied by physicochemical biology, acts as a plane of expression of the organism as a semiotic means (the body of a sign), the plane of the content of which is the biological sense to be studied in biohermeneutics. The basic categories of this version are the idea that the body of a living organism is a semantophore – the body of a sign, hospitable for meaning, *umwelt* (J. von Uexküll) as a habitat formed by an organism in an enlogue, a variety of ways to interpret biosemiotic objects (cf. interpretation techniques of G.I. Bogin). The main biohermeneutic processes are genetic regulation of biosynthesis, immune interactions, synaptic connections, immune responses, process of fertilization, various types of communication of individuals, sensory systems of animals, animal social behavior, etc. A separate sub-block is the consideration of the hermeneutics of biology – the versions of non-fiction hermeneutics, which deals with the interpretation of biology, interpreting the professional behavior of biologists, research methodologies and biological texts as a result of research.

The first two blocks should be in any course of this kind, the third one is authorial, representing the personal interests of the author.

MAPPING A SEMIOSPHERE: A CASE-STUDY OF CORVIDS IN TARTU, ESTONIA

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The concept of semiosphere is particularly interesting when one tries to understand complex relationships and communication. This is especially true when studying semiosis events and patterns between different species. In this presentation, I will use the concept of semiosphere as defined by Hoffmeyer (1997: page number) "a sphere just like the atmosphere, the hydrosphere and the biosphere," incorporating all kinds of "signs of life." In this sense it could also be called "ecosemiosphere" (Maran 2021), to use a specific term with a separate meaning. This question of terminology will be briefly discussed.

The understanding of different aspects and layers of these interactions can be seen as a map, which includes, in one object, different elements of an environment, different ways to see, explore or exploit it. To map a semiosphere, a lot of academic fields must work together: biology and ethology, anthropology and sociology, but also literature studies or linguistics.

In this communication, I will present different steps of mapping a semiosphere. Mainly, this presentation will introduce key-concepts needed for this work and methods used – what elements should be included? What methodology should be preferred and what are its potential flaws? How to encourage a good and relevant interdisciplinary dialogue? – before giving some examples of results. Results obtained through these steps will include elements of ethology or biology, elements of anthropology and literary elements, in order to present an exhaustive overview.

All the results and methodologies introduced in this communication are from an ongoing project in Tartu, aiming to study relationships and interactions between humans and liminal species, using the urban corvids as a case study – *Corvus cornix*, *Corvus frugilegus*, *Coloeus monedula* and, to a lesser extent, *Corvus corone*. As a part of this project includes comparative observations with the city of Paris, this communication will also briefly talk about key-points of vigilance when comparing semiospheres.

This communication will also address the question of why would anyone want to do something as complicated as mapping a semiosphere and how this kind of work is a valuable tool to understand biodiversity, human-animal interactions and species-environment interactions. I will also briefly explain how, without a tool of this kind, projects of sustainable urbanism, species reintroduction or biodiversity enhancement may fail to take into account subtle aspects of the semiosphere that are vital to carry out the project successfully.

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A BIOSEMIOTIC MODEL OF AN EVOLVING HUMAN SPECIES AND AN EVOLVING GOD

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At the Gatherings in Biosemiotics in 2020, university philosophy professor Lukáš Zámečník challenged the biosemiotics community. "What are we doing?" "Are we presenting a theory, or what?" It occurred to me at the time that in my own work involving biosemiotics I was not presenting a theory. Rather, I was working on a hypothesis aspiring to be a theory. Hypotheses can arise from a constellation of ideas. If one considers these five, a working hypothesis that is biosemiotic in character can be forged. (1) At the Gatherings in Biosemiotics in 2021, one year later than Zámečník's musings, Victoria Alexander made the following statement: "We have no ability to perceive God, and yet we have many signs for that object." (2) Two days earlier, Alexander had briefly touched upon a Rembrandt painting, the one entitled "The Mill." She reminded her audience of the painting's interpretation which sees the mill's illuminated blades as the signifier of a spiritual signified, the momentousness of the Christian crucifixion. (3) Likewise, Nora Bateson told the story of her own blindness to the presence of a potentially dangerous moose, a moose that her husband saw because he saw the signifier for the moose, its shadow. (4) In addition, one can recall Don Favareau quoting Nora's father Gregory Bateson: "Interesting phenomena occur when two or more rhythmic patterns are combined, and these phenomena illustrate very aptly the enrichment of information that occurs when one description is combined with another." (5) Finally, Jesper Hoffmeyer in *Signs of Meaning in the Universe* (1997) presents "code duality" as a vibrant partnering of an analogic code with a digital code. Of what rhythmic patterns am I thinking? There are two. One is a progression of basic human insights, each insight an identification of a characteristic of God, in other words deific insights. Here I am positing an extremely minimalist definition of God as simply that entity which is in dialogue with the human species toward some as yet unspecified goal. The other rhythmic pattern is a progression of basic human insights, each an identification of a characteristic of humans: anthropological insights. In other words, the overall pattern is double stranded. The appearance of each pair of insights at ap-

proximately the same time constitutes a 'nodal pair.' The thinkers who create each pair are Nodal Scribes. Socrates is a Nodal Scribe. There are, of course, many others. The time interval between nodal pairs is approximately 400 years, plus or minus one generation. One notices a genuine progression in the flow of deific nodes (the digital code) from 2800 BC to 1600 CE that is not a characteristic of the flow of anthropological nodes. This deific progression is evidence of an Evolving God. The probability that a hypothesis is valid is greatly strengthened if there is an underlying mathematics to the hypothesis that actually works. In the case of my hypothesis the underlying math is a set: the set containing as its elements the first three prime numbers 2, 3, 5. I hypothesize that the progression of nodal pairs from 2800 BC to 1600 CE moving through time (the analogic code), has a geometric relationship to the progression of DNA base pairs moving through space, if one thinks in terms of self-similar fractals. In addition, I can make a prediction of a new nodal pair which either has appeared or should appear between 1970 CE and 2030 CE.

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APPLIED BIOSEMIOTICS: CRAFTING AN ACCESSIBLE AND INSTRUMENTAL APPROACH (FOR EDIFICATION, PLEASURE AND PROFIT)

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In the late 1980s and 1990s, an applied semiotics for brands and corporations started to take off as a serious commercial proposition within marketing and market research. This was helped by the emergence of brand valuation and the rapid rise of cross-cultural brand management and strategy with the globalization of markets. Three decades later, with brand semiotics now a firmly established (and profitable) methodology in the marketing and research repertoire, this applied version of the discipline is constantly on the lookout for new ideas and services to offer clients. To this end, an incipient dialogue has been in place for some years between academic experts in biosemiotics and practitioners at work in the marketplace. Malcolm Evans gave a speculative account of how biosemiotics might become the next paradigm in commercial semiotics in his keynote presentation at the Tallinn Semiofest gathering in 2016. In the wake of this the main professional body for market research internationally, ESOMAR, requested a piece for its journal on what an applied biosemiotics for brands might look like. Conversations with academic and commercial associates and clients have been ongoing. At Space Doctors, the global reference point for best practice applied brand semiotics, Gareth Lewis is in the forefront of methodological innovation, and biosemiotics has also been on his radar in this respect for several years.

The purpose of this paper will be to report back on some initial tentative steps towards making biosemiotics, in the jargon of commercial research applications, more accessible and actionable for non-specialists, including commercial clients. We will also give feedback on the response to these endeavours so far from the academic biosemiotics community, which ranges from a feeling that the nascent discipline is as yet too speculative and in-house to be considering anything like applied outreach and accessibility, all the way across the spectrum to a 'let's pitch in pragmatically and go for it' attitude, learning by doing. The first wave of mar-

Marketing semiotics was rooted in a blend of French semiology and British cultural studies but has evolved eclectically and pragmatically to incorporate influences from Peirce and the Moscow-Tartu school, all based on collaboration and improvisation in dialogic engagement with client demand. Market needs have compelled the analysts to be flexible and innovative – a semiology constrained by linguistic and cultural models would find it difficult to engage fully, for example, with the sensory qualities of products, iconic and indexical dimensions of design, the non-symbolic functional aspects of technologies and pharmaceuticals, or biological processes that are not reducible to a notion of cultural construction.

Bio- and cybersemiotics are not the only disciplines the applied practitioners are turning to for inspiration. People like Bruno Latour and Donna Haraway, for example, have also developed models that span the traditional domains of the social and exact sciences – with others such as Lynn Margulis or Wendy Wheeler developing discourses that connect the biosemiotic with the social and political. Ultimately, the commercial semiotic practitioners, with their imperative to speak comprehensibly to more vernacular lay audiences, can also be collaborators in an educational and cultural mainstreaming of biosemiotic insights and epistemological dispositions, the work towards a healing of a disabling 'two cultures' divide and, further back, the primal Cartesian split. 'Descartes' Error' is very familiar ground for marketing people, perhaps for reasons purists in biosemiotics might find suspect. But progress, peace and reconciliation begin with dialogue. Here we are. It's good to talk.

IS 'UNIQUE WILL' 'FREE WILL' ENOUGH? CONTEXT, CHOICE, AND ACTION WITHIN AN INDIVIDUALIZED HISTORY OF MEANING

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"What makes us have control over things is the fact that we are causally undetermined in our decision and thus can freely decide between doing/choosing or not doing/choosing them" – Alexander of Aphrodisias, c. 198 AD

"Nobody doubts that, at any rate within certain limits, you can do as you like. But what determines your likings and dislikes? Did you make your own constitution? Is it your contrivance that one thing is pleasant and another is painful? And even if it were, why did you 'prefer' to 'make it' after the one fashion, rather than the other? ...the feeling we call volition is not the cause of a voluntary act, but [only our post-hoc] symbol [for] that state of the brain which is the immediate cause of that act" – T.H. Huxley, 1874

In biosemiotics, the concepts of 'semiotic freedom' and 'free choice' are often invoked as being fundamental to the evolution of living systems, while in traditional scientific and philosophic circles, questions about the nature of human and animal 'volitional action' have often taken the form of a debate between the 'determinism' of our physical being and the possibility (or non-possibility) of some kind of non-deterministic 'free will' existing and operative besides, or emerging from within, those parameters.

Biosemiotics, of course, has long held that the opposition between the extremes of pure determinism and pure non-determinism in the living world are too binary and entail a false dichotomy. But what is needed, too, is indeed an explanation of what exactly the relations are that allow for the emergence of 'free will' and 'choice' within systems that remain lawfully constrained by physical forces and chemistry.

Indeed, over the course of the last few years, Kalevi Kull has made the concept of 'free choice' central to the definition of semiosis, while insisting, too, that every instance of semiotic meaning making must ideally be

accounted for both in its logical and relational – what we normally think of as its ‘semiotic’ – aspects, *and* with regard to those underlying biological relations that actually instantiate the process in living beings, and that must be discovered empirically, using the methods of natural science. “This distinction between the *sign process (semiosis)* and the *sign-relation* is important and universal,” he writes, “[and] we may call it the *process-relation duality* that characterizes every sign (Kull and Favareau, *in press*; emphases added).

What Kalevi seems to be saying here is that if ‘free choice’ is central to the process of semiosis, and if the ‘motivations’ behind those choices can themselves be deeply constraining and historical without yet being fully deterministic – then there remains a crucially under-explained aspect of such ‘choice’ and its ‘motivations’ that must yet also be made explicable within the realm of empirical biology non-reductionistically.

Not surprisingly, this demand has renewed conversations within the biosemiotics community to discover how (and if) the nature of indeterminacy as it is found in complex non-biological systems may inform – or be understood in some sense to give rise to – the ‘semiotic indeterminacy’ of living systems. In a recent conversation with Joshua Bacigalupi on his work in this direction, Kalevi asked if the kind of complex systems analysis he was proposing was capable of ‘free will’ – to which he replied that he would more probably use the term ‘*unique will*’.

Congruent with my own interests in the ever-renewing emergence of a ‘relevant next’ set of possibilities in the cognition and behavior of living beings, I wish to expand in this talk on the ways in which this concept of a ‘unique will’ – one that comes into being via an individualized history of meaning-making that is itself always contextualized within the meaning-making of others, past and present – allows us to transcend the traditionally conceived ‘free will’ versus ‘determinism’ debate, and to continue to develop even more fine-grained biosemiotics of ‘choice.’

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“THE END OF THOUGHT IS ACTION ONLY IN SO FAR AS THE END OF ACTION IS ANOTHER THOUGHT.” EMBODIED, EXBODIED, AND INTERSUBJECTIVE INTERPRETANTS IN (BIO)SEMIOSIS

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According to Charles S. Peirce, there are three distinct things which may be regarded as interpretants (effects of the sign). First, the “immediate interpretant” is the effect that is “ordinarily called the meaning of the sign” (CP 4.536). Second, the “dynamical interpretant” is “the actual event” that some sign brings about “by virtue of really acting as such” (ILS 285). Third, the “final interpretant” is the Habit (“general rule operative within the organism” (MS [W] 397)) produced by the sign. The paper discusses some terminological and conceptual divergences and inconsistencies in Peirce’s writings on different kinds of interpretants and proposes a biosemiotic reconstruction of his typology of interpretants, suggesting that the distinction of immediate and dynamical interpretants can be mapped onto the distinction of embodiment and ex embodiment. According to the proposed reconstruction, while the immediate interpretants are the embodiment-oriented effects of sign, the dynamical interpretants are ex embodiment-oriented ones. Moreover, one can suggest that final interpretants can be analyzed into embodiment-oriented Habits (Habits of meaning) and ex embodiment-oriented Habits (Habits of action). The embodiment-oriented Habits of meaning enable the habitual production of immediate interpretants, but ex embodiment-oriented Habits of action enable the habitual production of dynamical interpretants. The study also discusses to what extent the distinction of immediate, dynamical, and final interpretants is applicable to the biosemiotic processes in the simplest agents (autogens). Additionally, the paper considers the distinction of intrasubjectivity and intersubjectivity as an additional dimension that is not reducible to the distinction of embodiment and ex embodiment. It demonstrates the relevance of intersubjective dynamical interpretants and intersubjective final interpretants for semiotic accounts of social conduct. Finally, the study also discusses how Peirce-inspired accounts of embodied and ex embodied interpretants

as well as intrasubjective and intersubjective interpretants map onto the models of interpretation and action from other traditions of linguistics, semiotics, hermeneutics, and phenomenology.

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LIFE PROCESSES AS PROTO-NARRATIVES: INTEGRATING BIOSEMIOTICS AND WADDINGTON'S THEORETICAL BIOLOGY

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In the concluding sentences of the epilogue to the fourth volume of the proceedings of the conferences on *Toward a Theoretical Biology*, C.H. Waddington, who organized these conferences, wrote:

To a biologist ... a language is a set of symbols, organized by some sort of generative grammar, which makes possible the conveyance of (more or less) precise commands for action to produce effects on the surrounds of the emitting and the recipient entities. ... And it is language in this sense – not as a mere vehicle of vacuous information – that I suggest may become a paradigm for the theory of General Biology (2012 [1972]: 288)

These conferences, which took place at Villa Serbelloni at Bellagio in Italy from 1966 to 1970, brought together most of the world's leading theoretical biologists, and the proceedings were immensely influential. For Waddington, they were the culmination of the theoretical biology movement begun at Cambridge University in the 1930s by himself, Joseph Needham, Dorothy Wrinch, J.D. Bernal and others, a movement that was continued after Waddington's death in 1975 by Brian Goodwin, Mae-Wan Ho, Gerry Webster and others who took seriously Waddington's suggestion that the study of language could provide a model for biological theory. This movement should be seen as allied to the biosemiotics movement, similarly concerned to replace the reductionism of mainstream biology. However, while influenced by some of the Bellagio conferences' participants, notably René Thom and Howard Pattee, for the most part those influenced by Waddington have developed in parallel with biosemiotics with little interaction between these movements.

One reason for this is that most of those influenced by Waddington who took up his challenge to advance biology through ideas from language turned to the structuralists, notably Jean Piaget, Noam Chomsky and

Levi-Strauss, while biosemiotics has been most strongly influenced by Peirce, although Thom grappled with the work Peirce. Waddington himself was closely aligned with the genetic structuralism of Piaget, who in turn was strongly influenced by Waddington, utilizing Waddington's theoretical concepts to generalize his own work on cognitive development to biology. However, Piaget focused on cognition as such, and only gave a derivative place to signs and semiosis.

In my presentation I will argue that Peircian biosemiotics, theoretical biology influenced by Waddington and Piaget's Waddington influenced genetic structuralism, all of which are aligned with and influenced by Jakob von Uexküll's work, share deep assumptions deriving from post-Kantian philosophy and process metaphysics, and so, despite appearances, are not only commensurate but complement each other. They combine constructivism with a form of realism that gives a place to indeterminacy and path dependency. In particular, I will argue that that the integration of concepts such as biofields, chreods (necessary paths) and catastrophes (in Thom's sense) with Piaget's concept of structures and the Peircian understanding of semiosis, acknowledging multiple levels of semiosis active simultaneously, allows living beings to be understood as biological proto-narratives, that is, as living stories, in their epigenesis, in their activities and in their interactions as biotic communities.

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FACE IMAGES, INDEXICALITY, AND THE 'LOSS OF THE REFERENT'

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The human face has played a key role in ancient and contemporary physiognomy as well as in the history of semiotics. Indeed, the history of physiognomy is rich with examples that assign to facial features and expressions a pivotal role in face reading systems. Signs of the face have been couched in different ways according to the system of reference used each time by the scholars (faces as cues, indexes, symptoms, expressions, stigmas, analogies, etc.) and have changed over time, but their relevance remains constant. If this is not enough to contend with, one may think of the resurgence of automatic face recognition systems, algorithms and artificial intelligence increasingly employed today in order to identify, track and archive face images for different purposes (ideological, political, surveillance, etc.).

In the history of semiotics, the human face has often been associated with natural semiosis indexicality as well as iconicity. Indeed, faces often enter in the analogical network of things present in the environment as they gather a host of different kinds of information, for the face is an important component of human nonverbal communication. The expressions of faces have often been the object of heated debates between two opposite fronts: those who assign to it an expressive edge and an intentional meaning and those who consider it as something that is, on the contrary, involuntary and accessory. The reference to the indexical power of faces is also apparent in the 'evidential paradigm' famously traced by Carlo Ginzburg and it is also constant in the tradition of medical semiotics, where faces are often treated as symptoms.

The understanding of faces in terms of indexes should perhaps be reconsidered in today's hyper-connected and ever increasingly digital reality, however, as a part of what we experience as human appearance is often mediated by images of various natures. Some have seen in the shift from analogic to digital codification a rupture and a change unheard of up to now. In a nutshell, the sign became detached from the referent. What is at stake with the shift from analogical to digital culture was un-

derscored with acumen and foresight by the post-modernists (think of Jean Baudrillard's simulacra) and proclaimed the 'death' of the referent. However, the implications of the 'loss of the referent' which they pre-cognized have yet to be pondered in their full scope. The paper seeks to unravel this conceptual knot and sketches out some possible antidotes to this problem.

ICON, IMAGE AND INQUIRY, AND A BATESON SPECULATION

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I have for a long time been intrigued by something which Peirce says about the icon – that “by the direct observation of it other truths concerning its object can be discovered than those which suffice to determine its construction.” (2010: 126-127). The icon is thus implicated in a “capacity of revealing unexpected truth.”

It is an interesting question, and I hope a biosemiotic one, as to how an icon, or image, can be constructed so as to have that capacity. It is a capacity which exemplifies itself by in some ways underlying the very image of the visual world which appears to our eyes.

Although this revealed iconic image is experienced as First, as phenomenologically primary, and self-evidently immediate, nonetheless the Ames experiments in vision, which Gregory Bateson experienced and described in numerous places (Bateson 1979: 32-38), reveal that visual image formation is the result of unconscious processes of construction. These processes make an image which is present to us, but its processes of construction are not themselves visible to us. We are thereby able to search that image and discover new truths concerning our immediate environment – and this very ability is dependent on our being unconscious of the axioms and principles by which that image is presented to us.

Gregory Bateson in 1979 said that image formation “remains almost totally mysterious. How it is done, we know not” (Bateson 1979: 37). But he had a speculation of *when* it might be observed. He suggested that such images or icons were important ways of passing information across *interfaces* – what he elsewhere called “boundaries that connect.”

He was inspired in this by World War II cybernetic technology. An anti aircraft gunner would aim a gun at a flying target. One moving dot on a screen summarized information from sighting devices; another moving dot indicated the direction of aim of the gun. When the two dots coincided, the gun was fired. This technology was possibly one inspiration

for a cybernetic inquiry into the sense perception systems of frogs (and, anecdotally, geckoes). These animals were said not really to 'see' still images. In Bateson's terms, only movement in the environment creates a 'difference' which makes a difference for the animal. But the moment something bug shaped is seen to move, the tongue, for example, flicks out.

In humans (and probably other mammals), however, the eye 'makes its own differences,' via nonpathological *micronystagmus*, a constant micro-movement necessary for creating a visual image. This movement in/by the observer is not always directed *instrumentally* toward a known target or even a specific goal. And is it this very non-instrumentalism which enables us to, in Peircean terms, discover unexpected truths? The psychological correlate to this kind of scanning of a field of vision could perhaps be seen as an orientation toward *exploration* or *inquiry*.

(What of the images which may be formed by e.g. the sonar of bats or dolphins, which do not depend on light? Might they be just as *scannable* or *explorable* as the images of sight? There are also many examples of 'active human echolocation' which have been described autobiographically, by observation, and by experiment. Image formation in these cases too may reveal itself as a *semiotic* rather than only a 'physical' phenomenon.)

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THE CONCEPTS OF INNENWELT AND PLANMÄßIGKEIT IN THE WORK OF JAKOB VON UEXKÜLL

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The empirical and theoretical work of Baltic German-Estonian biologist Jakob von Uexküll is undoubtedly foundational for biosemiotics. Perhaps the two most widely studied aspects of his work are the *Funktionskreis* [functional-cycle] and *Umwelt* [species-specific subjective world]. It is crucial to note, however, that according to Uexküll, the functional-cycle exists only insofar as it is composed by the reciprocal action of the *Umwelt* and the *Innenwelt* [inner-world] of the organism; these two aspects, moreover, form a whole built in accordance with a plan — “ein planmäßig gebautes Ganzes” (Uexküll 1920: 96). Previous analyses of Uexküll’s theoretical work in biology have neglected to identify and critically engage with the structure and function of the *Innenwelt* of living beings, thereby undermining the explicitly holistic approach advocated by Uexküll and precluding a comprehensive understanding of the principle of *Planmäßigkeit* [accordance-with-plan] upon which Uexküll endeavored to secure the epistemological foundations of biology. The aims of the research presented herein are twofold, and are, respectively, of theoretical and historical significance for biosemiotics:

1. Elucidate the content of the concept of *Innenwelt* in respect to the complete functional-cycle and demonstrate how an understanding thereof affords one insight into Uexküll’s motivations behind an organismic and semiotically-sensitive biology;
2. Explore how the concept of *Innenwelt* developed through revisions made between the first and second editions of both *Umwelt und Innenwelt der Tiere* (1909 and 1921) and *Theoretische Biologie* (1920 and 1928).

It will be asserted that the *Innenwelt* functions as a proto-cybernetic structure of reafferent control in the organism, as well as a means of apperception whereby raw sensory data is synthesized and utilized towards particular ends; the significance of the *Innenwelt* for the principle of *Plan-*

mäßigkeit will be understood within a larger discussion of the internal purposiveness of organisms and organismic biology of the nineteenth and twentieth centuries.

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THE MUSICAL TURN IN BIOSEMIOTICS — AN EXPRESSIVIST MODEL OF COMMUNICATION

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Human music and language are two systems of communication and expression that, while historically considered to overlap, have become increasingly divergent in their approach and study. Music and language almost certainly co-evolved and emerged from the same semiotic field, and this relationship as well as co-origin are actively researched and debated. Because music and language have a complex and intertwined history, for the sake of evaluating the semiotic content of zoomusicology, we wish to stretch the idea of music beyond the constraints of standard models that typically take human music and language as the basis for extending these monikers and analyzing the activity of nonhuman music and semiotics. By investigating music from a 'bottom-up' biosemiotic model, we wish to consider both indexical and iconic forms of meaning on equal footing, with each contributing essential aspects to acoustic communication. In so doing, both human and non-human musical communicative expressions can be analyzed according to common entwined media combining the elements of musicality, the syntactic and grammatical logic of language, and the iconic and indexical semiotic properties of aesthetics. Common to music and language in its many forms is that these communicative expressions are *interpreted*. They require defined cultural, semiotic, and ecological contexts in which they occur to provide each set of expression its meaning.

The historical trend to privilege the indexical over the iconic has led to an over-emphasis on language and under-emphasis on music in semiotics. In order to re-discover the iconic and aesthetic aspects present in all modes of communication and expression, we analyze acoustic communication in its myriad forms through a musical lens. Iconic, embodied, situated, even emotional expression, communication, and perception are all musical in fundamental ways. The semiosonic elements in an utterance or call that enable awareness, penetration, and meaning-making are evolutionarily useful, and should be expected to be part of biocommunication in general. There is an immediateness to iconic meaning-making where the producer or perceiver experience the qualitative, affective,

or even aesthetic qualities of the situation and call, and these are crucial to understanding the meaning-making going on. Music emphasizes the aesthetic and iconic features, which are under-emphasized when we think of these calls in linguistic terms only.

In this paper we present a model of semiosonic meaning-making, discuss examples of 'music' from the plant and bacteria world (and argue which qualities render such activity musical), and parse unambiguous instances of musicality in alloanimal communication. We review the anthropological case for how human language lost many of its elements of iconicity and indexicality, and then discuss how our conception of biosemiotic music, broadly conceived, can help rescue these features, leading to a more complete picture of environmentally-embedded intra- and inter-species biosemiosis. We aim to reveal how the iconic and aesthetic qualities many forms of expression not typically considered musical by human standards may possess are musical qualities for the individuals who express and hear them. By decentering our model from non-human music, we hope to find musical features of communication and expression that can more generally help us understand how meaning arises in interactions, and the various parameters organisms have at their disposal to generate and convey meaning.

TRANSFERS AND TRANSFORMATIONS OF AGENCIES IN THE FLOWS OF LIVING AND LANGUAGING

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Building on ideas developed in the article “Emergence and advancement of basic human capacities” (Ilyin 2020), this paper outlines a broader (bio)-semiotic approach to the study of agency as the ability of any kind of phenomena to reproduce itself and thereby act purposefully. The paper extends analysis of the capacities to any kind of agents to act purposefully in broad semiotic terms. Purposeful or end-directed processes surpass mechanistic determination and enact their own driving dynamism in a kind of autocatalytic mode. As I have suggested in *Linguistic Frontiers* 2020/2, flexible patterns of autocatalytic recursions molded in mutable curves of the Möbius loop constitute a fundamental prototype or an eigenform of evolution. In fact, the copies made by inside-out twists of the Möbius loop are not exact replicas of a prototype but rather its folded or revolved substitutes. Prototypes are not copied but increasingly multiplied into their own doubles. The altering twists of the Möbius loop interchangeably expose either energy-matter or information-structure aspects of our universe. Those shuttle transformations reshape forms into substances and resurge substances into forms. Eventually a series of fractal-like multiplications provides agentive potential for autopoiesis (Ilyin 2020).

The Hjelmslevian happy layout of two planes – expression and content ones – can be exported beyond the linguistic domain. Methodologically, such an arrangement of opposite but similar structures allows us to multiply modes of actions and transform them from one domain to another, e.g., from the mental one to the acoustic and back, from logical into grammatical and vice versa etc. It is also quite helpful to use the Hjelmslevian apparatus and devices like isomorphism, conformality, figures, etc. As a result, the extended technique of transfers between contrastive but conflated domains allows us to model the use of nearly all human abilities both bodily and mental, self-contained (organismal) and distributed (social), etc.

The present paper critically develops a tetradic typology of procreative

abilities and their respective vehicles (Kockelman 2013). This scheme includes agent (agency, causal capacity), subject (subjectivity, representational capacity), self (selfhood, reflexive capacity) and person (personhood, sociopolitical capacities). An alternative typology is not a tetradic matrix, but an evolutionary tree with multiplying and cumulating capacities.

In my contribution I further outline how a potential agent or self or interpretant builds up new ways of life and modes of communication. To overcome the inevitable fallacy of nominalization that reduces time-space dynamism to detached and steady 'things' I reinterpret the efforts of agents, selves and interpretants in the processual terms of living and languaging as well as learning, remembering, imagining, inventing, etc.

The paper capitalizes on recent advances in languaging research. Among key ideas and publications, one should mention Möbius loop dynamism, enactive linguistics, radical ecolinguistics, distributed languaging with its flows of living, and biocultural becoming.

The advancement of languaging studies and overcoming of the nominalization fallacy allows us to reconsider the so-called mind-body problem. It can be done in terms of transfer/translation processes that commute between two abstract limits but never reach them. Those limits were devised by René Descartes in a series of thought experiments. One limit reflects the extremity of the energy-matter residue of substance in our physical bodies, while another corresponds to the information-structure modality of the pure form of thought. The genuine Cartesian perspective of *me totum* as the foundation and criterion of scientific learning is extremely resonant with current languaging research.

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ORGANISMS AS SUBJECTS: JAKOB VON UEXKÜLL AND ADOLF PORTMANN ON THE AUTONOMY OF LIVING BEINGS AND ANTHROPOLOGICAL DIFFERENCE

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This paper focuses on the links between Jakob von Uexküll's theoretical biology and Adolf Portmann's conception of organic life. Its main purpose is to show that Uexküll and Portmann not only share a view of the living being as an autonomous and holistically organized entity, but also base this view on the seminal idea of the subjectivity of the organism. In other words, the respective holistic principles securing the autonomy of the living being – the *Bauplan*, for Uexküll; the *Innerlichkeit*, for Portmann – share an essentially subjective character. Such principles, indeed, express themselves in a centrally directed and formative way; moreover, in organisms endowed with a central nervous system, they also extend their influence on the overt behavioral sphere and on the organism's capacity to give meaning to the surrounding reality. The conclusion of the article will show how, though starting from this common background, the two authors develop divergent positions on the issue of the anthropological difference. If Portmann emphasizes the special status of the relationship between the human animal and the world, Uexküll tends to see a substantial continuity in the biosemiotic processes through which human and non-human animals constitute their species-specific worlds of experience (*Umwelten*).

In this paper, we will show that the reputation of Portmann and Uexküll among some evolutionary biologists as anthropocentric thinkers (cf. Gould 1977: 349, 369) is due rather to a misunderstanding of their philosophical preconceptions than to innate deficiencies in their basic concepts. For both Uexküll and Portmann, animal behavior always has an experiential component that is inseparable from biosemiotic representations of the environment. Further, the focus will shift to Portmann's biological investigation into the special status of the human relation to the world. Portmann followed the interpretative line of the *Umweltlehre* that was initiated by Scheler and taken up by many other authors of Ger-

man philosophical anthropology (cf. Plessner 2019). This position will be contrasted with the approach of Uexküll, who did not see a crucial difference in the life-worlds of humans and other animals. These opposite answers to the problem of anthropological difference will serve as examples of the typology of narratives comparing the cognitive capacities of humans and other animals. We will conclude that the portrayal of animal subjectivity cannot be separated from the picture of human subjectivity. This linkage is implicit in Portmann's thought, and if cast appropriately as a narrative of Transformativism (Jaroš and Maran 2019), it can both pay respect to non-humans and avoid some trends in post-humanist ethics characterized by a denunciation of the richness of the human life-world.

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MODELLING ABOUTNESS IN QUALITATIVE CONSTRAINTS NETWORKS

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Aboutness is a phenomenon widely studied in philosophy of language as an extension of the traditional truth-conditional semantics. It is supposed to account for phenomena like hyperintensional contexts which occur but cannot be explained solely in the truth-conditional paradigm (Yablo 2011). Aboutness is the relation of being a subject matter of something or being directed towards something without assuming anything about its structure, verifiability or truth conditions. In most utterances, there is a highlighted subject matter whose special role is not explained by any syntactic, grammatical or truth-conditional factors. If sentences can have aboutness as a separate factor of their meaning not dependent on satisfaction conditions, then aboutness could function on its own and even predate the propositional, truth-conditional relations with which philosophers of language and semioticians are concerned most often.

Being about something is also the defining property of signs, and thus a cornerstone of any semiotic system; especially salient for the Peircean triadic model, which hinges on interpretation. Recently in the *Biosemiotics* journal, Terrence Deacon (2021) proposed a sketch of a minimal, chemically plausible model of semiosis, trying to capture the conditions necessary for aboutness to arise in a naturalistic setting.

Despite the growing scope of applications of the concept, to date no formal definition of aboutness useful for modelling emergent communication has been proposed. This contribution aims to rectify the situation by offering an account of aboutness suitable for the analysis of communication on multiple scales. I propose one possible semi-formal model of aboutness defined for a broad class of dynamical systems, founded in the framework of constraints networks. I argue that it is useful to model reference, aboutness and other semiotic phenomena using a variation of Qualitative Constraint Networks, a flexible graphical model with wide interdisciplinary applications. The analytic power of the model may serve as a usefully precise point to establish the so-called "lower threshold" for biosemiotics (Lacková and Faltýnek 2021).

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BIOMOLECULAR CONDENSATES FROM A NETWORK PERSPECTIVE: A SIMONDONIAN INTERPRETATION

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For many years we have been promoting Gilbert Simondon's Theory of Individuation as a promising unifying framework that can harbour both scientific and philosophical dimensions of ontogenesis. We think that the wide spectrum of contemporary research related to biomolecular condensates can particularly benefit from such a holistic philosophical perspective.

During the last decade, mounting evidence has been revealing that biomolecular condensates and liquid-liquid phase separation as their basic mechanism of formation have a very central role in all cells. More recent findings additionally indicate that many of the biomolecular condensates in the cell are interconnected and communicate with one another. Also, almost all types of important macromolecules that play a role in gene expression (i.e. DNA, RNA, and proteins) are documented to be capable of undergoing liquid-liquid phase separation and forming condensates under certain conditions. Among many physiological functions served by the condensates, regulation of gene expression itself deserves special attention.

Accordingly, there seems to emerge a big picture where there is a tremendously complex intracellular network of dynamic structures and interactions that involves the genetic system, for the proper functioning of which biomolecular condensates and liquid-liquid phase separation are fundamental, and must be strictly regulated. In case such regulation fails, usually severe pathologies follow, including not only many neurodegenerative diseases like ALS, FTD, and Parkinson's, but probably most age-related ailments as well. Although modern analytic science proceeds at amazing speed in elucidating the details, there are also many questions yet to be answered, especially regarding the network character of the situation. A better understanding of the full complexity of this scheme can be reached by interpreting Simondon's Theory of Individuation in this specific context as follows:

Intrinsically Disordered Proteins (as well as other macromolecules that can take on alternative 3D conformations) have the innate capacity to undergo liquid-liquid phase separation and form biomolecular condensates, often involving multiple types of molecules such as proteins and RNA. The *in vivo* realisation of this capacity is usually guided by interactions between different condensates that collectively constitute a wide intracellular network, and driven by energy (ATP) expenditure. This way, the originally physico-chemical process of phase separation begins to be regulated and harnessed – or ‘tuned’ with respect to a biological context. Such phase tuning eventually creates what Simondon refers to as a “more complete regime of internal resonance”(page number) in the living being, not only definitive of its health and disease, but also its unity and identity in the ontogenetic register.

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THE BIOPHYSICAL AND BIOSEMIOTIC DUALITY OF CODE MOLECULES

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To date, the matter-symbol question in molecular biology remains unresolved. Even though we may never give it a thought, our cells function spontaneously and autonomously throughout our lifetime. Although information is recognised to play critical roles in the biofunctions of cells, the term 'information,' with respect to living systems, has yet to be clearly defined. Adami rightly argues that information must always be about something. Aboutness is abstract, conceptual, and formal.

The observations of spontaneity and autonomy lead to the recognition of two distinct and specific types of information *about* the functional working of living systems. These are biophysical and biosemiotic information about biological molecules.

In living systems the primary determinants of the biophysical behaviour of biomolecules are their specific physical characteristics. These specific biophysical characteristics may be described in terms of constraints. Atomic composition and bonding arrangements are physical constraints that generate specific physical characteristics described in terms of physical information about molecules. The specific physical information about molecules relevant to the spontaneity of biomolecular reactions and transformations is thermodynamic. The secondary biophysical determinant is ATP.

Semiotics is a broad field that may be described as the study of the science of signs. This field includes all languages and systems of communication including the codes and molecular communication found in molecular biology. Biosemiotics is dedicated to building a bridge between biology, philosophy, linguistics, and the communication sciences. Biosemiotic research is concerned with the study of signs and meaning in living organisms and systems.

Molecular biosemiosis in living systems is based on the functional operation of biomolecular codes that facilitate specific types of 'semiotic con-

trol' over the behaviour of molecules including manufacturing and signaling biosemiosis. Comprehension of biosemiotic information is therefore essential to understanding the nature of the living state.

Barbieri defines a code in terms of specific correspondences between the objects of different semiospheres. Since correspondence is a biological biofunctional biosemiotic constraint. then the functional logic of biology must be biosemiotic.

Therefore, specific biophysical and specific biosemiotic constraints are defining features of the molecular basis of life and essential for the 'functional working' of the living state. In biosemiotically prescribed reactions, any thermodynamic deficit is bridged by the site specific choreographic intervention of ATP or similar metabolic molecule. The observation of programming in the genome is an additional set of complex constraints that encode the semiotic memory of species.

Therefore, the living state is both defined and animated in terms of specific sets of biophysical and biosemiotic constraints. This understanding raises more questions about the origin of constraints and the question of intentionality.

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PERCEPTION-DRIVEN EVOLUTION OF BIOLOGICAL MIMICRY BASED ON THE ATTRACTOR FIELD MODEL

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Since Uexküll and Rádl, we are aware that the physical objective space is not the same as the biological space in which organisms spend their lives. Our models of biological reality thus should be able to translate between the objective (measurable) and perceived (experienced) spatial patterns. Despite this intuition, the theoretical formalization of a biological space is lacking. To fill the gap, we are taking advantage of the psychological Attractor Field Model (AFM) to explain the evolution of mimicry as a trade-off between optimization of structural similarity and the rate of visual interactions. AFM argues that representations of atypical (as opposed to typical) stimuli have wider 'attractor fields' because they are less densely populated in the peripheral regions of the relevant representational space, and there is less competition between them and other (atypical) stimuli. Mimicry requires coordination in the development, behavior, and evolution of two or more organisms in their environments, and yet the final functionality of mimicry still depends on the perceiver. People form a first impression about an unknown person just in tens of milliseconds. Vertebrate predators, as potential selective agents of mimicry, are in a similar situation. In a multi-species similarity space, it is more difficult to differentiate between individuals of atypical species than between individuals of typical species. This implies that mimicry can evolve more easily among atypical species than among typical ones: atypical species do not need the same level of similarity to their model as typical species do for the mimicry to be successful. Further, AFM may elucidate the existence of imperfect mimicry and explain why imperfect mimicry is functionally perfect. AFM may also shed new light on the existence of parapatric mimics. Eventually, we introduce the mathematical formalization of frequency-dependent perception-driven dynamics of mimicry based on perception-space deformation, which can be narrated in terms of the attractor field model.

THE CENTRAL QUESTION OF BIOLOGY, AND UMWELT ANALYSIS

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The biosemiotic turn in biology is ongoing. It naturally follows the epigenetic turn, which is already largely completed.

The key point of the epigenetic turn includes demonstration of the role of plastic reactions (frequently stemming from environmental changes) in development and evolution, and the discovery of epigenetic inheritance mechanisms.

What comes after epigenetics is understanding the role of organisms' decision-making. Decision-making is basically biosemiotic, because the core of decision-making is interpretation – which is semiosis. Decision-making covers everything in organisms' functioning that is not completely automatic or pre-determined.

The biosemiotic turn, with its emphasis on agential decision-making, i.e. the study of semiotic interpretation and choice-making, may also conclude that organisms' lives are not shaped by evolution and natural selection, but evolution is shaped by organisms' activities, by semiosis. Of course, this does not mean that organisms are fully capable of changing their bodies – there exist many chemical, morphogenetic, and regulatory (non-semiotic) limitations that constrain the interpretants and heritability.

Semiotic decision-making presupposes *umwelt*. There cannot be signs without *umwelt*. *Umwelt* and semiosis emerge together. This implies that *umwelt* is one of the fundamental concepts of semiotics, as well as of biology. Accordingly, an important focus of the biosemiotic turn in biology is to develop systematic methods for analysis of the *umwelt*.

Umwelt-research requires further explication of the *umwelt* concept as well as development of the modelling of semiosis. At least since the work of Krampen, the functional circle which creates the *umwelt* (as described by Uexküll) is identified as one among several models of semio-

sis. Both semiosis and *umwelt* are defined in two ways: as a momentary event, and as a successive process. These two ways to define semiosis and *umwelt* should be distinguished.

Umwelt analysis is, among others, a generalization of semiotic visual analysis as well as semiotic audial analysis, or rather, the biosemiotic (biological) basis of these more specific analyses that were worked out mainly for human examples. In addition, *umwelt* analysis includes bio-phenomenology. But *umwelt* analysis is also the basis for understanding behaviour.

The central question of biology concerns the process and event of decision-making. This means the study of organisms' freedom, which cannot be done without *umwelt* research.

GENERATING FACES: SEMIOTICS AND ARTIFICIAL LIFE BEYOND THE UNCANNY VALLEY

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The paper has three objectives. Firstly, to provide an overview of the area of theoretical and technological research called 'artificial life,' starting from the pioneering studies of Richard Matthew Doyle (2003) to the more recent ones of Tagashi Ikegami (2019) and Peter Robin Hiesinger (2021). This area, which can be summarily defined as that according to which the phenomena of life are embodied computational processes, is nowadays populated by feverish disciplinary crossovers, exploring theoretical concepts such as autopoiesis, homeostasis, and open evolution through technologies such as evolutionary robots, swarm agents/robots, artificial chemistry, complex cellular automata, and various evolutionary algorithms, in particular deep adversarial neural networks (GANs). The review will be conducted from the point of view of semiotics, and in particular biosemiotics, seeking to highlight the trends and elements that, in this field, could intersect with the interests and studies of the discipline of signs, taking advantage of its theoretical and conceptual background, while at the same time enriching it.

Secondly, the paper intends to dwell on a very complex theoretical problem, that of the relationship between the concepts of generation and generativity. Current opinion would have them separated, if not opposed, yet some of the most current research in the field of artificial life underlines how difficult it is to think of a generation of life that is not simultaneously generative, i.e., that does not explore the possible paths of adaptation to the environment before embarking on its journey.

Third, the paper sets out to explore a particular case study, that of the generation/generativity of a face. How is a face generated from the point of view of artificial life? This is not only a theoretical question, but one that touches one of the most sensitive strings of contemporary artificial intelligence and robotics, starting from the well-known problem of the 'valley of the uncanny.' The paper will return to the issue starting from a bio-semiotic examination of the tradition of studies inaugurated

by Edelman (1978) and then articulated with respect to the problem of face recognition by Freiwald, Duchaine, and Yovel (2016), according to which single neurons in a special area of the cortex can 'recognize' specific faces. As Hiesinger writes: "The neuron was there before the monkey saw the face, but the way the wave of information self-selected its propagation through the network, the single neuron became a node and part of the memory. We can say the neuron got selected, very much in an evolutionary sense" (2021: 259). The paper will ask whether such 'neuronal self-selection' is not in fact guided by principles that semiotics would recognize as its own, developing a reflection on what it implies, for a post-Anthropocene ethic, to rethink the question of the human face in the context of a biosemiotics of artificial life.

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EXHAUSTING SIGNS: A BIOSEMIOTIC VIEW ON THE PHENOMENOLOGY OF INVISIBLE ILLNESS

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Meditative traditions like Buddhism stress the significance of signlessness and awareness with regard to the phenomenology of living experience. However, what about communicating the invisible with regard to an experience that is not primarily mystical, albeit fundamentally existential? How shall we deal with the famous notion that it is impossible not to communicate (Watzlawick and his colleagues) when “trying to explain an invisible illness can be as exhausting as the illness itself” (as mental health advocate Leah Rocketto has put it date/page number). Taking up the biosemiotic distinction between physical and semiotic realities (i.e. a ‘physical eye’ and a ‘semiotic eye,’ cf. Kull in Emmeche and Kull 2011), this paper is going to explore what counts as legitimate knowledge when it comes to the experience of an illness that still lacks well-established biomarkers for diagnosis, i.e. a so-called ‘invisible illness’. If semiosis is the “mechanism of subjectivity” (Kull date/page), how do we include such subjective experience in biosemiotic terms? I am going to follow the cybersemiotic approach (Brier) and its call for a phenomenological foundation in order to deepen the ontology with regard to the underlying explanatory framework we use. In spite of more recent developments in the spirit of a holistic view on life and wellbeing, the predominantly objectivistic paradigm of medical science is a case in point. While clinicians are frequently reluctant to accept reports by patients with an ‘invisible illness,’ a non-reductionist view on the matter would demand a readiness to integrate the received version of science with the phenomenology and pragmatics of first-person lived experience. In contrast to an exclusively ‘physical eye’ on measurement and biomarkers, such an acknowledgement of the contextualised and embodied knowledge implied by semiotic reality would no longer silence patients by “labeling them in ways that are dismissive of their deep knowledge and understanding of their own bodies and lived experiences” (Dobson date/page number).

The phenomenology of illness reported by patients trying to cope with an invisible disease calls into question the exclusively objectivistic representation of physical reality as established by means of quantitative methods in science. By contrast, bringing in empathetic communication and dialogue that is open to the (self-)descriptive phenomenology of (semiotic) realities offered by patients promises to make the Batesonian difference that makes a difference: in other words, quality of life could be much improved by actually taking seriously the (pragmatic) signs of exhaustion reported by patients: that is, patients who have already been forced to exhaust themselves through yearslong diagnostic odysseys without any treatment, care or public health counselling options as in the case of ME CFS. Considering that patients more often than not are left with the burden of communicating their illness even to medical staff, the pragmatics of communication are of no small importance to the phenomenology of experience, including (invisible) illness. While the methods of the natural sciences (such as the search for objective biomarkers) hardly need to be denied, an adequately enlarged understanding of 'invisible illness' would demand such pluralist, qualitative and incommensurable methodologies as are offered by the approaches of bio- and cybersemiotics.

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ALLO-ANIMALS: THE ORIGINAL SEMIOTICIANS RETHINKING HUMAN-ANIMAL INTERACTIONS THROUGH BIOSEMIOTICS

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The latter part of the 20th century saw a resurgence of neo-behaviourist learning theory in academia. The employment of 'positive, reward based' training methods in behaviour management led to its re-popularisation nearly half a century after its inception and subsequent decline – but this time, rather than being used to manage autistic childrens' behaviour, the focus was on domestic and captive non-human animals. As an applied method of animal management, neo-behaviourist techniques have not only driven animal behaviour and cognition research, but have been popularised with the public; for example pet owners, zoo-keepers, animal rescue centres, and other individuals and organisations responsible for animal welfare have embraced neo-behaviourist theory and adopted its practical applications (Lewis 2021). This trend has gathered pace, and following the dog training industry, the equine sector is now using techniques such as 'clicker training.' This iterative behaviour 'shaping' process, whilst viewed as benign and 'humane,' is reminiscent of computer software programming using binary commands, and leaves little or no room for an animal's autonomy and agency. Moreover, laboratory animals are being 'trained' to cooperate with handling practices, with the accompanying and wide-spread belief that this improves their welfare, thus distracting from vital ethical questions as to whether animals should be trained to co-operate with actions that cause their own suffering.

Simultaneously, there has culturally been an increasing infantilisation of animals (notably companion animals), and Ainsworth and Bells' 'Strange Situation Test' has become a widely accepted method for assessing human-animal bonds, particularly in domestic dogs (Lewis 2020). Moreover, terms like 'fur babies' and 'pet parent' have become part of human vocabulary. This phenomenon appears to conflate human legal requirements and cultural/ethical animal welfare standards with the misconception that animals are infantile, helpless, and totally reliant on their human caretakers.

Whilst animals undeniably need to be trained to live in an environment which is dominated by our own cultural rules and expectations, the benefits of 'positive reward based' methodologies are leading to an over-reliance on 'training' over more complex communication. The justification for this appears complex and multi-faceted but relies on phenomena such as 'contra-freeloading' which, on closer inspection, lacks robust empirical data to support the interpretation that an individual has an intrinsic motivation to 'work.' An alternative explanation for empirical data which, *prima facie*, appears to support contra-freeloading theories, is a bias caused by current political and economic environments when interpreting behavioural data. Moreover, the compelling idea of 'positive reward-based training' masks the true nature of such techniques, which are based upon manipulation, and exerting control over another individual. As a training method which has, justifiably, been promoted as preferable to aversive (sometimes physically aggressive) training techniques, it is still certainly not without risk.

A more enlightened method of interacting with domestic and captive animals would involve employing zoosemiotic methodologies to study animal behaviour, and to communicate with domestic animal species. Whilst this would undoubtedly need to be in conjunction with reward-based training methods where behavioural compliance is necessary, animals are, evolutionarily, the original semioticians of the living world. Maintaining and utilizing our own cultural and species-specific traits, such as complex language, when interacting with them does not need to involve 'anthropomorphization' or infantilization. The *Umwelten* of domestic and captive animal species can be recognised as being different yet overlapping ours, and conversely, animals (especially those species now recognised as sentient), should be credited with being mature individuals who are able to recognise and understand the human *Umwelt* and the vast, artificially- enhanced *Umgebung* which encompasses their own *Umwelt*.

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BIOSEMIOTIC PATTERNS OF AGENCY EMBODIMENT IN NARRATIVE DISCOURSE

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The question of agency manifestation in narrative has always been the focus of intensive research. In structuralism, agency is associated with the character and their actions/transformations on the axis of time and space of the narration. In this aspect, the words and the actions are viewed as agents influencing the structure of the narration and its plot. This approach resonates with the former psychological view on 'the self' as a given entity, which is unchangeable and stable. This classical view on 'self' has been influenced by the psychological turn in the middle of the XX century, arguing that 'self' is susceptible to a processual and evolutionary development through dialogue (in the sense of Mikhail Bakhtin). 'A communicating self' is taking different positions in order to create a new meaning with another 'self' of the author, thus performing a consensual role (following Maturana and Varela). Dialogical self theory (Hermans 2001) sees 'self' as a multiple dialogical process of position-taking and it is put into the basis of Conversation Analysis (CA) theory and the Theory of Positioning (Harre and Carbaugh 2001). This positioning theory has the following relation to personhood: (1) embodied self (which is equivalent to personal representation in actions and speech acts), (2) self-concept (which involves beliefs, moral qualities, abilities, and fears as a form of narrative self-understanding in two forms: autobiographical and social selves).

Though being the focus of attention of the linguists, subjectivity as an emergent and self-referring phenomenon has not been the object of investigation so far, especially with the use of cognitive semiotics and cyber-bio-semiotics. Substantial grounds in this direction have been laid by the modern school of narratology (represented by Monika Fludernik, Jan Alber, Greta Olson, Nick Skov Nilsen, Brian Richardson, Marco Caracciolo, just to mention a few).

Therefore, this paper aims at tracing the variability and evolution of narrative patterns of subjectivity in the English fiction of the XIX-XXI centuries. The novelty of the research lies in applying a biosemiotic approach

(particularly in the case T. Sebeok, C. Peirce, P. Cobley and V. Alexander) to narrative fiction analysis and taking the category of agency as the main focus of lingo-semiotic research. 'Self,' as a broad umbrella term, is related to other psychological notions like reflexivity, agency, and endurance, which are applicable to the narrative discourse of intentionality and teleology.

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MEANINGS FOR THE DEGROWTH SOCIETY: THE SEMIOSIS OF THE LIVING AND COLLATERAL BEAUTY

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In the recent decade, the degrowth movement has opposed the human progress narrative by advocating a simplified society and decreased human use of energy and natural resources. In this talk, I will analyze the semiotic aspects of great acceleration and argue that transformation to the degrowth society needs to be accompanied by the restructuration of human semiotic systems towards more coherence and better connectivity with ecological processes. From a semiotic perspective, the Anthropicene is manifested as a massive multiplication and spread of abstract signs and information content that is detached from biological and material processes. The mass of symbols separated from their object domains instigate hasty and superficial interpretation.

I propose the view of the semiosis of the living as an understanding that meaning and significance arises foremost from the semiotic participation in the specific lived (cultural, social, and natural) ecologies (Maran 2022). This is a processual aspect of Thomas A. Sebeok's (2001) maxim of coinciding semiosis and life. The semiosis of the living approach sees semiosis as a flow-like participatory process that unfolds at its own pace, event by event and connection by connection. We can also find support for the degrowth transformation from the biosemiotic aesthetics as recently developed by Kalevi Kull (2022). If diverse organisms aim towards better fitting, perfection, and beauty, then aesthetics rises in ecosystems occasionally but recurring. Perceiving such collateral beauty becomes an effective means to create new semiotic connections and associations, thereby contributing to the integrity and coherence of the semiotic system.

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WE, THE CYBORGS

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Due to the trends, contingencies, and vagaries of evolution, living beings and/or their lineages inevitably stray into states of dependency upon the services of others. As a matter of fact, there could hardly exist a species whose members could prosper in mutual independence (axenically), at least not in the long run. Attempts at a laboratory cultivation of axenic organisms require, on the part of the scientist, the delivery of diverse services normally provided by the biosphere and in most cases, such experiments fail.

On a theoretical level, the mutual interdependence of inhabitants of the biosphere can be explained by reference to a deletion/dysfunction of vital genetic information (gene) in a particular species/lineage that has no consequences for the survival of that species/lineage because the environment comes to its aid, thus the inability of humans to synthesise vitamin C (ascorbic acid) has no impact on our survival in environments that provide fruits and vegetables. The dependence of most animals on plants is even more striking. A negligible fraction of animals is instead dependent on chemolithotrophic organisms: bacteria or archaea. Such scenarios in fact constitute examples of the Black Queen hypothesis, named after the eponymous card game (Morris et al. 2012): some plants drew the Black Queen and must deliver (without a reciprocal service) the vitamin to humans. In this round, the humans 'win'. It turns out, though, that all inhabitants of the biosphere draw a Black Queen in different variants of the game.

We suggest another scenario, a symbiotic/symbiogenetic one, according to which lineages to some extent understand (or guess) the moves of the partner, and based on them adjust their own behaviour. To illustrate this, one can use the notion of cyborgs (Markoš, Švorcová, submitted). If we characterise a cell as a closure against its environment (first-order closure), any organism can constitute a second-order closure for other organisms or be a part of that relationship. The biosphere is thus full of cyborgs who provide for the needs of other organisms. Such second-order closures can be weaker, established among various interchange-

able players in the biosphere, often *ad hoc*. Turning the image upside down, each living (sometimes even dead) being is part of a cyborgian contraption that serves others. We shall list selected examples of biospheric 'cyborgs,' such as holobionts, bacterial communities, or mycorrhiza. Our aim is to show that such cyborgian dependence can be described using various models, but our preferred model is collaborative rather than competitive and is based on mutual evolutionary history and mutual understanding (the Norm). Our arguments will be supported by current scientific literature.

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“I CONTAIN MULTITUDES”: BIOSEMIOTIC NOTES ON THE HOLOBIONT AND INDIVIDUATION IN MICROBIOME STUDIES

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The explosion of genetic research has helped to characterize the human host, its microbes, and their relevant role in health and disease. The role of the gut microbiome in human functions is being thoroughly explored, with exciting results from the biological sciences, neuroscience, and the humanities. Several inquiries arise from understanding the relationship between humans and their microbes. However, questions about *who they are and what they are doing* remain unanswered.

There is no doubt that gut microbes strongly influence brain function and superior activities, even with no agreement on how they work. It has great significance that there is a brain in the gut, which could even be a source of emotions: *the awareness that there is more to what, and how, we feel opens a great path for us to understand what we are*.

The idea of the self is being reevaluated, and the notion of *being human* has been questioned. Some claim that we are more like an ecosystem or a holobiont, and others say that this approach needs to be taken with care. Several authors, such as Robinson (2020), have pointed out that it is important to review how we think about ourselves.

We want to present certain open questions about the microbiome, from a biosemiotic approach, that require research attention: the concept of the holobiont, the individuation process and its possible mereology, and finally, some aspects linked between protosemiotics and biocommunication processes.

The holobiont concept has its *homeomorphic equivalent* in Jesper Hoffmeyer's notion of 'swarm of swarms'. Semiotic competence is delegated to decentralized units such as swarms. While Hoffmeyer reflects on the decentralized cells that swarm in the host organism, we try to ask about this concept in the set of microbiota that, for the most part, reside as symbionts in the intestine.

Our problem lies in the question of the human holobiont as a mereological and *pre-individual system*. Can we say that the holobiont is a whole or a single sum of its parts? Everything will depend on addressing the functional and metabolic network of the microbiome as an organism that interacts with higher hierarchies of cells.

The multilevel semiosis generated between species of microbes and between microbes and nerve cells and biofilms within the intestine constitutes a new development of functional individuation. Therefore, it becomes essential to understand better the transfer of information – or *transductive operation* – between symbionts and integral parts of the hierarchical swarms of the human host, as well as its role in the development of mereology, agency and even consciousness (proprioception) as the dichotomy between body and mind.

We propose the method of allagmatic epistemology of Simondon (2005; Karatay et al. 2016) – an exchange of information between analytical science and analogical science – as a robust model for studying the ontogenetic pre-individuation of the holobiont, as well as a new ontological and biological paradigm of the living being and, above all, of the concept of the human being and its populations.

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SOCIAL MEDIA PLATFORMS, ALGORITHMIC MEDIATION AND THE EMOTIONAL TURN IN COMMUNICATION

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The interest of this work is to discuss how the new dynamics of content circulation in social media platforms (SMPs), mediated by machine learning algorithms, have amplified the role of messages of moral-emotional appeal in decision-making processes.

We start from the hypothesis that there is an ongoing emotional shift in communication, a shift away from argumentative reason to make room for content constructed by images (memes), short videos and content with a strong emotional charge.

SMP's algorithmic systems distribute content based on emotional discourses, which impact on subjectivities, deepening fears, anxieties, aversions, doubts, hatred, and reinforcing prejudices.

In the SMPs environment, which are characterized by speed, instantaneity and large amounts of content, the user stays for seconds on each message and reacts immediately, getting trapped in a circle of stimuli activated mainly by moral/emotional content, which quickly fires in the cognitive system.

Based on Peirce's semiotics, we will discuss how in this environment, the methods of fixation of beliefs by tenacity and authority (EP 1 1992) are favored, since we are stuck in a first-secondary cycle, and we look at the contents without rational mediation, that is, we do not move on to a higher cognitive stage, in which time and space are embodied to allow the representation of these contents.

This emotional turn is displacing rationality from the center of decision-making processes, negatively impacting the public sphere and democracy, which poses new epistemological challenges to understanding the ongoing changes.

We define this turning point as the *dissemination of content of a moral/emotional nature favored by algorithmic mediation to access emotions – from specialized strategies to achieve practical and rapid persuasion effects – and use them to manipulate and modulate impulsive social behaviors, which do not require understanding processes and do not have an argumentative reason to form beliefs and guide attitudes.*

Lakoff (2009) developed an extensive study in the field of cognitive sciences on how the functioning of the mind plays a role in the political decision-making process. He says that it is an innocent mistake to believe that people only take a stand on the basis of a conscious rationality, whose attributes are logic, literalness and the absence of emotion aimed at serving their interests. For Lakoff, the use of emotion in political persuasion is legitimate and not an appeal to irrationality.

Peirce points out that emotions “arise when our attention is strongly drawn to complex and inconceivable circumstances” (CP 5292):

The indescribable, the ineffable, the incomprehensible, commonly excite emotion; but nothing is so chilling as a scientific explanation. Thus an emotion is always a simple predicate substituted by an operation of the mind for a highly complicated predicate. (CP 5292)

Based on the discussions brought by Lakoff and Peirce, this work will reflect on how emotions triggered by algorithmic models and expression dynamics marked by instantaneity are interfering in this rational dialogue.

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QUESTIONS CONCERNING CERTAIN FACULTIES CLAIMED FOR SEMIOTIC SELVES

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Despite their astonishing diversity and varying degrees of complexity, lifeforms share a semiosis-based subjectivity. This Sebeokian hypothesis positions Semiotic Self Theory (SST) as an intrinsic part of phenomenology at large, and as an existential part of biosemiotics in particular.

With such a premise, this presentation will firstly revisit SST, proposing it as a pragmatic framework that explains the fact that sign processes are not disembodied, decontextualized, and autonomous, but contingent to the *relational* selfhood of interpreters or living beings.

Secondly, it will be argued that selfhood is often described in ambiguous terms, as a non-ubiquitous and liminal process, or as some sort of transition-phase. Naturally, this makes it especially difficult to *define* what a semiotic self (e.g. a 'subject') is, or what it is not. However, a biosemiotic take on SST makes it possible to identify the collective faculties of living beings, rather than producing a minimal definition of isolated subjects.

Namely, I will observe that semiotic selves are (1) **multilayered** or *multi-voiced*; (2) **dialectic** or *relational*; (3) **communicative** or *social*; (4) **extended** or *distributed*; (5) **normative** or *value-making*; (6) **agential** or *teleonomic*; (7) **incomplete** or *open-ended*; and (8) **anticipatory** or *future-oriented*. While these eight features might deviate from Wiley's classic work on the semiotic self, they encompass further developments in biosemiotics that bring SST closer to being an evidence-based cognitive theory.

Therefore, instead of confining SST to a psychologist and nominalist notion of the human-ego (e.g. the ontogenesis of individuality and personality), the above traits emphasize the public, intersubjective notion of semiotic reality throughout living beings (e.g. in the phylogenesis of *Umwelten*) (cf. Colapietro, Nöth, Cestari 2020). This observation will be supported by referring to Tønnessen's ideas on *semiotics of being*, when he states that semiotic thinking "restores subjectivity not as an internal-

ist conception, nor as an externalist conception, but rather as a relational conception. Our self is social. A self is always bigger than itself" (2010: 377).

Finally, I will highlight the relevance of SST in answering a ubiquitous existential question, the relevance of which cannot be overstated: why *relations* seem to be the universal essence to our very selves and that of others? As a matter of fact, Peirce's phaneroscopic categories are currently applied throughout SST as an attempt to continue answering such a daunting question. It comes as no surprise, I will conclude, that SST inherits the dialectic and anti-Cartesian spirit of "Questions Concerning Certain Faculties Claimed for Man," and "Some Consequences of Four Incapacities"; so much so that one of the premises of SST is that the self is a sign or, more exactly, a triadic sign mediation (Petrilli 2013: 8), one that cannot be reduced to a unidirectional subject-object relation (e.g. a mind-dependent reality 'observing' a mind-independent reality).

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DISINFORMATION AND BIOETHICS – CONNECTIONS BETWEEN BLOCKCHAIN TECHNOLOGY AND PEIRCEAN SEMIOTICS

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This study proposes to create connections between Charles S. Peirce's semiotics and pragmatism and the characteristics of blockchain technology when it is used to combat disinformation. We argue that disinformation has characteristics related to bioethics and that they are directly related to the evolution and survival of the human species.

From semiotics, we can define disinformation (or fake news) as assertions of symbols on digital platforms that express information about a state of affairs belonging to possible (non-existent) worlds, created fictionally and shared by communities of interpreters who develop arguments and narratives to achieve well-defined political-ideological or economic-financial purposes.

According to Romanini, one of the sources of bioethical dilemmas is "the control and use of information collected on living beings" (2013: 12). Now, it is known that disinformation – or fake news – makes use of the massive collection of personal data by its disseminators so that they have greater adherence to already ingrained beliefs.

About beliefs, Peirce teaches us, they are habits that guide our behavior and that there are four methods to fix them: the tenacity method, which is the most individualistic method, in which the individual clings to his own beliefs and does not abandon them for nothing; the *method of authority*, which is the one in which a third party (church, state, etc.) is delegated the power to define what one should believe; the *a priori method*, which is the one in which the individual only clings to evidence that corroborates previously accepted conclusions; and, finally, the *scientific method* which, according to Peirce, is the only one capable of bringing us closer to the truth of the facts. Truth, however, is a future conditional. It would be achieved if an infinite ideal amount of resources was employed in the inquiry.

Blockchain can – potentially – automate the truth-seeking process, which

would be of great value in combating disinformation. The need for a consensus to validate the information recorded in the blocks is an essentially pragmatic aspect. The blockchain dynamics simulate the scientific method proposed by Peirce and the shared search for the truth by an interested community. Each investigator contributes his experience, which is indelibly engraved in the chain. It is not necessary to start over from scratch each time we engage in an inquiry. According to Jing and Murugesan, "blockchain is an emerging technology that is capable to disrupt the publishing industry and rebuild trust with the media" (2019: 955).

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UMWELT AS EMBODIED MEDIATIZATION: A BIOSEMIOTIC APPROACH TO TECHNOLOGY

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I propose nesting the concept of *medium*, as originating in media theory, in a biosemiotic framework. I argue that this is necessary for construing a notion of the body and, implicitly, of mind, from a fully semiotic perspective. As such, biosemiotics can be employed as a theory to address the environmental effects of media technologies. Particularly, I explain that in this way biosemiotics can align to Steve Fuller's (2021) recent suggestion that the mind-body problem should be replaced by a mind-technology discussion. Fuller credits Charles S. Peirce's view on evolution as instrumental for, eventually, ushering in this new interrogation of the (human) mind as determined not only by past evolution but also by future possibilities. Indeed, this perspective is made possible by Peirce's notion of (final) causation, which, in biosemiotics, is discussed as semiotic causation and implies a semiotic view of scaffolding (Hoffmeyer 2015). From this perspective, the mediality that evokes new semiotic possibilities is also what limits them, as scaffolding channels learning.

Thus, to pursue this latency of Peirce's theory, I relate the notion of *medium* to the biosemiotic notion of *model*. Particularly, I adopt Elleström's (2018) semiotic notion of medium as extension of mind where, updating media theory with state-of-the-art cognitive sciences, mind is understood as embodied. Exploring this concept of medium from a biosemiotic perspective helps both to scrutinize more finely the semiotic build-up of environments as modeling and to develop a semiotic notion of the body. This allows us to define the body as that which evokes the mediality within which an organism's semiotic competences are exercised. From this perspective, modeling is understood as a mediatic phenomenon, which is to say that the construction of subjective environments occurs within medial affordances. Through modeling, organisms redefine affordances by discovering new semiotic resources and, consequently, acquire new competences for meaning-making. As such, semiotic competences, which underpin *Umwelten*, are deemed embodied but not fixed.

Further, this broaches Fuller's problematization of the mind in regard to

technology. An advantage of great salience for biosemiotics that Elleström's notion of mediality brings is that it accounts for the continuity of semiosis across media. He argued (2018: 270) that mediality is evoked by corporeality, which external technological devices enhance (or modify). From this perspective, technological media cannot be alien to human embodiment, as new technologies are conceived within the affordances of existing media. In Peircean terms, existing media provide the icons that are employed in the scaffolding of more complex meaning. Scaffolding processes, from this point of view, are media transformations. Hence, Elleström's notion comes in support of Hoffmeyer's (2015: 252) theory that the catalyzing of diversity of expressivity in newly emerging levels of semiotic systems implies the homogenization of semiotic activity at lower levels. Hoffmeyer illustrates this with examples from media history: printed books had to be more standardized than handwritten manuscripts because they opened new varieties of expression. As such, this proposal also aims to shed light on emergence, as one of the main concerns in biosemiotics. By providing a fluid view on humanity in relation to technology, through the instrumental notion of medium, this biosemiotic perspective can be employed for media analysis. To conclude, I exemplify the advantages of this approach by commenting on recent social, cultural and environmental implications of the rapid progress of technological media as semiotic scaffolding.

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CONTEXT, TIME, AND SPACE AS EMBODIED SITUATIONALITY? A META-STUDY OF PERCEPTIONS IN (ANIMAL) COMMUNICATIONAL STUDIES BASED ON UTTERANCE THEORY

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A meta-study of zoo-communicational studies concluded that context as an academic, disciplinary concept is under pressure, mainly due to increased complexity in research design and in applied theories (Ongstad 2021). The study applied a theoretical framework that defined utterances as a compound of form, content, act, time, and space and further termed kinds of utterances, and hence kinds of communication as life-genres, assuming that animal basic life functions may generate partly generalised behavior (Ongstad 2019). By moving the aspects time and space from their 'usual' place as key constituents of context into the utterance, a traditional perception of context concept as a chronotopical 'box' is challenged.

To suggest that animals communicate by life-genres may provoke traditional perceptions of what is conceived as a communicational situation. However, applying a genre-perspective implies to consider 'situation' as already partly embodied. This view in turn questions what context at the end of the day means for communication in general and zoo-communicational theories in particular. As a consequence each of the focused concepts in this paper's title, context, time, space, and situation and how they relate are in play.

With the above-mentioned framework as a methodological lens, theoretical perceptions of context in general communicational theories were inspected. Further, perceptions of the focused concepts were searched in an excerpt of recent empirical zoo-communicational studies, among others Nomura et al.'s study of so-called E-time series (Nomura et al. 2020).

After preliminary investigations of context in communicational theories,

context as a general communicational concept could be described as an accompanying background that can carry or support co-meaning. It is shaped as a direct side-effect of the immediate, conscious attention to utter from a certain physical and theoretical position implies. Descriptions of specific contexts will therefore depend on a complex interplay between the many sub-aspects in the focused 'object' and many sub-aspects that are generated as background by the physical and theoretical position taken.

In general, the study of both the theoretical and the empirical studies supports not only the idea that situationality and genre are embodied and hence mental. They are even socially shared by a taxon's community as a means to sustain its specific life-functions. This comprehension indicates that embodied situationality and hence animal life-genres are developed evolutionary and experienced, practiced, and adapted by each new generation in time and space. Regarding future design of research, a conclusion is that complex, multi-disciplinary studies, although necessary, will nevertheless face a bundle of different kinds of contexts requiring an advanced, multidisciplinary methodological regime of contextualising, decontextualising, and recontextualising across disciplinaries in order to validate outcomes.

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ANALOGY IN EVOLUTION: A PEIRCEAN BIOSEMIOTIC PERSPECTIVE

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Analogy is iconicity in action. Far from the static formalisms to which simple analogies are often reduced, C. S. Peirce defines analogy as the active, comparative relation of iconic sign patterns or 'diagrams' reliant on three basic modes of inference: guessing, concluding, and testing (otherwise known as abduction, deduction, and induction) all intertwined in iterative inquiry (Peirce 1902: CP 2.787, 1903: CP 2.77, 4.33). This paper explores the biosemiotic implications of applying Peirce's definition of analogy and his theory of evolution to an original language development case study involving novel paradigm formation over a six-week period by a child aged 1;08–1;09 in the domain of free play focused on a set of blocks. In referring to the blocks, the child produces creative lexical blends involving abstractions drawn from shape, colour, and food-based iconicities. In the process, evidence for three interacting (irreducible but interdependent) modes of language evolution emerge that are arguably domain general: analogy, automation, and diagrammatization (as previously defined in Pelkey 2013, 2015). Developing ideas from C. S. Peirce, John Deely, and a range of linguistic theories concerned with concept formation, conceptual blending, and language evolution, the paper attempts to map relationships and clarify concepts between disparate frameworks related to the nature of language, the evolution and development of languaging, and the vital relationships (and subtle distinctions) between these activities and animal communication in general. Relationships between linguistic and biotic evolution are also addressed.

The bridging connections require a process-oriented semiotic perspective grounded in the experiential, or tonal, relations of iconicity. The ultimate goal of the paper is to better understand the nature of analogy in its various modes, including those that unite us with and distinguish us from alloanimal cognition. The argument concludes with a distinction between analogic agency, automated processing, and diagrammatic process that is germaine for evolutionary theory in general along with a reappraisal of the unique nature of those cases in which simple analogies are reduced to static formalisms rather than being experien-

tially enacted as iconic events.

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VALUES IN MOTION

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Gatherings in Biosemiotics have been characterized as a “collective effort to understand the value of signification for living organisms” (call for papers). Recognizing this effort, this paper is about a connected issue, which can be called the “signification of values.” Biosemiotics is one of the approaches to life and cognition, which recognizes normativity as being at the roots of the studied phenomena. In this aspect it is compatible with deeply embodied and situated approaches to cognition such as enactivism, interactivism and ecological psychology. James Gibson characterized his work as “moving toward a psychology of values instead of a psychology of stimulus” (Locker 1980, cited in Reed 1988: 296), and it seems that the latest ecological turn in the cognitive sciences has the potential of granting values the theoretical and empirical attention they were long claimed to deserve (Hodges and Rączaszek-Leonardi 2021).

Yet in order to be able to put values in the centre of our investigations and to design novel methods to study them in various living systems, we need to answer the very basic questions of where and how to look for them. How do values manifest themselves, how do they make themselves visible and readable both for interacting cognitive systems and for researchers? This paper will invite the biosemiotic community to a joint search, together with ecological psychologists, for phenomena and situations which reveal values in ways amenable for study. We will consider a variety of processes over a variety of timescales, seeking the signs of the presence of values, but we will pay special attention to the phenomena which are closest to our everyday experience: the shape and timing of every move we make.

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TRANSACTIONAL UMWELT: NEITHER UPGRADING THE BODY NOR DOWNGRADING THE MIND

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In a somewhat passing comment, Eduardo Viveiros de Castro complains about the two basic modes of overcoming dualisms: “one side reduces reality to representation (culturalism, relativism, textualism), the other reduces representation to reality (cognitivism, sociobiology, evolutionary psychology)” (Viveiros de Castro 2004: 484). ‘Overcoming dualisms,’ particularly those of the nature-culture, body-mind, organism-environment variety, is so widespread as to appear an already solved problem – an uninteresting one, in fact, a beating of a dead horse. Yet old habits die hard, and as the above quote indicates, the ways of “overcoming” are as established and entrenched as the dualisms themselves: the ‘decision’ of overcoming is either to reduce the mind or subjectivity to biology, or to uplift the body to the phenomenal. In the biological reduction, the mind is an organ of the body, and in phenomenology, the body is an organ of the mind. Even theories of embodiment follow this pattern by suggesting to ‘upgrade’ the merely physiological body as an object external to cognition to a functional part of cognitive processes. It is a spiritualization of the body as much as it is an embodiment of the mind. This basic pattern of ‘overcoming’ can be extended to other dualisms as well. They all assume that there is an originary division which must be mended.

We ought to keep in mind Gilles Deleuze’s remark that “There is only one form of thought, it’s the same thing: one can only think in a monistic or pluralistic manner. The only enemy is two” (Deleuze 1973: 3). Uexküll thought transactionality may be one possible alternative, for Umwelt is indeed just an entire meshwork of functional cycles that make up both the organism’s world and the organism itself. The boundaries that separate an organism from its environment appear only as a function of particular sorts of transformations, be it distinction-making or effecting; the Innenwelt and Umwelt are transformations and continuations of each other. Rather than beginning with two pre-givens which then become conjoined, it is from the myriad perception-action cycles that the en-

tirety of the Umwelt grows. The organism-environment distinction is the result of a process of schismogenesis: it is a consequence, not a starting point.

The presentation will thus attempt to argue the following: an Umwelt does not result from a coupling of organism with environment; the transactional distinction or schismogenesis between the latter is grounded on and proceeds from the Umwelt. The organism and its environment are not the preconditions of Umwelt; Umwelt is the precondition of organism and its environment.

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THE ROLE OF METAPHORS IN MODEL-BUILDING WITHIN THE SCIENCES OF MEANING

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There is a *kind* of research area that deals with meaning in a wide sense. While we may ascribe semantic, semiotic and psychological roles to the peculiarities of how meaning is treated, there is no cross-discipline conventionality on what *meaning* is supposed to mean.

This presentation will try to develop a conceptual scheme for understanding what a *science of meaning* might be considered as, and in the identifiable cases of a science of meaning, what the models of explanations might be for a given case. It will be argued that metaphors are an important building block in at least some analytic models of meaning, but at the same time, their status as metaphors may lead to conflicting ontologies within the scientific picture that they may try to portray.

FROM PROTEINS TO ALGORITHMS: A (BIO)SEMIOTIC APPROACH TO ARTIFICIAL INTELLIGENCE

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After nearly three decades of a 'winter,' artificial intelligence based on neural networks (NN) has been warmed up by big data and now seems in a spring mood. There are great expectations that an all-purpose general machine based on multi-layered NN will be capable not only of 'deep learning,' but also of emulating most – if not all – characteristics of a complex living being, including expression of emotions, action based on moral choices and even aesthetic judgments that would allow it to create art. The definition of intelligence is critical when such claims are made. In the early 60s of last century, Rosenblatt, Minsky and their followers took the biological functioning of the brain as the prototype for building artificial neurons and emulating intelligence. The culminating point was AlphaGo and similar algorithms that can not only 'learn' and master any board game, but also solve many difficult problems in chemical, medical and pharmaceutical fields, such as diagnosis and the synthesis of new molecules. But this is not the final proof of intelligence as envisioned by Alan Turing. Turing was adamant in putting human communication as the highest possible bar in the pursuit of artificial intelligence. We are far from this yet. One mocking dictum among philosophers of mind is that 'intelligence is and always will be whatever a computer cannot do – yet,' which exposes the everlasting difficulty between what C. P. Snow once called the 'two scientific cultures': hard and soft, hard being mathematically minded and soft being humanistic in its nature. Maybe biosemiotics, understood here as the general logic underlying the behavior of living beings, could be of some help in solving this aporia. Biosemiotics is much more about the mind than the brain, meaning that it is much more concerned about the general logic of perception, representation, and communication than the activation threshold of neuron networks and their convergence to a final state. We will propose here a model inspired from protein folding as a minimal syntax for AI, developed based on Peirce's notions of habit and abduction. Since artificial intelligence is taken to be the next turning point in the evolution of human culture, we find it critical that we might be developing something that we do not re-

ally understand. It is not an overstatement to say that this might be a real threat to our civilization. We hope that biosemiotics can contribute to the debate.

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IMAGE SCHEMAS AND DECEPTIVE BEHAVIOR IN AMERICAN EASTERN GREY SQUIRRELS: A ZOOSEMIOTIC APPROACH

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This paper contributes to the biosemiotic understanding of deception by discussing the adoption of a new behavior in eastern grey squirrels as an adaptation to certain environmental conditions. Steele et al. (2008) found that overlapping home ranges and harsh living conditions of free-living eastern grey squirrels in parks in Pennsylvania and Massachusetts led to individuals of this species acquiring means of deceiving conspecifics, to protect their food.

To prevent being robbed of its nutriment, the scatter-hoarding rodent invests little in defense but pretends to bury food items in various hollows, without placing anything inside, actually. This method of back-filling empty pits is a means to confuse other individuals, who perceive digging movements as representamen for the possibility of hidden seeds at an exact place (object). As such, they construe the interpretant 'that individual is burying food'. The animal concretely communicates false signals to manipulate the receiver's conclusion of what it sees. This deviation from a usual, basic caching habit seemed to be triggered by the presence and proximity of other squirrels. I argue that intentionally imitating a normal behavior (excavating and covering a hole to bury a seed) by exploiting a common code to explicitly mislead robbers demonstrates certain cognitive capacities, such as the *theory of mind*, the awareness of schemata and the knowledge or experience that one's own actions influence others' conclusions.

Deceitful behavior was already identified in some other species, as studies of the mimic octopus (*Thaumoctopus mimicus*) (Gómez-Moreno 2014) or femmes fatales fireflies (*Photuris*) (El-Hani et al. 2009) illustrate. As Steele et al. consider the squirrel's conduct from a biological/statistical point of view, I investigate and analyze their observations and findings within a (zoo)semiotics framework. In this way, I explain deceptive behavior in the American rodent in light of Uexküll's *Umwelt Theory*. From this perspective, specific behaviors are part-and-parcel of the build-up

of the species' particular *phenomenal world*. By considering behavior as embodied, performed through the species' unique set of senses, biosemiotics contributes to exploring deception qualitatively and from a non-anthropocentric and non-dualistic perspective.

As such, I explain the small animal's movement pattern, classified as deceptive behavior, by following the mental steps underlying its habit. For this, I employ the concepts of *Merkwelt* and *Wirkwelt*, *Figure* and *Ground*, *Fremdbild*, *intention*, *consciousness*, *mimicry* and *theory of mind*. In this analysis, I describe the animal's deceiving act as semiotic modeling, following the Peircean perspective in biosemiotics. The cooperation between *object*, *representamen* and *interpretant*, regarded from the perspective of the observed and the observing squirrel, provides insights into the logic of deception. This leads to my argument, confirming the basics of biosemiotics theory, that iconicity is at work at the core of squirrels' nonverbal deception.

Finally, following Ureña Gómez-Moreno, I illustrate why image schemas are suited perfectly to comprehend non-human animal behavior in a more 'fine-grained' way than a non-semiotic biological view can reveal. This also sheds light on the capacity of squirrels to imagine *possible worlds*, which invites a discussion on *visual metaphors*, *mental images*, *future planning* and the applicability of the term *semiotic cognition* for this and other non-human species.

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THE OTHER SIDE OF SYMBOLIC REFERENCE

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In the course of human evolution, our species has undergone semiotic development from icons and indexes to symbolic reference; but beyond such vertical scaffolding, we are blessed and cursed with the ability for horizontal scaffolding.

Terrence Deacon notes, "Although we do not treat everything in the world as standing for something else or as conveying some cryptic content... We humans are nevertheless notorious for these kinds of projections. In almost all societies, people routinely interpret natural disasters, diseases, the appearance of comets, bad luck, and even simple mechanical failures as 'signs' of something" (2006: 30). He further suggests there may be "a sort of symbolic savant syndrome, by which [he means] to emphasize the almost compulsive [human] tendency to apply this one mode of sensory cognitive evaluation to a far wider scope of objects and events than is instrumentally warranted" (1997: 30).

Tyler James Bennett notes Deacon's view that symbol use "is both the source of the evolutionary advantage that verbal language provides, while at the same time presenting a serious danger or disadvantage, a sort of double-edged sword that can even be portrayed as a maladaptation" (Bennett 2015: 448). He further notes that Deacon argues that symbol use allows humans to operate in "ungrounded cognitive constructs or 'virtual realities'" independent of sensory stimuli, allowing them to perceive symbols even when they are absent.

I have suggested that symbolic reference gave us the ability to create concepts that are not-exclusively physical. This allowed the expansion of our cognition to concepts which lack the physical characteristics of mass, energy, and observability but which can nevertheless have causal influence on our world.

In this paper, I will propose that certain phenomena may be aspects of this 'other side' of symbolic reference, one that generates problems for individuals and the sources of which remain mysterious. Here I am re-

ferring to phenomena such as psychosomatic illness, the placebo effect, phantom limb phenomena, the Havana syndrome, false belief, social contagion, interpretation of political events, purported influence of spirits/demons, excessive expectation of low probability outcomes, and disappointed hopes.

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BEING HORIZONTAL: ON HUMAN AND NON-HUMAN RELATIONS WITHIN THE CRITICAL POSTHUMANITIES

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When thinking about the possible different definitions of human and non-human actors, there are numerous ways to frame and approach each of them. In this talk, we choose the prism of posthumanism, specifically drawing from the critical posthumanities and the posthumanist condition. The posthumanist condition can be described through its interest in redefining humanity and humanism from intersectional, feminist, postcolonial and poststructuralist positions, as it critically evaluates anthropocentrism and neoliberal hegemony, including the works by Donna Haraway, Kathrine N. Hayles and Rosi Braidotti. Braidotti is also the main author of the theoretical foundations for critical posthumanism. The latter is an emerging field of scholarship that combines posthumanist and post-anthropocentric approaches and is based on designating the humanities as insufficient, because of their exclusive focus on the human. Braidotti thus articulates the need for a new post-disciplinary discourse and a related epistemological framework that inherently rejects the anthropocentrism and eurocentrism of the 'traditional humanities' and calls for inclusive humanities. Inclusion and empathy are also understood in relation to non-human actors and objects.

The focus of this talk is therefore on relations between human and non-human actors in the post-anthropocene era and the ways of approaching them in terms of 'horizontality'. We understand horizontality as a redistribution of power and capital accumulated only by certain types of actors. It can also be described as a relationship between actors not strictly defined by a vertical hierarchy. As a philosophical foundation, we introduce the aspects of flat ontology that reject the passivity of non-human actors and view them as full-fledged parts of relational networks – or, in other words, ecosystems – thus also asserting the principles of horizontality. The aforementioned is complemented by analysis of concrete

works of art that intervene within the field of synthetic biology or synthetic ecology. The examples are used as tools to demonstrate the theoretical framework and propose a more specific definition of horizontality as a possible epistemological tool for critical posthumanities.

TOWARDS A THEORY OF SEMIOTIC AGENCY

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Traditional semiotic theory ignores the notion of agency because of its anthropocentric nature and the fact that perception and cognition are relatively uniform among educated humans, especially within the same culture. Biosemiotics breaks with semiotic anthropocentrism in two main directions: first, by recognizing sign processes in all organisms, most of which differ drastically in their semiotic competence from humans, and second, by grounding human cognition in the action and communication of subagents, such as organs, cells, organelles, and functional proteins. As a consequence, agency appears as one of the key concepts in biosemiotics, because organisms have species-specific perception-action circles as elements of their subjective world (Umwelt). The notion of semiotic agency, which refers to a *capacity for acting purposefully and using signs to make informed choices*, is applicable not only to organisms but also to functional organism parts, multi-organism units (e.g., colonies, species, ecological consortia, human organizations), and even autonomous human artifacts (e.g., cars, computers, and robots) (Sharov and Tønnessen 2022). The role of computers and robots for humans is functionally comparable to the role of ribosomes for a living cell. Although semiotic agency transcends the difference between living and non-living systems, all agents are rooted in life, and in this sense, the biosemiotic principle that semiosis is coextensive with life is preserved. The notion of semiotic agency overcomes Cartesian dualism. Firstly, this is because agents vary in their complexity, ranging from simple functional mechanisms in living cells and human technology to complex organisms and even super-organisms. Thus, there is a continuous scale of agential properties and capabilities, instead of a binary choice between rational agents and non-agents as in the Cartesian outlook. Secondly, complex agents are always multi-level: they construct, recruit, or grow subagents of lower complexity to help perform their functions, including the top-down regulatory functions. And thirdly, agents are embedded in their environments by way of embodied perception, functional circles, and niche construction. All agents are produced by parental agents, and are fully or partially programmed by them. Agents can be classified into primary, self-reproducing agents, and secondary agents that are produced by pri-

many agents and perform some of their functions. In terms of activity, agents are classified into active, dormant, and potential (e.g., viral capsid); in terms of resources, they can be divided into autotrophic, heterotrophic, and parasitic; and in terms of individuation, there are single agents, physically connected colonies, and swarms of fully isolated individuals. The levels of semiosis comprise protosemiosis, eusemiosis, cognition, and symbolic thinking. Agents and signs are functional roles rather than physical substances, although specific types of agents or signs have physical constraints. The role of signs is to signify, whereas the role of agents is to interpret signs and act. In a system hierarchy, agents are generally above signs, except in rare cases where agent-roles are not differentiated from sign-roles (e.g., at the origin of life). Signs can in effect change the activity of agents, but agents are ultimately in charge of sign relations, not the other way around. Simple agents and lower-level subagents of complex agents are mechanisms. However, the mechanistic approach is insufficient for studying complex agents, where mechanisms can be replaced without loss of functionality and the exact mechanism therefore does not matter. In light of this, we propose extending science beyond mechanisms into the domain of semiotic agency, but without abandoning the mechanistic approach where it works.

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RIGHT QUESTIONS, WRONG METHOD: WHY FOLK ABDUCTION IS FAILING SEMIOTICS AND THE RIGOROUS NEO-SYNECHIST ALTERNATIVE

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Biosemiotics is well positioned to spark a methodological revolution in science and philosophy, but only if it stops relying on the methodology that has come to make much of science and philosophy more like pseudo-engineering than explanation.

There have been two scientific revolutions. A third is pending. The first imposed rigor on formalism (coherence, deduction). The second imposed rigor on empiricism (correspondence, induction). The third would impose rigor on categorization (continuity, abduction).

Folk abduction categorizes based on attributes in common. As presently applied across the sciences and philosophy, it's a multi-disciplinary blend of intuition, metaphor, anecdote, and reverse-engineer sketch work with reified categorial nodes and arrowed correlations. The appearance of engineering gives it the impression of rigor, but it is little better than taking a God's eye view on natural processes and sketching a model of how we would design those processes, employing black-box nodes and ambiguously causal/teleological/correlational arrows. Models proliferate, but with no rigorous standard by which to judge one model more realistic than another since, with formalism, any model is possible and one can find supporting anecdotal (e.g. empirical) evidence in support of any model.

Neo-synechism emphasizes sequential continuity and suggests a way to impose sequi-disciplinary rigor on abduction based on the tacit assumption of an integrated scientific perspective: to understand a category of phenomena, we must be able to explain its emergence as a change in likely work (i.e. ergodynamics) from prior qualities. In other words, the ontologically prior sciences must explain what an ontologically subsequent science assumes. For biosemiotics, this requires explaining how

beings doing work that works to keep them working (i.e. functional, interpretive effort) emerge from chemistry which does not have those categorical attributes.

IN THE SOCIETY OF MICROBES – OR: A CALL FOR AN APPLIED, HIGHER-ORDER, DATA-INTENSIVE BIOSEMIOTICS FOR MICROBIAL ECOLOGY

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That there is a lack of theory at the heart of biology is a common lament among theoretical biologists. While most experimental biologists have been able to bypass this lack by way of experimental design, it seems that this state of bliss might now come to an end. The age of 'big data' has reached biology with the rise of high-throughput, omics, and metagenomics methods, and with it, the question of how to handle the complexity of biological systems. For example, via metabarcoding sequencing of environmental samples, we can now get a readout of the abundances of a taxonomically wide range and a high number of organisms by, in essence, performing high-throughput DNA sequencing on a specific marker gene (Steward 2007). In recent years, this methodology has found its way into long-term ecosystem monitoring programs and promises deeper insights into the dynamics and ecology of microbial communities. As do the other omics methods, metabarcoding brings together data-intensity and (to a degree, and especially for environmental research) an observational way of doing science. In this, the long-forgotten lack of theory takes revenge: as the statistical methods that are currently available were created for well-controlled experimental setups, most of them are theoretically inadmissible for the study of omics datasets that capture the high degree of inter-relations between biological entities. The consequence of this is that, for example, the state-of-the-art in big data microbial ecology remains descriptive (Prosser 2020).

In this talk, I want to pose the question of how to alleviate the lack of theory, and with it, the lack of methodology, that is haunting the study of environmental microbial communities at the moment. To fulfill the task at hand, a theory would need to be able to (I) describe information transfer between organisms, (II) describe the higher-order patterns that emerge in communication involving multiple parties, and (III) provide quantifiable hypotheses or concepts. Of course, such a theory does

not exist yet – and one would, most probably, not be able to present it in a fully formulated form in a talk. Nevertheless, I want to use the opportunity of this talk to present and discuss a point of departure for its development. I suppose that such a theory will, at its foundation, be biosemiotic, as the first of the aforementioned requirements can be readily met by protosemiosis. To support this, I will describe biomonitoring in complex ecosystems using the distinction between syntactic, semantic and pragmatic information, the notion of *Umwelt* and second-order observation. To also take into account higher-order patterns, I propose to integrate protosemiosis with the theory of complex systems developed by the sociologist Niklas Luhmann (Luhmann 1987). Being self-contained, highly abstract and, itself, an amalgam of disciplines such as cybernetics, semiotics, structuralism and phenomenology, the quantification of some of its central concepts might be possible. I will end this talk with a few ideas of how to motivate computational methods for the analysis of microbial communities with reference to semiotics, linguistics or structuralism, hoping that these approaches can point towards a way of translating qualitative into quantitative statements. Taken together, my talk will present a very practical problem that can put biosemiotics to the test in its ability to make more-than-descriptive statements based on high-throughput observational data.

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PEIRCE'S IDEAS OF THE MAN-ANIMAL DISTINCTION

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Peirce was an evolutionist and one of the first to generalize the concept of evolution from biology to physics and sociology alike. He also took some interest in locating what it is that separates the human animal from other higher animals. As to biological instinct, it was the human urge to externalize signs in art, technology and science and other products of the *extended mind*; semiotically, it was the ability to make *hypostatic abstractions*; psychologically, it was the notion of extended *self-control*. This paper revisits Peirce's conceptions of the human condition. Peirce ascribed to humanity great tasks in the evolution of the planet as of the universe; yet, his evaluation of the individual human animal was very low, as to autonomy, courage, moral, as well as intelligence. By which means did he think this chasm between the individual human animal and the grand aims of humanity could be bridged?

NATURAL SELECTION: A BIOSEMIOTIC RECONSTRUCTION

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For non-experts, natural selection is one of the most acknowledged biological processes, and perhaps, still today, the most acknowledged evolutionary process for many people. However, it has, since its inception, been prone to misunderstandings. Among those misconceptions, the most relevant are the following: that it is tautological (i.e. it has no real meaning and empirical import), that it operates exclusively by elimination of unfit organisms (i.e. it is not creative), that it is purely mechanic (i.e. algorithmic), and that it reduces or naturalizes teleology.

That confusion is partly explainable on two related grounds: that the alleged process has frequently been described in metaphorical terms, and that theoretical reconstructions of the process have lacked important features of it (Fodor and Piattelli-Palmarini 2010). At the core of this confusion is the concept of “selection,” which Darwin chose to describe the kind of relation that he tried to explain. Nonetheless, this *prima facie* intentional concept was progressively deprived of such teleological overtones in order to be construed as a purely causal or even mechanical device (Suárez Pascal 2017).

To the contrary of those authors who assert that teleological aspects of living beings can be reduced to their being produced by natural selection, I argue that, in order to properly reconstruct natural selection, we need an account of teleology which is applicable to all living beings (i.e. not intentional).

Indeed, I argue that such an account of teleology is also presupposed in von Uexküll’s theory of meaning (*Umweltlehre*), which serves as an additional way to analyze the links between the surrounding worlds (*Umwelten*) of organisms and biological evolution.

Besides exposing an account of teleology which might be relevant to biosemiotics, and to biological theorizing, in general terms, the presented account also sheds some light upon the problem of evolutionary creativity, which has been a debated issue concerning natural selection (Beatty

2016). However, as will be shown, the biosemiotic reconstruction of natural selection is neither mechanistic nor algorithmic.

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BIO-SEMIOTICS OF MEMORY: TOWARDS SEMIOTIC REALISM

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Usually, memory is analysed as an *individual mental ability* and considered as an object of study for epistemology, cognitive sciences and psychology. The proposed research suggests developing the theory of memory as an ontological and evolving phenomenon that has a (bio)semiotic nature. It is argued that such an approach could help partly to overcome 'biosemiotic solipsism' (biosemiotic internalism) and pave the way for biosemiotic realism. There are at least three *ontological* types of memory responsible for the maintenance and reproduction of global, evolving systems: *physical*, *biological* and *social*. In short, *physical memory* can be defined as stable structures or processes in the physical world that carry ('record,' retain) information. *Biological memory* is biological or ecological structures and processes responsible for the re-production of the living systems by means of inherited information (inheritance systems). To *social memory* belongs all 'ratchets' and practices of maintenance and re-production of the social system via education, cumulative knowledge and traditions. In the case of social memory, it can be stated that the social system produces from itself *conventional signs* for its re-production (for example, road signs for re-production and regulation of traffic). Road signs remind us where and what to do, playing the role of embodied, embedded and 'extended memory'. Signs of this extended memory are conventional and must be learned. Meanings do not belong to these signs *per se* but to the traditions of their usage in society, to the intersubjective semiosphere. On the other side, in the case of physical and biological types of memory, we could see '*natural signs*' that are causally connected with reality or grounded in the environment. For instance, physical memory is based on *indexical signs* and 'records' (preserves, reflects) events that have happened in the world. Living systems use it to reconstruct past events and transmit information to the future. For example, footprints on the ground keep information about the animals that left them and the events that happened here. Marking territory by social animals helps to transmit information in time, signifying property (ownership) of this territory. The information preserved in sedi-

mentary rocks also tells scientists from geochronology or palaeontology about the history of the Earth (e.g., the rise and decline of the dinosaurs). In this case, we can say that these 'footprints' carry information in themselves no matter who interprets them and how, otherwise, the existence of the natural sciences would not be possible. If we take biological memory and DNA code as the main biological structure responsible for the accumulation of heritable information, we also can see that this code is not arbitrary in its origin. In comparison to human natural languages, which are different in different cultures, DNA code is surprisingly universal for all living organisms. The research argues that these facts give the foundations for externalistic approaches in biosemiotics and for the ontological revision of memory.

ECOSEMIOTICS AS A BIOPHILOSOPHICAL TOOL FOR THINKING OF EXTRATERRESTRIAL LIFE

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Anthropocentrism has become one of the key targets for attack by the expanding critical theory. In addition to its critical, negative force, criticism also creates a space for new, non-anthropocentric views on life and the creation of new scientific and philosophical complex paradigms. In this context, I propose to look at the potential launch of ecosemiotics into space to analyze potential life that would be radically different from what we see on Earth.

Allowing ourselves a speculative and a little fantastical questioning about extraterrestrial life, one way or another, we are faced with the problem of methodology, even more acutely than in the case of the study of terrestrial phenomena. After all, thinking about extraterrestrial life, the very object of our thoughts is unseen and unknown. In this case, the critical view primarily serves to help get rid of the prejudices imposed by the anthropocentrism and terramorphism of natural sciences, which build their theoretical basis on earthly empirical material. One possible consequence of the discrepancy between the rational models of Earth sciences and potential extraterrestrial life forms is the Lovecraftian image of a terrifying nature. One of the possible ways to avoid, or at least weaken the aesthetic horror and crushing of rational expectations, is to build a transdisciplinary layout that combines the philosophical multiplicity of angles, the sciences of life and a critical attitude to the human condition, the position from which knowledge about other beings is formed. The name for such a project without clear boundaries can be the concept of 'biophilosophy,' which has gained popularity in recent decades as an opposition to the analytical rigidity of the classical 'philosophy of biology'. Ecosemiotics in this scheme is assigned the role of one of the crucial elements of the biophilosophical approach, since it also has a complexity that combines philosophical questioning and developments in the life sciences. This complexity combines:

1. the ecological scale of research needed in conditions where ignoring the complex intersections of agents and focusing solely on a single species would be an anthropocentric fallacy extended to extraterrestrial life forms;
2. taking into account the primary role of interspecies relations for the formation of the ecosystem as a whole and individual species;
3. the ontological agenda, which is not limited to just describing relationships and interactions, but seeks to look into the inner worlds of agents, into their onto-ethological structure.

Also, it is worth considering the potential difficulties arising from the same problem, against which the tandem of 'biophilosophy' and 'ecosemiotics' must contend. These problems are caused by potential radical differences between terrestrial and non-terrestrial life. Such problems are:

1. the potential differences in individual or species autonomy;
2. the pace of individual or species processuality;
3. the potential (albeit rather phantasmagoric) possibility of non-semiotic interaction.

Thus, critical approaches to reasoning about biological (terrestrial and non-terrestrial) life and the multiplicity of its forms encourage the search for new forms of knowledge that avoid anthropocentrism and terramorphism. Ecosemiotics can occupy this niche by offering a synthesis of the analysis of ecosystems and the aspiration to clarify the ontological structures of their agents.

MISSING SIMPLE MUSICALITIES: THE INCOMPLETE NATURE OF MUSIC

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This paper focuses on an exploration of the problem presented by Terrence W. Deacon in his famous book *The Symbolic Species* (1997). Deacon has proposed the thesis that there is an insurmountable rupture between human language and all other communication of non-human species. Deacon refers to this fundamentally limiting presupposition as the 'symbolic threshold' (or 'symbolic barrier'). Deacon identifies the species-specific nature of human natural language on the basis of its combinatorial power, however the crucial difference is humanity's possession of a mental symbol system. A symptom of this threshold is the unprovability of anything that we might describe as 'simple language.' The aim of my paper is to attempt to deterritorialize Deacon's ideas from the fields of evolutionary neuroanthropology and linguistics to the cognitive semiotics of music. If we start from the assumption that music is, next to language, the second most important way in which humans organise sound, a number of questions arise. Is music – analogous to language – an exclusively human activity? What happens if we cautiously ask whether music is not something that might – in Deacon's terms – manifest (or not manifest) aspects of the sought-after simple language?

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WHAT “APPEARS TWICE”: A METHODOLOGICAL HYPOTHESIS FOR BIOPOETICS BASED ON LEV S. VYGOTSKY’S THEORIES

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In recent years, there has been a rediscovery and revision of the work of Soviet psychologist and pedagogist Lev Semyonovich Vygotsky (1896-1934). Studies on the subject are shedding new light on the wider scope of his thought, together with the complex editorial situation that characterised its reception. Amongst the various fields in which the author has left some reflections, art theory and criticism and the psychology of aesthetic reaction – literary reaction in particular – seem to find a broader articulated structure in his thought. Furthermore, Vygotsky’s theory of art – expressed in his early works *Tragedy of Hamlet*, *Psychology of Art*, and *Aesthetic Education*, and the 13th chapter of his *Pedagogical Psychology* – finds an integration within his later theories, which are specifically psychological. However, the topic appears to be little studied.

After a general overview on the biopoetics studies phenomenon (main authors, themes, and methods), a methodological hypothesis based on the ‘cognitive semiotics’ of Lev S. Vygotsky is expected. About the Russian psychologist and pedagogist, the theory of psychic development and the process of signification model will be illustrated, as a further theoretical and methodological background of biopoetics. Indeed, his idea about artefacts (as tools and signs) can be a useful framework for the theory and the methodology of biopoetic studies, together with his model of psychic development based on the co-called *stimulus-mediator*. According to Vygotsky, each cultural acquisition cannot be acquired through the same simple scheme S-R (stimulus-response) as the biological ones are. In addition, this also needs a third element: the *stimulus-mediator*, meaning the human artefact, like tools (e.g. a knife) and signs (e.g. language). Moreover, the individual can find this outside himself in the first place, then inside society, and then as part of his higher psychic functions. In this way, it ‘appears twice’: first in society (it is *interpsychological*) and then inside the individual (it becomes *intrapsychological*).

The millennial practice of narrative can be then considered a cultural artefact, i.e. a *sign*. According to this 'cognitive semiotics,' narrative becomes a sociocultural factor of the psychic development of the human mind, which plays a major role in the evolution of the species.

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“WAVES OF MAGNETIC DEBRIS”: J. G. BALLARD’S “THE VOICES OF TIME” AND THE BIOSEMIOTIC POSTMODERN

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J.G. Ballard’s “The Voices of Time,” a 1961 science fiction short story, depicts both human and nonhuman animals in a transitional state. Occupying a highly irradiated future, all lifeforms on earth have begun mutating in unpredictable ways. The story’s protagonist, Robert Powers, a retired psychologist who is himself experiencing a narcolepsy symptomatic of the first stage of mutation, responds to this evolutionary crisis by radiating himself using a GE Maxitron X-ray projector, accelerating the activation of a gene called the “silent pair.” Ballard’s depiction of accelerated evolution attends to the active roles of *Umwelt* and technology in both cultural and biological change. My analysis uses biosemiotic concepts—Jesper Hoffmeyer’s code duality, Wendy Wheeler’s semiotic freedom, John Deeley’s ultramodernism, and W. John Coletta’s biosemiotic approach to literary criticism—to interpret “The Voices of Time” as a fable about phenomenological freedom in the context of environmental change. I argue that the story’s arrangement of radiation, mutation, technology, and consciousness offers a view of the postmodern condition that emphasizes what Hoffmeyer identifies as freedom at the level of execution—an aspect of analog semiosis.

While most contemporary interpretations of postmodernity emphasize its imbrication with digital technology, a biosemiotic analysis of postmodern literature reveals the primacy of analog phenomena (rooted in physiological and electromechanical relations) in cultural change. I read Powers’ use of the GE Maxitron (a real machine used in oncological applications) as analogous to developments in music technology in the early 1960s, in order to show the feedback relationship between modeling systems that constitute historical experience. While textual or discrete (digital) semiosis allows for the dissemination of knowledge through time and without noise, the analog relations shown in “The Voices of Time” and in the history of music devices like the distortion unit, echo machine, and synthesizer evince a sensitivity to the qualities of the present mo-

ment, and thus serve as a unique basis for cultural interpretation. My analysis uses analog technologies as models of/for accessing historical Umwelt, expanding the cultural implications of biosemiotics toward an interpretation of the history of technology, revising current interpretations of postmodernity (and contemporary history) to make room for semiotic freedom in its technologically mediated varieties.

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THE BIOSEMIOTIC ROAD TO PSYCHODERMATOLOGY: SKIN AS A MEDIUM AND A METAPHOR

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Psychodermatology is an evolving specialty of medicine working at the interface of dermatology, psychiatry, and psychology. Dermatology and psychiatry belong to natural science, while psychology is a part of social sciences. Integration of these two cultures into an emerging third one is mediated by biosemiotics as a transdisciplinary stance.

I use biosemiotics as a transdisciplinary interface that creates space for marriage between dermatology and psychology, that is, the skin and the self, the body and mind. Biosemiotics' view of life as a semiotic process is a core premise that can bridge the hard problem of dualism created by modern science.

Failure of the conventional biomedical model in solving many skin diseases necessitates the search for a new paradigm that can reframe such complex medical problems. I have found that biosemiotics can help us understand the interdependence among different systems: biological, psychological, social, and ecological. The translational nature of the semiotic process makes these systems function as whole and part of a whole, that is, as a complex adaptive system. Health and illness are emergent phenomena resulting from the biosemiotic interaction among these four interdependent systems. The kind of outcomes in this system is correlated with the kind of semiosis, a communication that can be synergistic or antagonistic.

Psychodermatology emerges as a result of encountering a patient with a skin problem that can't be explained by the biomedical model. The dualistic nature of the biomedical model was found to reduce etiopathogenesis to external pathogens overlooking the agency of the patient as a person. Biosemiotics is an anti-dualistic stance that views life and reality as different levels of semiosis, indexical, iconic, and symbolic. Biosemiotics' view of life as semiotic agency can explain the complexity, emergence, and chaos inside the biological system at all levels of organiza-

tion, from a cell to a human being. Understanding human beings as a symbolic species rather than a linear machine system is the first step towards biosemiotic personalized medicine. The symbolic nature of human beings makes their health and illness dependent on intrapersonal and interpersonal communication in addition to that of non-human animals like microbes. Placebo phenomena and the psychoneuroimmunology model provide empirical evidence that confirms such claims. Human beings differ from other life forms by their ability to respond to the absence, the possibility, that is, the meaning of things, not just the physical things themselves. Self and body are different levels of semiosis rather than different ontological substances. In psychodermatology, the physical skin functions as a signifier, a medium that communicates our thoughts and feelings.

Adopting a biosemiotic stance helps us to avoid the trap of dualism and reduction of health to the biophysical domain. Biosemiotics as a transdisciplinary stance embraces both the search for indexical causality and the symbolic response. Skin diseases like vitiligo, eczema, and psoriasis can be understood as symbolic diseases, as metaphors, if we bracket the positivistic modern science stance and adopt a biosemiotic phenomenological one instead.

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BIOSEMIOTIC ASPECTS OF THE EVOLUTION OF EVOLVABILITY

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In the field of evolutionary biology, it has long been known that anagenesis is subject to constraints (e.g. unreachable phenotypes, prevailing directions of change) and does not proceed completely without restrictions or channelling. However, it becomes increasingly clear that evolutionary constraints are themselves subject to long-term evolutionary pressures that optimise possible evolutionary reactions of the lineage based on its previous evolutionary experience. Under a broad range of conditions, heavily constrained lineages that are able to quickly and effectively, albeit not very creatively, react to changes in the environment have an advantage over lineages that are subject to fewer constraints. Therefore, constraints are better seen as a form of evolved evolutionary canalization than obstacles blindly preventing evolutionary lineages from reaching certain states. This is a manifestation of the fact that evolvability, i.e. the capacity of a lineage to generate heritable, selectable phenotypic variation, itself evolves. One striking aspect of the evolution of evolvability that has gone nearly unnoticed until today is its biosemiotic nature. Evolutionary lineages keep the memory (both genetic and non-genetic) of their previous states, including those that are not expressed in the phenotype anymore, as is exemplified by the presence of certain ancestral structures in the embryonal development, or even structural and functional re-evolutions. The evolution of evolvability can be then described in the terms of learning and interpretation of this information. In line with Jurij Lotman's ideas (Markoš 2014), and in a similar way to the evolution of teachings, societies, and other cultural phenomena, it does, however, tend to become habitual, less changeable in time, limiting its evolutionary potential to small peripheral modifications at the expense of major evolutionary novelties. Frozen evolution theory, the concept we have developed to describe long-term dynamics of evolutionary changes, argues that the reason for this tendency is stability-based sorting, i.e. nearly ubiquitous phenomenon of accumulating contextually more stable elements of the system. This can be overcome; and the ways various evolutionary lineages achieve this goal

constitute several of the most fascinating evolutionary phenomena. We have shown that it might have led to extreme simplifications of the phenotype of certain lineages, the origin of new (epi)genetic systems, or even be the cause of increasing hierarchical complexity of eukaryotes (Toman and Flegr 2018). The importance of the evolution of evolvability in the evolutionary process has been highlighted recently, showing that even the frequency of particular mutations in specific places of the genome is non-random and under selection (Melamed et al. 2022). With only a little exaggeration, evolution can be described as a process in which the biosphere, through the evolution of evolvability, learns about, recognizes, and builds itself, as well as the world around it. Therefore, it can be argued that, rather than random mutation with selection, macroevolution should be conceptualised as a multi-level semiotic process.

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The chapter presented here (Tønnessen, forthcoming) outlines semiotic studies in ethology and zoology, starting with foundational work and contemporary developments and proceeding to relevant methodologies and prospective future studies. The conception of zoosemiotics as a field of study has evolved considerably since Thomas Sebeok coined the term in 1963, and currently signifies a far more comprehensive field than what Sebeok's original definition of zoosemiotics as "the scientific study of signalling behaviour in and across animal species" indicates (1963: 465). In contrast, Maran et al. (2011: 8) distinguish between ethological zoosemiotics and anthropological zoosemiotics, with the former overlapping with Sebeok's initial notion of zoosemiotics and the latter programmatically expanding the conception of zoosemiotics. The contemporary notion of zoosemiotics entails that the semiotic study of animals cannot simply be understood as a synthesis between semiotics and ethology, although such a synthesis remains at its core. It must furthermore be understood as engaging and intersecting with ecology, cultural studies and other fields of study where animals appear in one form or another. Contemporary zoosemiotics is markedly post-Sebeokian in that it deviates from Sebeok's outlook in the framing of the human being's position within nature at large. In similar terms, it also deviates from Sebeok's worldview in the framing of culture's position within nature. In the first case, contemporary zoosemiotics is arguably more consistently *pluralistic*, and has less of an anthropocentric bias, than Sebeokian zoosemiotics. In the second case, in its view on the relation between culture and nature, it is arguably more consistently *holistic*. These developments, representing deviations from classical Sebeokian zoosemiotics, appear to be regarded as advances by most scholars and students in the newest generation of zoosemioticians – and to be more in line with the contemporary *Zeitgeist* among concerned scientists and environmental and animal protection activists.

In modern science, the agency and subjectivity of animals has tended to be neglected. This has largely limited studies of animals to quantitative methods, whether in the study of animals in themselves, or in the study

of how animals relate to human beings. Today, zoosemiotics is arguably the theoretically and empirically soundest approach to 'taking the animal's perspective'. More research is needed on how humans relate to animals. And more research is needed on how animals relate to humans. In the near future, work is needed that connects semiotic studies in ethology and zoology with issues in global human ecology, develops flexible zoosemiotic tools and methodology for application by practitioners such as field ethologists, veterinarians, zookeepers etc., and makes further connections between semiotic studies of animals and phenomenology, ethnography, and anthropology by developing tools and a methodology tailor-made for studies related to human agents and their dealings with animals.

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HOLISM AND ONTOLOGISM AS HISTORICAL AND EPISTEMOLOGICAL COMPONENTS OF TARTU BIOSEMIOTICS

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Each scientific school and each scientific direction at some point begin to need their own epistemology – not only in order to more clearly understand their origins and their history, but also in order to predict the ways of their further development. This also applies to the Tartu semiotic school, which today is developing very actively in several directions, not necessarily explicitly related to each other. One of these directions is Tartu biosemiotics, institutionally associated with a group of scholars from the Department of Semiotics of the University of Tartu (first of all, Kalevi Kull, Timo Maran, Riin Magnus, Nelly Mäekivi, Silver Rattasepp). The premises of Tartu biosemiotics go back, in particular, to the meetings of Tartu-Moscow scholars in the 1960s-1980s and to their interest in biology in connection with the humanities (one of the best examples is Juri Lotman himself with his ever-growing interest in non-human semiotics, explicitly manifested in his later works). Indeed, if the legacy of the Tartu-Moscow semiotic school, at first glance, is associated primarily with the semiotics of culture, the study of the epistemological origins of this school can make it possible to show the interconnectedness of the majority of modern trends in Tartu semiotics with regard to their historical and epistemological foundations. In our paper we are going to dwell on the notions of holism and ontologism as particular consequences of the implicit 'semiotically structuralist' way of academic thinking of the Tartu-Moscow scholars, considering these notions as important components of the formation of biosemiotics within the framework of the Tartu semiotic tradition. It will allow us to raise the question of the temporal continuity of the Tartu (bio)semiotic school in its connections with other academic schools and currents (both semiotic and structuralist) of the past (Saussurean structuralism and semiotics, Prague semiotics and structuralist tradition, Geneva and Copenhagen schools of structuralism, among others).

MACHINE SEMIOSIS AND THE QUASI-SIGNS

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Contemporary research in biosemiotics provides metrics for the measurement of artificial intelligence that are not offered by computational approaches, and in some respects semiotics and AI studies have developed in parallel from the beginning. Michael Polanyi's concept of *tacit knowing* (1966) as beyond the capacity of codification was introduced just at the time when, in semiotics, Umberto Eco was proposing the s-code as a signal-based grammar distinct from fully-fledged codes; and contemporaneously, Doede Nauta (1972) was theorizing the same signal-sign distinction between both fields. Early AI began from the presumption that tacit knowledge can be fully processed in a computational manner. In connectionist AI on the other hand, algorithmic systems are prompted to generate their own statistical quasi-significations within the black boxes of neural networks. The latter still fails to fully apprehend contextual and referential information and, in general, AI studies remain mired in a pre-semiotic understanding of information. There have been enormous advances in language-transformer models that enable statistical analysis of co-occurring words (word prediction and text generation); most of them still rely on structural linguistic and generative grammar-based language models. While the latter are still relevant to the semiotic investigation of artificial intelligence, and may even controversially be revitalized for a domain in which they have lost their popular currency somewhat, the limits of these approaches have become obvious. Leaving aside the ontological questions of the 'inner lives' of the digital black boxes, a semiotic approach to AI can still utilize structural-syntactic-generative models, and the inevitable dead-ends and bottlenecks at which these approaches otherwise arrive usefully demarcate the area of inquiry for which proper semiotic tools really are necessary, such as provided by Søren Brier's discussion of the limits of the 'information-processing paradigm' and Terrence Deacon's development of the notion of 'referential information'. We use the quasi-sign doctrine to organize these tools, and to show how the biosemiotic inquiry into the lower threshold of semiosis is instructive for the inverse exploration of the upper threshold, between organic life and artificial intelligence.

Understanding the basic features that makes sign use possible in the simplest organisms allows us to identify the moment when those features disappear at the upper threshold, in the case of highly complex, but nevertheless still dyadic, computational and machine processes; or to identify the other hypothetical scenario, when artificial intelligence really does come to exhibit triadic, fully-fledged sign use. The latter would contribute to the ongoing discussion of so-called 'machine semiosis' (Andersen, Hasle and Brandt 1997).

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BUILDING A BILINGUAL ONTOLOGY FOR BIOSEMIOTICS. PRE-ENGINEERING PHASE

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Biosemiotics is a young interdisciplinary domain that faces the issues related to its chaotic nature. Its representatives have different academic backgrounds and, as a result, also have domain-specific ideas to contribute, which in turn implies usage of relevant vocabulary. Moreover, biosemiotics encompasses various subdomains, e.g. physical biosemiotics, Darwinian biosemiotics, zoosemiotics, sign biosemiotics, code biosemiotics, and hermeneutic biosemiotics (Barbieri 2009), with their own vocabulary sets.

As long as the discipline under discussion is a developing field, there is an evident need for accurate terminology, and the biosemiotics community finds it crucial (Favareau 2012; Pattee, Kull 2009). Thus, biosemioticians a) may use unpatterned vocabulary and b) introduce new categories and name them, therefore a thorough review of the categorical apparatus is needed.

That being said, the current research is dedicated to the analysis of the conceptual framework of biosemiotics and is focused on the preparations for the development of a domain bilingual ontology. English being the 'interlingua' of today, and Russian being the mother tongue of some pioneers of biosemiotics, these two languages will provide the core concepts for the ontology.

Before engineering an ontology, a whole set of preliminary tasks is to be performed. Hence, two linguistic corpora containing texts on biosemiotics (in Russian and in English) have been compiled, and form the empirical basis for the research.

The words extracted from the corpora should be classified and clusterised in order to be used as nodes in the semantic web to be engineered. Then, the classes must be proven valid by experts. Eventually, after the validation procedure they are to be annotated with semantic relation types and properties (where possible).

A domain ontology serves as a specific container for the categorical apparatus of a discipline. It is not supposed to include exact words used by representatives of a domain, although these words can be matched with ontology classes. Such a semantic web can be visualised as a directed graph where vertices are general concepts (ontology classes) implied by authors when they use different words, and edges are the relations between these concepts.

Lexical and semantic analysis as well as comparative analysis and further classification and conceptualisation being a time-consuming process, and ontology engineering being carried out in several stages, just one particular part of the future web of concepts is to be presented and discussed.

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SEMIogenesis OF THE INORGANIC: A BIOSEMIOTIC READING OF THE THRESHOLD BETWEEN LIFE AND NON-LIFE

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The topic of the presentation is a speculative proposal on the study of semiotic processes from physical matter. The working proposal is to show how physical matter can entertain semiotic processes with what surround it. The intention is to extend the boundaries of biosemiotics and to integrate inorganic matter into its field of research. In fact, since the birth of biosemiotics, semiosis has been identified with life. During its development and progress, this thinking has been maintained by advancing the search for semiosis in the realm of the biological. Although biosemiotics has had the great merit of moving away from an anthropocentric perspective on semiosis, it has maintained a largely biocentric view. However, recent theories of physics and biology make it increasingly difficult to separate what is life and what is not. Thus, the same goes for understanding where semiosis begins. When it is not possible to establish what is life once and for all, it is likewise not possible to establish any a priori semiotic threshold. The research proposal tries to show that a certain process of 'reading' can be assumed already at the level of primordial molecular organization (Deacon 2021). In this way, relations of choices, selections, and sifting are established between the objects, expelling or accommodating complementarities (Prodi 2021). Independently of denouncing the term 'reading' as a metaphor, it is a matter of rethinking semiosis starting from the relationality of material bodies existing in a certain environment. Physics and inorganic chemistry show that the molecular organisation of certain materials is determined by their environment. In this sense, plants themselves are a model of semiotic translation between the absorption of inorganic material and the biosphere. Even for fungi that decompose rocks, inorganic matter is significant in providing nutrition for the ecosystem. The working hypothesis is to rethink semiosis as an intrinsic activity of physical matter that differs in degree and complexity up to the most complex life forms. The term semiotics must be thought of in a broader philosophical perspective. This leads us to rethink biosemiotics as a life-centred

field into one that is able to accommodate the hypothesis that semogenesis can already be found in non-living inorganic matter. The aim of showing semiosis on a material level makes sense as we learn more about the emergence of organic life on the planet. Semiosis or semiotic process refers to the agency processes of actors who stand on the borderline between life and non-life. The sign process is any form of activity, conduct or process involving signs, including the production of meaning for someone or something. Inorganic matter, in fact, is relevant to the sustenance of the biosphere and this seems to have been somewhat removed from the research. The biosphere cannot be thought of as a composition of living things that are impermeable to the inorganic substratum. In this sense, James Lovelock's Gaia hypothesis will be reinterpreted through the principles and methodologies of semiotics. The aim is to activate a new concatenation model between ecosemiotics and physiosemiotics (Nöth 2001). The philosophical and semiotic analysis will be integrated within the broader theoretical framework identified in general complexity theory, in order to avoid reductionist analyses and to consider semiotics in its evolutionary and transversal dimension.

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ON THE VALUE OF HANDWRITING: EMBODIED LITERACY THROUGH THE LENSES OF PEIRCE'S SEMIOTICS

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With digital technologies becoming increasingly prominent in everyday life, we find ourselves writing on a keyboard much more often than writing with a pen. This change seems well-motivated by the benefits of digital writing and goes for the most part unquestioned. In many educational systems around the world, teaching writing in cursive has been dropped from school curricula. We believe that this state of affairs is facilitated by a particular view of literacy as a disembodied competence that can be reduced to effective transfer of symbolic information. Embodied aspects of reading and writing—such as contact with the physical medium, handling of the writing tool, etc.—are treated as merely contextual factors.

Conversely, embodied theories of cognition recognize interactions with the physical world as constitutive for all cognitive processes. It is the structure of the environment which informs the organism and allows it to offload cognitive effort. From this perspective, reading and writing can never be decontextualized. Mangen and Schilhab (2012), for example, argue that reading is a complex multisensory practice, which involves a body, a mind, and a technology; accordingly, the process of text comprehension should not be conceived of in separation from the sensorimotor experience these elements create. Similarly, haptic stimuli experienced when writing influence letter recognition, as suggested by neuroscience studies (James and Gauthier 2006).

Consequently, a message conveyed by a piece of handwriting should be seen as rich and multifaceted. We propose to explicate the interplay of meanings involved in its interpretation by means of Peirce's three trichotomies: icon-index-symbol, qualisign-sinsign-legisign, rheme-dicent-argument. Thus, before conventional meanings of written words are discerned (symbol-legisign), other processes of interpretation take place. Taking a glance at the page, we get an idea of the rhythmicality of letters (icon-qualisign-rheme). Correct recognition of multiple variants of

a written letter is a skill of its own (icon-legisign-rheme). Some of these variants may be culturally specific or suggest a certain time period (index-legisign-dicent). It is also possible to gain knowledge about the circumstances in which the text was written: the tool used (index-sinsign-rheme) or the writer's psychological state, e.g., anger (index-sinsign-dicent). Such specific examples can inform more general observations: for instance, legisigns seem to correspond to conventional, culturally specific messages; sinsigns necessarily involve physical properties of the medium; qualisigns capture the aesthetic side of a grapheme. The iconic layer of interpretation refers to the recognition of familiar shapes; the indexical—to the recognition of a relationship between the sign and external circumstances; the symbolic—to the recognition of a sign as a realisation of a systematic choice (cf. Deacon 1997). Crucially, many modes of interpretation which are prominent in handwriting are not available or have become obscure in printed or digital media.

We advocate taking into account both the cultural history and the embodied characteristics of writing when planning literacy education strategies. This should not be seen as opposition to the digital change, but rather as an attempt to complement it, as, in fact, many of the existing conventions concerning print and typography also have roots in handwriting practices.

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Notes

