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Article

On Representation in Information Theory

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Abstract: Semiotics is widely applied in theories of information. Following the original triadic characterization of reality by Peirce, the linguistic processes involved in information—production, transmission, reception, and understanding—would all appear to be interpretable in terms of signs and their relations to their objects. Perhaps the most important of these relations is that of the representation-one, entity, standing for or representing some other. For example, an index—one of the three major kinds of signs—is said to represent something by being directly related to its object. My position, however, is that the concept of symbolic representations having such roles in information, as intermediaries, is fraught with the same difficulties as in representational theories of mind. I have proposed an extension of logic to complex real phenomena, including mind and information (Logic in Reality; LIR), most recently at the 4th International Conference on the Foundations of Information Science (Beijing, August, 2010). LIR provides explanations for the evolution of complex processes, including information, that do not require any entities other than the processes themselves. In this paper, I discuss the limitations of the standard relation of representation. I argue that more realistic pictures of informational systems can be provided by reference to information as an energetic process, following the categorial ontology of LIR. This approach enables naïve, anti-realist conceptions of anti-representationalism to be avoided, and enables an approach to both information and meaning in the same novel logical framework.

Keywords: dynamic opposition; interaction; logic, process; reality; representation

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1. Introduction

1.1. Rationale

Many semiotic theories of information have their foundations in the triadic categorization of phenomena and the related epistemology and logic of Charles Sanders Peirce. In his seminal book, *Cybersemiotics* [1], Sören Brier concludes that it is not possible to establish a foundation for a transdisciplinary information science without relating it to theories of cognition, communication, mind and meaning that span the humanities and social sciences on one hand, and the classical sciences, including a theory of evolution on the other. Peircean semiotics, combined with the concepts of autopoesis and second-order cybernetics are necessary for grounding new perspectives in all science, including that of information.

The subtitle of Brier's book, however, is *Why Information is not Enough.* By information, Brier here clearly refers to information of low levels of complexity defined as a set of true propositions or by Shannon-Weaver conceptions of entropy, definitions that fall far short of providing an adequate foundation for information science. Further, such information must be supplemented by concepts of cognition and communication, Central to the understanding of semiotics is the nature and function of a sign, and accordingly, in this approach, of the relation of *representation*.

At the 4th International Conference of Information Science in Beijing, August, 2019, I presented a paper [2] in which I made a critique of semiotic theories of information. The basis of my critique was my recent extension of logic to real process phenomena (Logic in Reality; LIR) [3], including "information" seen as a complex set of generation, transmission and reception processes.

In this paper, I use the principles of LIR to analyze the notion of representation in information and in general, in representational theories of the mind and as a core concept in semiotics. My thesis is that the concept of representation fails to capture aspects of the relations between elements of cognitive and other real processes that are essential to the understanding of information.

1.2. Outline of Paper

After a brief summary of the key principles of Logic in Reality (Section 2), I provide an overview of the discussions of representation in relation to several current theories of the mind (Section 3). In Section 4, I introduce the Peircean semiotic approach to information and the role of representation that I see as central to it. I indicate how my logical system offers an explanation of informational relations without the need for representation or mediation. As an alternative to the use of representations, in Section 5, I present an LIR view of information as process and as a natural operator. The paper concludes with a discussion of representation in the General Information Theory of Burgin, whose affinity with LIR he and I have discussed elsewhere [4].

2. Logic in Reality (LIR)

In [3], I presented a reformulation and update of the original work of the Franco-Romanian philosopher Stéphane Lupasco (Bucharest, 1900–Paris, 1988) in a book entitled *Logic in Reality.* Since then, through contacts and discussions, in particular with Wolfgang Hofkirchner, Pedro Marijuan,

Rafael Capurro, Mark Burgin and Gerhard Luhn, to whom I am very grateful, it has emerged, literally, that LIR may offer a useful framework for the discussion of information. This has led to a series of papers in which I explore the application of LIR to: (1) ethical aspects of information; (2) aspects of levels of abstraction and reality in information and most recently; (3) information as a natural and social operator, in addition to the one mentioned above. Since these are not yet widely circulated, I have provided here the minimum overview of LIR necessary for an understanding of my approach.

2.1. Fundamental Postulate and Components of LIR

The development by Floridi [5] of a *logic* of and for information (Information Logic; The Logic of Being Informed) began to fill a major gap in the current effort to characterize information, since standard propositional epistemic and doxastic logics fail to capture some of its essential characteristics. In [6], I referred to several of the remaining open problems in information to which Floridi called attention earlier [7]. I proposed an even more radical change in logical approach for their solution, by the introduction of a new *kind* of logic.

Logic in Reality (LIR) is a new, non-propositional logic that extends the domain of logic to real processes. LIR is grounded in particle/field view of the universe in which the fundamental dualism (dynamic opposition) inherent in energy is present in all real phenomena. The picture of the world that is used is one of different, physical levels of reality, at all of which LIR applies. As Capurro notes [8], technology, especially information technology, is "non-neutral", and hence LIR is appropriate to it, rather than standard logics that are virtually required to be topic-neutral and context-independent. The LIR axioms and rules provide a framework for analyzing and making inferences about complex real world entities and interactive processes at biological, cognitive and social levels of reality or complexity.

The term Logic in Reality (LIR) is intended to imply both: (1) that the principle of change according to which reality operates is a *logic* embedded in it, *the* logic in reality; and (2) that what logic really *is* or should be involves this same real physical-metaphysical but also logical principle. The major components of this logic are the following:

- The foundation in the physical and metaphysical dualities of nature
- Its axioms and calculus intended to reflect real change
- The categorial structure of its related ontology
- A two-level framework of relational analysis

Details of LIR are provided in [3]. Stated rapidly, its most important concepts are that: (1) every real complex process is accompanied, logically and functionally, by its opposite or contradiction (Principle of Dynamic Opposition; PDO), but only in the sense that when one element is (predominantly) present or actualized, the other is (predominantly) absent or potentialized, alternately and reciprocally, without either ever going to zero; and (2) the emergence of a new entity at a higher level of reality or complexity can take place at the point of equilibrium or maximum interaction between the two.

LIR should be seen as a logic applying to processes, in a process-ontological view of reality, to trends and tendencies, rather than to 'objects' or the steps in a state-transition picture of change.

Processes are described formally as transfinite chains of chains of chains, etc. of alternating actualizations and potentializations of implications, considered with the other logical operators, conjunction and disjunction as real processes themselves. The directions of change are either: (1) toward stable macrophysical objects and simple situations, the result of processes of processes, etc. going in the direction of a "non-contradictory" identity or diversity; or (2) toward a state of maximum contradiction (T-state for included third term) from which new entities can emerge. LIR is, therefore a logic of emergence, a non-propositional, non-truth-functional logic of change.

Standard logic underlies, rather, the construction of simplified models which fail to capture the essential dynamics of biological and cognitive processes, such as reasoning (Magnani [9]). LIR does not replace classical binary or multi-valued logics but reduces to them for simple systems and situations. The interactive relationships within or between levels of reality to which LIR applies are characteristic of entities with some form of internal interaction, biological or cognitive.

In contrast to standard logics, LIR has no difficulty in accepting inconsistency, interpreting it as a natural consequence of the underlying oppositions in physical reality. Many if not most of the problems in the (endless) debate about the nature of change seem to require a fundamental inconsistency in the world, which LIR naturalizes. Logic in Reality, then, is an information system that is not "brittle, like a classical logic system" ([7], p. 161) in the presence of an inconsistency. Inconsistency is in the former is not only not as destructive as in the latter, but is accepted as an essential part of its ontology.

2.2. An Initial LIR Approach to Information

Given its contradictorial approach to all complex real phenomena, LIR can be seen as a logical methodology that would encourage the retention and use of partially conflicting notions and theories of information, among others. LIR thus can provide bridging concepts or "glue" between the concept of semantic information at the lowest data level and broader applications. LIR places this concept, and thus Hofkirchner's "superconcept" [10] of information, in a naturalized physical, metaphysical and logical context. Information is both a means to model the world and part of the world that is modeled, and LIR describes the dialectic relation between them. Floridi found the concept that semantic information is true if it points to the actual state of the world somewhat equivocal, but I believe its fits the LIR processual logic, in that logical (in the LIR sense) information *is* the actual state of the world.

To repeat, Logic in Reality does not pretend to offer or to constitute an independent theory of information that would supersede any or all existing approaches. LIR provides a new interpretation of the concept of qualitative information or information-as-process (Brenner [2]) as contrasted with quantitative information.

Among the key open problems in the philosophy of information, Floridi [7] includes several concerning the relation addressed here between information and the actual world. In this view, information can be viewed from three perspectives: information *as* reality (e.g., as patterns of physical signals, which are neither true nor false), also known as *environmental* information; information *about* reality (semantic information, alethically qualifiable); and information *for* reality (instructions, like genetic information, algorithms, orders, or recipes).

Many extensionalist approaches to the definition of information *as* reality or *about* reality provide different starting points for answering the question of what information *is*, but theories of information require an understanding of the properties and role of information at all levels of reality, in all entities. Whatever contributes to this understanding must accordingly be valuable for philosophy in general, and I propose this paper as a clarification of the relevant *ontological* properties of information.

As I have noted elsewhere, the definition of information that is most congenial to LIR was made by Kolmogorov [27] to the effect that information is any operator which changes the distribution of probabilities in a given set of events. This is quite different from his well-known contribution to algorithmic information theory, but fits the process conceptions of LIR. In LIR, logical elements of real processes resemble (non-Kolmogorovian) probabilities, and the logical operators are also processes, such that a predominantly actualized positive implication, for example, is always accompanied by a predominantly potentialized negative implication. It is possible to analyze both information and meaning (Brenner [6]) as having the potential or being a mechanism to change the informational context.

2.3. Process, Form and Structure

The application of LIR to discussion of information and representation implies further fundamental differences in the terms "form" and "structure". Neither can be considered as a static entity but as a process constituted by energetic, causally efficacious elements in dynamic interaction. Against the potential objection that this concept blurs the distinction between energy as information and as a carrier of information and meaning, I would reply that such a distinction is neither desirable nor necessary, since the two aspects are themselves in a two-level, contradictorial or dialectical relationship.

3. Representation and Mind

The position taken in the last Section brings Logic in Reality into direct conflict with theories in which entities are introduced as being required to mediate between information and its object (the world), maintaining in fact the same dichotomy as that between mind and world. I thus have adopted two primary strategies in my general approach to information. The first, to be discussed in detail elsewhere, is to show that the categorization of the world made originally by Peirce and retained in Brier (and with some modification in Hofkirchner [11]) cannot be justified on scientific grounds. Arguments based on the alleged properties of a category are valuable in classification but have no explanatory power. The second is that the basic semiotic concept of a sign as a representation, something standing for something else describes only inert properties of phenomena as symbols or symbolic operators, that is, abstract entities which do not involve energy nor evolve in time (the same thing). I will first compare the LIR theory of mind with some standard theories.

3.1. The LIR Theory of Mind

The LIR contradictorial picture of the operation of the human mind is a *form* of identity theory of mind that avoids the difficulties of both standard identity and dualist theories by the introduction of the principle of dynamic opposition at all levels of perception, mental processing and action. It is based on The LIR epistemological approach which is to analyze the details of our acquisition of perceptions and

effectuation of actions into actual and potential components. In the LIR theory of mind, afferent stimuli are "split" into conscious potentialities and unconscious actualities. Thus while your mind is physically external to mine, some of its perceptible potentialities can be internalized by me, perhaps by mirror neurons in the concept of Ramachandran. At all levels of reality, I will assume that there is a dynamic opposition between epistemological elements and the energetic processes to which they correspond. I may and in fact always will focus on one or the other aspect, but what I have called a contradictional relation is present, one aspect is actualized while the other is potentialized.

In general, accounts of mental processes suffer from the need to introduce representations as additional entities due to the lack of a principled categorial method of relating its critical dynamic processes contradictorially. LIR is such a method. No new, independent entities of the kind postulated in the various forms of representationalism are required, due to the availability, in LIR, of the dynamic relation between internal and external, actual and potential and identical and diverse aspects of phenomena. It is the alternating actualizations and potentializations derived from initial energetic inputs that *are* our ideas, images, beliefs, etc. Some further phenomenological classification of these process elements (such as that made by Husserl) is possible, but it does not change the overall structure of my proposed picture. A mental phenomenon, which is not something other than the physical processes with emergent properties 'displays' its contradictorial origins in appearing to have symbolic and non-symbolic aspects, and being closer or farther from the center of attention at a particular time.

3.2. The Major Approaches of Cognitive Science

The major, related approaches of cognitive science to the phenomenological data of human mental processes are the following:

- *Representationalism*, according to which internal mental entities stand for or correspond to real external properties and events. Representationalism includes the next two approaches, in which the entities involved are the symbols and properties respectively.
- *Computationalism*, the view that thinking is basically a form of computation ion the sense of computer science, an algorithmically determined process of manipulation of symbols in a neural network;
- *Connectionism*, which sees cognitive function as the operation of the system of neural networks, not with isolated symbols, but with vector distributions of properties according to a dynamical model and following rules for non-linear dynamic systems.

In standard representationalist theories of mind, internal entities of some sort stand for or correspond in some way to external processes and events. These mental representations explain or are explanatory devices for cognition in that they are, or correspond to (this vagueness is typical) intentional states, instances of intentionality considered as embodying the irreducible first-person properties that are alleged to characterize consciousness, reasoning and qualia. The focus now shifts, therefore, to intentionality and the representation of intentional states. I will not reproduce the relevant theories in their entirety, some of which are derived from Husserl and more recently from the intentional realism of Fodor and the computationalism of Dretske. I will discuss primarily the former.

The mental elements involved in cognition are mental states that possess intentionality, defined as being a relation of aboutness. Intentional content is the referent of the aboutness relation, the object, and is contrasted with the type of intentional state—belief, desire, wish, etc. In Fodor's intentional realism, a cognitive process is a causal sequence of intentional states. However, such states are not physical properties in the usual sense. To naturalize the initial intentional state, to which causal efficacy is ascribed, it is first transformed into a representational one, and this subsequent representational reconstruction is naturalized. The former is characterized as a symbol, similar to a linguistic symbol, but its intentionality is given by the original intentionality of the mental state. In other words, intentionality is identified with the semantic properties, including the capacity of physical causality, of a mental representation.

The language-of-thought hypothesis adds the concept that the system of mental symbols constructed above has a language-like structure, but the fundamental premise remains that a mental representation is a symbol, where a symbol is defined as something standing for something else, as noted.

The first step of the Fodorian construction, however, implies that mental state and symbolic mental representation are identifiably separate entities, and in addition the second always exists in the relation between the state and the object. In other words, the idea that mental states could relate directly to objects without intermediaries is excluded. This depends on the idea that if a symbol makes a relation with something else possible, and is accordingly also an element, an intermediary one, all such relations must *eo ipso* be indirect. This is explicitly stated in Hofkirchner ([11], p. 69). On the other hand, this is in contradiction with the accepted idea that some mental states are intuitive and accordingly in a direct relation with an intentional object.

Although I do not subscribe to this theory, if the principles of LIR *were* applied to it, a mental representation could have a direct *and* an indirect relation to the object, but not at the same time, in the usual manner. The difficulty with this picture, however, is the difference in treatment of mental states *vs.* intuition, which some people might consider a fiction. In the LIR view, intuitions, as diversities, and more permanent or salient mental states, as identities, are related contradictorially. *The real existence of intuitive processes provides an argument against Fodor and against the introduction of what in my view is an unnecessary additional entity into the causal chain.* Following Bennett and Hacker (see below), this is my basic argument against the introduction of representation in semiotics and semiotic theories of information.

As discussed by Roy [12], the approach of Husserl was to separate the intentional act (process) into two components–matter, defined as the element responsible for establishing the intentional relation with the object, and quality, which designates features of the act having the property of being irrelevant to the individuation of the intentional object.

The process as described by Husserl is not so different from that in Fodor: it is the representation (representative content) that mediates the relation between the matter of the intentional act and its object. Every intentional state is conceived as a relation with one entity mediated by another. Since, however, Husserl does not give up the distinction between the symbolic and the intuitive, he retains the idea that what distinguishes a symbolic intentional state is its indirect structure. On the other hand, Roy suggests that what Husserl meant was that "to apprehend a representative content intuitively means to interpret it in such a way that the resulting intentional correlate is considered the object itself. In turn, this means that the object is apprehended as being present. But how is the notion of presence to be

understood here?" The only way out is to consider that an intentional relation with an object can be "symbolic" but not involve the mediation of a symbol. The essential nature of the difference between symbolic and intuitive intentionality has something to do with one being "present", (and presumably, accordingly, the other being "absent").

The unresolved difficulties in the relation between intuition and symbolic intentionality led Husserl to the postulation of still more relations and processes that I will not discuss here. I simply restate the problems with the Fodorian picture, namely, how and where a symbol is to intervene and what, accordingly, are the properties of symbols. As Roy shows, however, the essence of a solution is to be found in the early work of Husserl himself. He observes that representative content interpreted by the "matter of the act" does not have the status of an intentional object: We are not conscious of our sensations in perception. Although sensations become presented objects on psychological reflection, intuitive presentations are components of representative experience but are not at all its objects.

Again, in the LIR epistemology, the difference of status between a representative content, in this picture, and a symbol can, first, be connected with the shift of attention that accompanies the movement from consciousness to consciousness of consciousness, as originally proposed by Lupasco [13]. Further, however, the underlying intuition is that representative content, although it is in a sense an intermediary in the intentional relation, is something other than a symbol because a symbol is an intended element as defined. What is this "something other"? Is LIR a representationalist theory or not?

My answer is that we are dealing here, as usual, with a dialectics between the appearance of an isolated representation and the underlying, deterministic reality of the physical phenomena themselves.

3.2. State Context Property (SCOP) Formalism

In their State Context Property (SCOP) formalism, Gabora and Aerts [14] give further details of a non-deterministic change of cognitive state under the influence of a context, involving a "before and after" categorization. Their idea that the conceptual equivalent of a state p that is a superposition state with respect to a context e collapsing to a state q that is an eigenstate with respect to e but a superposition state with respect to a new context f is reminiscent of my description of a phenomenon A and its contradiction non-A giving rise to a new state that is the T-state or emergent included middle. Also, in LIR, change of state (or simply change) is context dependent and that accordingly, as here, the probability distributions that I have associated with the degree of actualization and potentialization are non-classical. The authors describe the contextual manner in which concepts are evoked, used and combined to generate meaning.

Despite the difference in starting point and terminology, from the Gabora-Aerts work, it is again clear that the LIR approach is not a representational theory, in which concepts are seen to take the form of separate mental representations.

3.3. Representation and Interactivism

Interactivism, the interactivist model of representation developed by Bickhard and his associates [15], is essential to the debate on the nature of representations since it purports to link representation, anticipation and interaction. In interactivism, anticipatory processes are emergent and normative,

involving a functional relationship between the allegedly autonomous organism and its environment. The resulting interactive potentialities have truth values for the organism, constituting a minimal model of representation. A representation, whose evolutionary advantages would appear easy to demonstrate, is of potentialities for future action or interaction by the organism, and Bickhard shows that standard encoding, correspondence, isomorphic and pragmatic views of representation, such as that of Drescher, lead to incoherence.

A major problem with the interactivist view is that it still defines its validity in terms of the truth of propositions, without regard to the underlying real processes that constitute existence. Unfortunately, representation as postulated by Bickhard and his followers in my view continues to ignore its dynamic ontological requirements. The theme of a recent conference[1] is that "the notion of representation is essential for the project of naturalizing (sic) the mind and meaning" and the question is asked as to whether "mental representations are propositional or image-based, connectionist, analog or digital". Their existence seems not to be a major issue.

Accounts of mental processes, these and others, suffer from the need to introduce representations as additional entities due to the lack of a principled categorial method of relating its critical dynamic processes contradictorially. In the LIR conception, a mental phenomenon, which is not something other than the physical processes with emergent properties, "displays" its contradictorial origins in appearing to have symbolic and non-symbolic aspects, and being closer or farther from the center of attention at a particular time.

3.4. LIR and Representationalism

There is a vast literature on the subject of representation in philosophy, cognitive and social science. There has been and still is a major debate between supporters of the existence and functionality of representations in cognitive processes (representationalists) and their opponents (anti-representationalists). As I will show, Logic in Reality supports anti-representationalist positions, while avoiding the skeptical, ironic and anti-scientific dogma which often accompany them.

I would first like to observe that the potential problems associated with representation and the representation relation seem to have received relatively little treatment in current semiotic theories of information. The simplest explanation is that the concept of representation as both necessary and fully understandable in semiotic terms is taken for granted.

Perhaps superficially, I consider that the anti-representationalist/representationalist debate leads to an admission of failure. As suggested by Haselager *et al.* [16], cognitive science has no empirically applicable means of answering the question of Cliff and Noble "…if evolution did produce a design that used internal (mental) representations, how would we recognize it?" As these authors point out, the fact that in several disciplines scientists use a representational vocabulary when talking about the systems they analyze is not enough to establish the presence of representations that as such and in virtue of their content do causal work. In fact, in semiotics we are generally told that doing causal work is not among the tasks which signs are required to perform. The problem is whether if this is the case, signs can provide the foundation of information.

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[1] Varieties of Representation: Kazimierz Naturalist Workshop, Kazimierz Dolny, Poland, September, 2011.

Boros [17] has provided a good summary of the origins of anti-representationalism in the work of Rorty and its support by Davidson, but their neo-pragmatist arguments depend for their validity on the rejection of any form of realism. As Boros writes: "Anti-representationalism does not try to see the world as it is, it does not investigate knowledge or accurate representation of reality, since in every statement about the world there is an inseparable "mixture" and "cohabitation" of the subject and the object. That means if we think we know something about the world, we can never exactly make a distinction between what part of it comes from us and what part comes from the "outside world".

Logic in Reality cuts through the simplistic anti-representationalist view by providing a principled basis for the interactive processes that occur in cognition, especially, the categorial *inseparability* of subject and object. LIR sees no reason for a requirement of absolute knowledge, in any case impossible, of an absolute difference between internal and external that in any case does not exist.

Rorty rejected the separationist representational model of knowledge and preferred to think of its acquisition as a continuous interaction between human beings and the outside world. However, he at the same time made no distinction between objects as they appear and as they are in themselves, claiming that it makes no sense to think about them substantially and hence that traditional philosophical questions should be rejected.

The astute reader may see, at this point, that the LIR arguments against both representationalism and anti-representationalism are very similar! LIR gives a basis for a principled, non-reductionist realism that rejects the arbitrary, abstract aspects of both. It supports the (rather timid) view of Chemero that "cognitive science can do, at least in part, without representations" [18].

My view of representations is supported by Searle, who states specifically that reality (which I hope includes information) is not *logically constituted* by representations; there is no logical (or physical) dependence. "Representations are one thing; the reality represented another" [19]. Searle criticizes the doctrine of autopoesis of Maturana and his followers, who rejected any objective reality, saying that "from the fact that our knowledge/conception/picture of reality is constructed by human brains in human interactions, it does not follow that the *reality* of which we have the knowledge/conception/picture is constructed by human brains in human interactions". Among other things, this concept results in a vicious circularity. Searle's view is consistent with the LIR designation of representations as appearances, causally effective only in their energetic, that is non-semiotic, relation to reality in subsequent mental processing.

3.5. The Neuroscientific Basis for Anti-Representationalism

I should also call attention to the joint work of the neuroscientist M. H. Bennett and the philosopher P. M. S. Hackett. In their massive document, *Philosophical Foundations of Neuroscience* [20], these authors show how virtually *all* of the standard modern approaches to mental entities involve some form of confusion, to use their word. I consider their positions as *incontournable* for any adequate science of mind, consciousness or information.

The Bennett and Hacker approach is basically to focus on the human being as a psychophysical unity, avoiding the mistake of both neuroscientists and others in attributing perception, thought or knowing to the brain or its parts, such as its hemispheres. In the LIR view, such confusions are the consequence of the separations which have been the unavoidable consequence of applications of

standard logics. I outline the authors' major conclusions with regard to several constructions in addition to representation for comparison:

- Mind and Self

The self, defined as something that is identical with me, as something I have or as something in me is an aberration. There is no such thing, and "I" does not refer to an "Ego" owned by me. One has, as arguments, the formal one from infinite regress and the phenomenological one from our existence as human beings, not brains or minds. There is no such thing as my perceiving, rather than having, my own thoughts. The LIR appearance/reality dialectics is useful here. The mind is not an entity or a thing or a "domain"; this term refers idiomatically to a wide range of human powers and their exercise.

- Representation

It is a mistake to say that what we or some "mind" perceive is an image or representation of an object or that perception involves *having* an image of the object. The so-called binding problem is a false problem, since the brain does not construct a perceived world, but enables an animal to see a visible scene. Damasio was mistaken in his distinction between having and feeling an emotion, as if emotions were some sort of somatic image or marker.

- Qualia

The concept of qualia was introduced to signify the alleged private character of experience, its phenomenal qualities or qualia for short. This led to Nagel's strategy of explaining the subjective or qualitative feel of experience in terms of their being something it is like to have it. However, as Bennett and Hacker show, neuroscientists such as Damasio and Edelman shift the sense of the term quale from the qualitative character of experience to the qualitative character of objects. The term quale equivocates between what it is like to have an experience and the experience itself. The indexical approach clarifies the problem, although in the LIR conception of human psychological types, it will never convince everybody. The question "Why is seeing red like seeing *this* (Wittgensteinian pointing to a sample) is misguided because seeing red does not *resemble* seeing *this*, it is seeing this. The alleged incommunicability of the subjective qualities of an experience is confused. One cannot describe a quality in the same way as one describes an object by specifying its qualities. A description is not a substitute for experience, and a better vocabulary seems needed in any case.

- Zombies

Explaining phenomenal qualities, in David Chalmers' view, is just the problem of explaining the conscious mind. The whole literature on zombies, *pace* Chalmers, is thus also misguided. If zombies without consciousness are logically possible, then some or all of our fellow human beings might be zombies. But this is absurd: it is not a hypothesis that other human beings are conscious, and it is not an inference, based upon one's knowledge of one's own consciousness. It is science. The only argument that holds is that *all* of us are *sometimes* zombies, when we, from time to time, function

automatically in a waking-dream state or a similar state that is in any event not predominant; it would be pathological if it were, and arguments from pathology are non-extendable.

As a corollary of this naturalistic, causal-role theory of mental content, LIR provides a naturalistic means of drawing the analytic/synthetic distinction [3]. This is because LIR *always* defines a real interactive relation between the intensional notions or aspects of a phenomenon and the extensional ones. Kaye [21] claims that his causal role theory of content identifies the meanings of representations in the brain with the causal relations of representations that are determined by their structure and by the structure of cognition. Despite the incomplete knowledge of the details of the causal relations within our mind/brains, LIR theory of mind defines the operation in them of dynamic opposition as a structural or better structuring principle, *sans* representations. With this background on the LIR view of representation (or the lack of it) in cognitive processes, let us turn to the situation in semiosis.

4. Representation and Semiosis

At first sight, the semiotic approach to information might appear to capture its multiple facets, ordering them into the functional categories proposed by C.S. Peirce, and Brier has provided a complete current interpretation of Peirce in [1].

Peirce based his theory on the categories of Firstness (possibility), Secondness (existence) and Thirdness (reality), without the requirement for radically different ontological domains. The "First" is a "Sign" or "Representamen" which is in a genuine triadic relation to a "Second", called its "Object" so as to be capable of determining a "Third", its "Interpretant" to assume the same triadic relation to its Object in which it stands itself to the same "Object". The term "Sign" was used by Peirce to designate the irreducible relation between the three terms, irreducible in the sense that it is not decomposable into any simpler relation, such as some form of part-whole relation.

The standard Peircean definition is used of semiosis as a process of meaning making, of construing a material entity or phenomenon as a *sign*, rather than simply interacting with it energetically: "semiotic interpretation differs from simple physical interaction". One could consider information and meaning as energy here, but the *distinguo* is not trivial; meaning is at a higher level of interpretation in its including of "meaning for". This is the essential distinction between information considered in the sense of Shannon as simple negentropy and what Logan has called instructional or biotic information [22]. Standard logic is applicable to the first since it represents only the non-contradictory aspects of diversification. The second requires LIR since it involves emergence and meaning.

To make this difference more specific, it should be clear that Logic in Reality is a logic of change, perhaps the only one. Real, energetic change involves the caused appearance of new entities, and to the extent that higher-level information and meaning emerges from lower-level information or data, such non-Shannon information is a new entity, instantiating "newness". (Such newness may be of interest *per se*, but this does not concern us here.) As discussed further in Section 4.1 below, semiotic signs, whatever else they may be, are not required to characterize the informational aspects of dynamically evolving systems.

Thus as might be guessed from my previous comments on dualism and emergence, I do not fully accept the Peircean theory, which I consider insufficiently dynamic, despite the common interpretation that the relation is dynamic because it leads to "chains of triads". I think this because there is no energy

that can be assigned to the triadic relation that would give it a basis in reality (physics). I see the same problem [2] with Peirce's categories as with the Hegelian triad of thesis, antithesis and synthesis: there is no deductive basis for the movement from one term to the other or a description of any physical interaction between them. If the argument is made that nothing of the sort is required, my response is that is exactly the problem—the terms are not physically grounded and hence have limited explanatory value other than as a heuristic device for keeping track of the entities involved in biological and informational processes; its use should not make one neglect the real properties of the system.

The Peircean semiotic concept of information has been summarized by Quieroz, Emmeche and El-Hani [23] (QEE) as a "triadic dependent" process where a form is communicated from an Object to an Interpretant through the mediation of a Sign. My critique of this approach is that as stated by Peirce himself, it is derived from a *formal* science of signs that provides an *analytical* framework. Thus the QEE approach to information as process is constrained by the abstract characteristics of the Peircean categories, that is, their abstraction from dynamic aspects of real physical phenomena.

In contrast to QEE, I derive the triadic characteristics from the LIR view of the contradictorial evolution of all real processes, providing the physical basis for the QEE differentiation of potential and effective (actual) semiosis and consequent definition of potential and effective *information* as well. In LIR, information is a complex of processual interactions with both binary (dyadic) and ternary (triadic) properties, all of which can be predominantly actualized (effective) or potentialized (not effective) at any time. An example of elements of these processes would be the conflicting messages as to a real state-of-affairs of some catastrophe. This characterization would seem preferable to the concept of a Sign as a Medium for communication of Form.

The essentially static linguistic definition of Form in terms of "conditional propositions" states that certain things would happen under certain circumstances. Strikingly, as quoted by QEE, Peirce said that "*Form can also be defined as potentiality (real potential:* (EP 2.388)" (emphasis mine). In LIR, structure and form are also physical processes, including the physical processes of their conceptualizations. Form is characterized not as "potential" only, but as a process whose elements are both actual and potential at the same time.

LIR confirms the QEE critique of the argument by Jablonka that "for a source to be an information input rather than merely a source of energy or material, its *form*, or variations in its form, rather than any other attribute should affect the interpreter's response in a consistent, regular way". Here, a distinction has been created according to which form is idealized as something non-energetic, but still with causal properties. To say that form is also energy is not to make a physicalist reduction, but to avoid conceptualizing it out of existence.

4.1. Signs

Semiotics is a theory of representation—it is things standing for other things, clearly to be distinguished in some views (see for example Quieroz and El-Hani [24]) from "reactive", that is physical systems, composed of "Dynamical Objects". In a sense this is exactly the problem I address: the semiotic relation is one of "standing", that is inactive and causally and physically inert. The LIR thesis can be illustrated, if not proved, by reference to a citation by these authors from Peirce ([24], p. 15): "…we have to distinguish the Immediate Object, which is the Object as the Sign itself

represents it, and whose Being is thus dependent upon the Representation of it in the Sign, from the Dynamical Object, which is the Reality *which by some means contrives to determine the Sign to its Representation"* (CP 4.536) (emphasis mine). For me, this statement is an implied disavowal of a purely semiotic concept of the representational relation.

The issue only arises if representation is supposed to be about a processual change, otherwise the concept is satisfactory. If it is the sign relation—a member of parliament "officially" represents his constituents, it is trivial. What is not trivial here is the causally efficient group constituted by the elected official and his electorate. In this case, complex interactive processes between them are involved, and their dynamics depend on many other factors, the socio-political context and so on [25]. What is common to all types of signs is that they are all ontologically subordinate to the existence of what they are a sign of, that is represent. In a simple definition of a representation, for example, as a theatrical performance, the term is simply a shorthand synonym for a play involving fictitious characters, a plot, *etc.*

Let us make this critique more direct by looking more closely at the kinds of signs defined by Peirce: A sign or Representamen is something which stands to somebody for something in some respect or capacity, and Peirce classified signs, *in his earliest work*, into three groups: icon, index and symbol, based on the different relations between a sign and what it represents. An icon represents something based on the resemblance between a sign and its object; an index represents something by being directly related to its object; and a symbol represents something by convention. In later work, Peirce complexified these distinctions, even collapsing them into a concept of a sign that displays all three characteristics (Short [26], p. 227).

I will not discuss further the extremely complex taxonomy of Peircean signs and the multiple changes in interpretation and application they underwent. At one point in the Peirce's development of his theory, as mentioned by Short, the only true, genuine or complete sign seems to have been the symbol. Other signs may be incomplete or composite, but as far as I am concerned, the critical relation of representation remains unchanged for all of them. In complex human situations (a lawyer representing his client), the abstract formal relation of representation will always be accompanied by an underlying dynamic relation to which the ascription of the term "sign" is superfluous. One might say that if a relation moves and changes, it is not, or not only, a representational relation. What I mean by "not only" is that I am perfectly aware that the concept of representation is strong and compelling. It is not going to "disappear" as a consequence of this paper. I wish only to suggest the utility of its being understood in dynamic terms, in other words, our representation of a thing must be seen as a "thing" (process) in itself. Deacon [32] correctly criticizes notions of representation and meaning when they are collapsed into something like a physical pattern as being reductionist, but a physical pattern or structure in LIR terms does not suffer from this drawback, as indicated in Section 2.3 above.

5. LIR and Information as Operators

5.1. Information as a Natural Operator

In his recent book [28], Burgin has presented an extremely complete approach to a General Theory of Information (GTI) based on a thorough analysis of information processes in nature, technology and

society. In particular, Burgin gives an extensive treatment of how information is modeled by mathematical structures. As Burgin and I have shown elsewhere [4], Logic in Reality supports many of the conceptions of the properties of information in the GTI.

I am now in position to offer a "non-representational" logical (in my extended sense of logic) theory of information that complements the semiotic, "representational" theory. The essential binding of the two terms is indicated in Quieroz and El-Hani ([24]). With Burgin, I claim that it is necessary to see information, better the information generation process not as a symbolic operator but as a natural and social operator. In the General Theory of Information of Burgin, information is characterized by a system of principles [28]. The second of his Ontological Principles, the General Transformation Principle O2, describes the essence of *information* in a broad sense as the potential (capacity) of things, both material and abstract, to cause changes (transform) other things. When this capacity (potential) is actualized, it becomes a nature or technology *operator*, which acts on different systems. The operational essence of information is further emphasized by an Ontological Principle O5, the Interaction Principle, which states that transaction/transition/transmission of information takes place only in interaction. Thus, it is reasonable to distinguish *potentialized and actualized* components of information, whose evolution follows the pattern of Logic in Reality, as discussed above. Energy is information in a broad sense, according to the Ontological Principle O2, and thus the most basic natural operator. From this point of view, natural information operators are present in all natural systems. Also, information exists in the form of *portions of information*. A portion of information, for Burgin, is or can be considered (treated) as a separate entity. For instance, information in a word, in a sentence or in a book is a portion of information, and each such portion is an operator in its own right.

In the language of LIR, it would be more appropriate to say that since process elements are the information themselves, "portion" refers to the energy of the element that is more or less actual or potential, as the case may be. It is important to state in this connection, however, that the categorial feature of Non-Separability operates both within and between ontological levels of reality or complexity. The rules of the LIR logical framework are the same, and they will apply to both basic information-as-process and to the emergent higher-level meanings that can involve different receivers.

A further consequence of the LIR process approach to information is that words are not looked at in isolation but in a context of their actual transmission and reception as *non-abstract* entities by specific actors. By the LIR Axiom of Non-Identity, no real phenomenon at one time can be identical to that phenomenon at another time. The possibility of differences in the meaning of the allegedly "same" word follows naturally.

5.2. Representation as a Symbolic Operator

Against this background, it would appear more useful to consider signs (and representations) as symbolic or symbolic operators in the sense of [4] in contrast to natural operators. Natural operators, such as those of LIR, may embody intentionality and meaning, and some can be considered as processes in their own right. However, once established, symbols and symbolic operators have only the capacity to cause abstract changes, and they are invariant, never with a specific meaning of their own.

It is often claimed by proponents of the semiotic stance that "man is a sign of himself", and if we agree that man has meaning, the claim would negate my position. In fact, viewing man (or any natural

process) as a sign is a process of linguistic abstraction, resulting in "abstracting away" its dynamic properties and projecting the remainder into a representation space of lower dimensionality.

I conclude, therefore, that semiotic representation is one way of characterizing or classifying the elements of language, but that it should not be made the part of the foundation of information. This statement is in agreement with the view of Deacon [29] that "semiotic theories have tended to be predominantly phenomenological taxonomies rather than dynamical explanations of the representational processes of natural systems." In the LIR conception, informational processes and relations depend directly on the contradictorial (oppositional) properties of the real systems that are involved in its production at both cognitive and non-cognitive levels of reality. In LIR terms, representation is an *appearance* of which the underlying *reality* is an evolving dynamic system. The two are connected dialectically to the extent that when the sign, as appearance, dominates the perspective (is actualized), the existence of the reality is potentialized and *vice versa.* The point is not to ascribe to representation an ontological status and functionality it cannot have.

6. Representation in Burgin's General Theory of Information (GTI)

In his GTI referred to above [28], Burgin discusses three aspects of representation in information that are relevant to this paper:

6.1. Infological Systems

An infological system plays the role of a free parameter, providing for representation in this theory for different kinds and types of information. The concept of an infological system, in general, is not to be limited by an exact definition. Identifying an infological system IF(R) of a system R, one can define information relative to this system, that is, the conceptual *locus* of the interactions that constitute the information processes in progress. This definition is expressed in Burgin's Ontological Principle O2g (the *Relativized Transformation Principle*): information for a system R *relative to the infological system* IF(R) is a capacity to cause changes in the system IF(R). On the other hand, Logic in Reality attempts to avoid a dichotomy between information and the broader context or system in which it operates. Thus, one must include in the discussion a process that is the obverse of the above, namely, the capacity of information (once represented, so to speak) for causing changes in R. Similarly, Burgin discusses representation as a structural information quality dimension, specifically, in the action dimension, together with user and information, and in the interaction dimension, which includes context in addition. The properties of representation are not indicated in detail, but I suggest that they are not fundamentally different from those defined in the semiotic theory outlined above.

6.2. Phase Representation Spaces

A standard definition, given by Burgin, is that a system R is represented in a space L when states or phases of R correspond to points of L. It is possible to give a dynamic interpretation to a phase as a process in progress in R, but the examples provided refer to processes *without* dynamic opposition, that is, they do not involve mutual interaction and change.

When the concept of representation space is applied to information, an algebra of representation spaces for cognitive infological systems, can be developed. However, the major discussion is related to propositional systems, state transition systems and static and dynamic phases where even the dynamic states are bivalent as above. All of these can be described by standard logic, without reference to the interactive evolution for which LIR is required. The representational relation is thus adequate for semiotic analysis, but suffers from their limitations I have discussed.

6.3. Information Representations

Burgin distinguishes information carriers and information representations: "An information carrier only contains information, while an information representation contains and represents information". Information representation is further stated to follow a number of additional ontological principles which serve to carefully delineate the epistemological but not the dynamic properties of information.

However, Burgin's Ontological Interaction Principle O5, which refers to the interaction of a carrier *C* with the system *R*, does not seem to require the postulation of an intermediate "representation". I therefore conclude with regard to this GIT that the concept of representation used remains equivocal: either something represents (stands for) something else in a simple, non-dynamic epistemic relation or two elements themselves are in a dynamic relation and do not need to be mediated by something between them, as in the discussion of representation in general above.

6. Conclusion

Based on my proposed new Logic in Reality, the major conclusion of this study is that, given the equivocal, paradoxical nature of representational relations and entities, their use to date in information theory complicates and misdirects the understanding of information processes. To the extent that semiotic theories of information depend on such entities and relations, their application may be restricted to that of symbolic, quantitative and largely abstract information spaces. In my view, the elements of semiotics (signs, representations) are in reality only abstract symbolic entities, incapable of dynamic interactions, symbolic and not natural operators. Representation is at the heart of semiotics, and thus if my ideas are relevant, they may offer a useful perspective on the foundations and scope of semiotics.

I have proposed an alternative approach to a realistic understanding of information that does not depend on semiotic signs and representations, but nevertheless fits with a number of current theories, such as that of Marijuan [30], which emphasizes its biological, qualitative and value-laden aspects. The trend today is toward what I might call a "weak pan-informationism" as it appears in the work of Floridi, Burgin, Wu, Markov, Hofkirchner and others. Most importantly, These authors do not seek to imprison information in a single all-encompassing definition but envisage a transdisciplinary metatheory or metaphilosophy (Wu, [31]) of information, unified only in the sense that it would be constituted by many non-reductionist approaches that would co-exist and inform one another.

Open questions which a theory (or theories) of information embodying the dialectical principles of Logic in Reality should answer include the following: if information is constituted by processes, does it make sense to require that these processes can be measured, and if so how? How can the qualitative properties of information be formalized sufficiently to naturalize them, that is, bring them into science?

Can the evolution of processes seen as chains of implications be placed on a more familiar mathematical basis? In particular, can the concept of potentiality in LIR, which implies partial absence, be related to Deacon's view of information and representation as dependent on specific absences in their dynamics? Work to answer these questions is in progress.

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