

TOWARDS A FRAMEWORK THAT MODELS THE EMERGENCE OF MEANING STRUCTURES IN PURPOSEFUL COMMUNICATION ENVIRONMENTS: APPLICATION IN INFORMATION SYSTEMS

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ABSTRACT

So far, meaning constitution and processing in artificial information systems has been supported either by merely rule-based local and distributed algorithmic processes, or by purely dynamic processes of self-organization. These approaches differ due the fact that the former accepts the need of representations which are viewed as sequences of symbols being manipulated by externally given apriori rules, while the latter tries to understand natural cognitive systems from the perspective of dynamics, and keep at the same time, a non-computational and non-representational stance. Both these cases are characterized by the inadequacy to handle the emergent phenomena that characterize complex information systems, since they either process information based on static meaning structures, or their internal variety and discrimination ability cannot exhibit open-ended evolution. On the other hand, meaning structures may emerge in a communicative/cognitive framework that supports interaction. In this paper, an inclusive systems theoretic framework which supports the emergence of meaning structures from the semiotic interaction of self-organized cognitive systems is investigated, in terms of its main components and their relations. It is argued that representations are a necessary element in meaning-based interaction, but they should be defined with respect to, and in the context of, the semiotic behaviour of a system within an environment. It is believed that the richness of the discussed framework can offer fresh impetus to the design and implementation of meaning-based evolving information systems.

Keywords: meaning, intention, semiosis, interaction, information-systems.

INTRODUCTION

Contemporary information systems research is focused on tackling the enormous quantity and complexity of information involved in these systems. This has led to the need of adopting techniques from other disciplines (such as artificial intelligence, artificial life, cognitive science), which seek to analyse and reproduce human cognition, in order to enrich systems with intelligent decision support subsystems. An important outcome from these disciplines are their results on the design and implementation of autonomous agents and indeed, they have primarily concentrated on the building of agents based on the cognitivist/connectionist or the dynamical and emergent paradigm.

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However, inadequacies in these approaches have been noted by many philosophers and researchers (Searle, 1990), (Harnad, 1990), (Dreyfus, 1992), (Prem, 1995), (Ziemke, 1999), (Brown, 2002), etc. The problem is centered around the notion of 'meaning' and its generation and manipulation in the artificial information systems. Although many frameworks have been proposed, the problem of intrinsically generated meaning in an information system, so that it can adapt to its environment, requires a holistic and systemic approach. Solutions that separate the system from its environment, or postulate a system that is capable of evolving its own, do not seem promising.

A framework which supports such an inclusive holistic and systemic approach has been proposed (Brier, 1996, 2001), where cognition, information and communication have to be unified under the concept of semiosis, and especially the Peircian sign processes (Peirce, 1958), in order to better understand the dynamics of meaningful interaction. Brier argues that such a framework will give us a better understanding and conceptualization of how meaning and signification function in adaptive systems. Although there is evidence that signification and meaning emergence can be found in all levels of evolution (Emmeche, 1992), (Hoffmeyer, 1996), (Pattee, 2001), (Taborsky, 2001), we believe that the cognitive and the communicative level are enough to provide a rich framework which will support the emergence of meaning in artificial adaptive systems.

Therefore, we attempted to find the basic structure and relations of a framework which will connect a phenomenological theory of meaning with the self-organizing dynamics of 2nd order cybernetic systems, through the information realm that is provided by semiotic processes. Since meaning-driven interaction cannot be either studied or propagated outside of a communication framework, we consider that meaning structures are communicated in a Luhmann's socio-communicated system (Luhmann, 1995), by means of semiotic processes.

This paper begins with a critical description of the underlying theoretic frameworks regarding the development of adaptive (human-like knowledge) systems. It would appear that so far, either the system is designed top-down or bottom-up, its 'intelligence' is based on the ways the designers have decided to connect the system's internal states with its environment (meaning mapping). As has already been stated, the problem is concentrated on the lack of intrinsic meaning and intentionality. Based on Husserl's theory of intentionality (McIntyre and Smith, 1982) we continue, by defining a basic structure of the states of a genuine meaning-based system, from which it is shown that meaning and intentionality are inseparable, and also that, representations are needed for intentional behavior. Such a combination is not easily accepted by the advocates of 2nd order cybernetics and especially autopoiesis, which can see information only in the realm of structural coupling, for which no representations are needed. Furthermore, Husserl's structure of intentionality does not have the flexibility to be easily incorporated in the framework of 2nd order cybernetics. This is the point where the Peircian sign processes may provide the mechanism for the intentional and meaning-based interaction and communication of such systems with their environments. With the implication of

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semiotic processes, it can be shown how information can drive the meaningful and intentional interaction of these systems. Since meaning has to be seen in its pragmatic aspects (and not only in its generation place), as well as in its communicative horizon, we outline the fundamental properties of Luhmann's meaning-based socio-communication systems. As meaning is an interplay between psychic and social systems, we endeavour to show that Peirce's sign processes are suitable for doing so. Although the resulting framework, can in no way can be said to fulfil all aspects of the abovementioned theories, it offers important components and structural relations in order to orient ourselves appropriately for the design and implementation of meaning-based evolving information systems.

THE MAIN APPROACHES TO MEANING PROCESSING AND CONSTITUTION IN ADAPTIVE SYSTEMS

Behavioral Systems

The endless quest for explanations on the functioning of human mind by philosophers, as well as from researchers in the area of Cognitive Science and Artificial Intelligence, has given us enough theories and even more paradigms of the design and development of such systems based on those theories.

Among all these movements there is one which has seriously questioned even the existence of the mind. As it is argued in (Kampis, 1999), behaviorism was an early twentieth-century movement which denied the existence and/or the importance of the mind as altogether non-empirical. It is obvious that reactivity was the basic norm of this movement, something which cannot guide a system (or the system's interaction) effectively in a dynamic environment. Waiting for a learned stimuli from the environment in order to react is not what happens with our minds.

In opposition to behaviorism, Cognitive Science opened the 'black box' while retaining behavior as the object of its investigation. It offers a theory of what goes on inside an organism with cognitive capacities when it engages in cognitive behavior. The dominant element of this process is of an informational nature, but the respective activity is not uniquely defined. The various ways this information processing activity can be defined are tantamount to different overall approaches to cognition (Petitot et al., 1999). For the purposes of this paper it is useful to distinguish three major approaches:

The Cognitivist-Computationalist/Symbolic Approach

Computationalism is based on the hypothesis that the mind is supposed to process symbols that are related together to form representations of the environment. These representations are abstract, and their manipulations are so deterministic that they can be implemented by a machine. Computationalism is the metaphor of the sequential, externally-programmed information processing machine based on the theories of Turing (Turing, 1950) and vonNeumann (vonNeumann, 1958). Therefore it implies that the key to building an adaptive system is to produce a system that manipulates symbols correctly,

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as enshrined in the Physical Symbol System Hypothesis (Newell, 1980). Computationalism has two requirements: forms of representation and methods of search. Thus, first one should find a way to formally represent the domain of interest (whether it will be vision, chess, problem-solving) and then to find some method of sequentially searching the resulting state space (Mingers, 1995).

Consequently, these are purely formal systems and their symbols are related to an a priori correspondence with externally imposed meaning. They are processing information based on a static meaning structure, which cannot be internally changed in order to adapt to the ever-changing demands of a dynamic environment. Since these systems by their nature, separate syntax and semantics, and manipulate their externally given representations (meaning) as sequences of symbols being manipulated by also externally given rules, they will never be able to produce inherent meaning in order to intentionally classify their environment. It seems that the efficiency of cognitive architectures which acquire their validity from the Church-Turing thesis are disputed as they are invalid outside the semantically closed domain of mathematics (Rocha, 1995), (Eliasmith, 2002).

The Connectionist-Dynamic Approach

Connectionism argues that the mind is a system of network that gives rise to a dynamic behavior that can be interpreted as rules at a higher level of description. Here, the dominant view is that mental elements are a vector distribution of properties in dynamic networks of neurons and the proposed solution for a proper modeling of the phenomenon (thinking process) is the set-up of parallel distributed architectures. Connectionism overcomes the problems imposed by the linear and sequential processing of classical computationalism and finds application in areas like perception or learning, where the latter is, due to its nature, too slow to deal with the rapidity of environmental input.

Connectionism has also borrowed the idea of emergence, from the theories of self-organization, which has as a central point the system's nonlinear dynamical processing. In this context the brain is seen as a dynamical system whose behavior is determined by its attractor landscape. The dynamics of the cognitive substrate (matter) are taken to be the only thing responsible for its self-organization, and consequently for the system's behavior (vanGelder and Port, 1995). It should be stressed that there is an on-going debate between dynamic systems theory and connectionist networks. The latter exhibit many of the properties of self-organizing dynamical systems, while not discarding the notions of computation and representation. Instead, they find it necessary in order for the system to exhibit high-level intelligence (Eliasmith, 1998), (Clark and Eliasmith, 2002), or even any kind of intentional behavior (Bickhard, 1998), (Clark and Wheeler, 1998), as long as representations emerge from the interaction in a specific context of activity.

On the other hand, Fodor (Fodor and Psyslyn, 1988) among others, insists that the form of the computation, whether logico-syntactic or connectionist, is merely a matter of implementation, and in addition, the implementation of computation, whether classical or connectionist, lies in causal processes. The only real difference between this form of connectionism and computationalism is that the former uses a vector algebra, rather than

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scalar, to manipulate its symbols (representations) (Smolensky, 1988). In this perspective and in relation to intrinsic creation of meaning, connectionist architectures cannot evolve and be adaptive.

The Emergent-Enactive Approach

Advocates of the pure dynamic approach (Varela et al., 1991), argue that connectionism remains basically representational, as it still assumes a pre-given independent world of objective and well-defined problems. These problems seek the proper set of representations together with an efficient mapping of one set of representations onto another.

On the contrary, the emergent-enactive view, although it shares with connectionism a belief in the importance of dynamical mechanisms and emergence, disputes the relevance of representations as the instrument of cognition (Mingers, 1995). Instead, in the enactive framework, cognitive processes are seen as emergent or enacted by situated agents, which drive the establishment of meaningful couplings with their surroundings. Emergent cognitive systems are self-organized by a global co-operation of their elements, reaching an attractor state which can be used as a classifier for their environment. In that case, the distinctions thus produced are not purely symbolic, therefore meaning is not a function of any particular symbols, nor can it be localized in particular parts of the network. Indeed, symbolic representation disappears completely – the productive power is embodied within the network structure, as a result of its particular history (Beer, 2000). The diversity of their ability for classification is dependent on the richness of their attractors, which are used to represent events in their environments. Therefore, their meaning evolving threshold cannot transcend their attractor's landscape complexity, hence, it cannot provide us with a framework for meaning-based evolution.

It is almost globally accepted that purely symbolic approaches cannot give answer to issues related with the emergence of new meaning structures and levels of organization, which justifies the existence and the role of anticipation in adaptive systems (Collier, 1999). On the other hand, although the emergent dynamical mechanisms have more potential for self-organization, there are also some issues in human cognition, (such as high-level learning, long-term memory, the stability of old pattern of neuronal activity in the face of new ones, etc.) that cannot be satisfactorily explained within these frameworks (Cariani, 2001). Moreover, the functionality of an adaptive system must be examined in a framework which will justify all or most of its phenomenal aspects, as these emerge from its striving for adaptable interaction with its environment.

As it has been mentioned, although the self-organized dynamical systems seem like a good candidate for meaning-based adaptation and evolution, their capabilities are limited due to the limitations of their attractors. The complexity of an emergent self-organized system can only be enriched through its interaction with other systems in its environment. In the context of 2nd order cybernetics and especially in autopoietic systems, the proposed solution in order for the ability of the system's classification to be increased is to be structurally coupled with its environment (Kaufmann, 1993). This way, the environment

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will act on certain structural changes of the system and it will force it to choose specific dynamics (particular states) for a certain task. Therefore, meaning-based adaptation can come to such a system in an open-ended way. But in which way is the system going to be structurally coupled? Second-order cybernetic systems admit no functional usefulness to representations and they regard information only as socially ascribed to a process from other observers (Maturana and Varela, 1980).

It seems that if one accepts the dominant view that all of the necessary information for an adaptive self-organized system must be embedded in neuronal patterns, which are cross-correlated with incoming ones, in order to be built up (in case of similar patterns) or to dynamically form new ones in dependence with the system's anticipation, then one must understand the relationship between intentionality, meaning, information and representations.

MEANING AND INTENTIONALITY

As it has been mentioned above, the computationalist and the connectionist paradigm make use of representations in order to map the external world into the mental states of the system. On the other hand, the enactive and dynamical paradigms do not seem to bother with representations. In this section the basic structure of an intentional state is described based on Husserl's phenomenological theory of intentionality. It should be noted that the choice of Husserl is based on the first-person phenomenological roots of the constitution of the theory of, especially autopoiesis, and in general 2nd order cybernetics, as well as the adoption of the Husserlian notions of Sinn (meaning) and horizon from Luhmann. As it will be shown, meaning and intentionality have a common root and the existence of representations is imperative.

Husserl's Theory of Intentionality

Thoughts, beliefs, perceptions, hopes, and perhaps most of the events that make up a mental life of a cognitive system, have a characteristic property of being 'of' or 'about' something and so giving it a sense of something in our world. As (McIntyre and Smith, 1989) very simply state, "when one sees a tree, for example, his perception is a perception "of" a tree". Such a mental state is in this way a *representation* of something other than itself and so gives one a sense of something. This representational character of mind or consciousness, that is, its being "of" or "about" something, is intentionality.

Husserl's first step in his attempt to find some answers regarding the common root between meaning and intentionality is to perform the phenomenological reduction. Thus, the thesis of an independent existence of things and consciousness is suspended, and one tries to observe things as they appear to consciousness. In this way, one is forced to explain the intentional character of a system's conscious acts by appealing only to the internal structure of acts of consciousness that make them intentional experiences. Husserl calls these features of an act (which are internal, by virtue of the bracketing) that make it a distinct state from other mental states or experiences, as the 'content' of the act.

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Each act is due to this internal content 'of' or 'about' a state-of-affairs. Husserl called this state-of affairs as "object" and he distinguished it from the "content", based on which this act is aiming at this "object". As (McIntyre and Smith, 1989) say, Husserl noted that the intentionality of an act is independent of the existence of its object, but is dependent on the concept by which the object is intended. It is the act's content and not its object that make the act intentional. For Husserl, an act refers through its content to an object, which gives the act its intentional character.

The Basic Structure of an Intentional State

Each content consists in two parts: an non-intentional and an intentional one. The non-intentional part is called the *hyle* (or sensory stuff). Hyletic data are components of sensory experiences and since they belong to the contents of experiences they are distinct from the object of experience. Although hyletic data refers only to perceptive actions, later Husserl labeled the non-intentional part of the intentional state as the *representative content*. The intentional part is called *noesis* and includes the *quality* and the *matter* of an act. The former is that inner feature(s) (irrelevant to the individuation of the intentional object) of an act that distinguishes it from acts of other kinds. The later is defined as the element responsible for establishing the intentional relation with an object. Specifically, it is the conjunction of the act's matter with the non-intentional part of the act which gives the act (by virtue of the bracketing to the subject also) its *meaning* or *sense* of the object. This meaning-component or sense is an abstract entity whose role is to determine just *which* object an act intends and precisely *how* it does so. By virtue of the bracketing, this indirectness is a result of the subject's act, thus every act, or as Searle (Searle, 1994) says, every mental state has *intrinsic*, as opposed to *derived* intentionality. In addition, as intentionality is a primitive feature of mental states (a first-person experience), it is considered to be irreducible to causal roles, computations, or to behavioral and neurophysiological explanations.

The Indirectness of Intentionality

As (Roy, 1999) argues, since a matter is included in every act, and an act is included in every intentional state, all intentional states exhibit a kind of indirectness. According to Husserl an assertion (expressive intentionality) refers through its meaning and in language, in the sphere of signs that function by virtue of an inherent sense, reference to an object must involve sense. The same inseparability also occurs in the realm of the meanings (or senses) which we find embodied in our perceptual experiences. (Roy, 1999) explains that in the case of expressive intentionality, there is a complex intentional state composed of two also intentional components. The first one is an intuitional component which establishes an intentional relation with a written or spoken *expression* (it should be noted that it can be any kind of expression supported by all modalities). The second one, called the *signification intention* is correlated with the referent of the expression. It is obvious that one can find indirectness in expressive intentionality, as one intuitively one object, which functions as a substitute for the referent. Consequently, expressive intentionality (an assertion, perceptive or imaginative) is an act by means of a symbol. One intuitively a symbol in order to be intentionally related with its referent. Consequently, a symbol is the substitute for a content that is not given directly as is, but only indirectly.

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So far, it has been shown that although both perceptive and expressive intentionality are indirect phenomena. Thus, indirection cannot be the property which distinguishes them. Indeed, one can find similarities between the role of *matter* and *intention of signification*, as well as between the *representative content* and the *referent*. As much as the *representative content*, as well as the *referent* are indispensable, as the *matter* and the *intention of signification* need their mediation in order to relate intentionally to an object. Thus, in both cases, the *matter* and the intention of signification receives a meaning-giving function from their counterparts. Also, as it is noted in (McIntyre and Smith, 1989) and (Roy, 1999) the conjunction of the same matter of act with the same representative content of a certain shade of color, can give rise to an intentional act of the same intentional correlate. Hence, their difference is in the type of the conjunction of these two elements. Husserl, calls this separating property as the *form of the representation*, or the *form of apprehension*. It is this form of representation that gives to the subject (system) the meaning of the object. At this point Husserl says that the structure of the meaning consist of the core meaning, which he calls *X* and its predicates. Consequently, meaning is not a copy of the act's object, it is rather an abstract structure that composes and encodes the limits of the object. Put another way, the meaning encodes the properties that give it content. By such encoding, meaning is characterized by those properties in such a way, that whenever a system (subject) entertain such a meaning, it is led to expect and anticipate an object that exemplifies them (Zalta, 1998).

Husserl also adds that in the case of perceptive intentionality the matter apprehends its representative content in such a way that *the most possible* of the determinations attributed to the intentional object are considered as having a corresponding element in the representative content. In contrast, in the case of symbolic intentionality, the determinations of its representative content are not apprehended as corresponding to those of its intentional object. Accordingly, in symbolic intentionality there is no necessity for apprehending the intentional object as fully present, as being there in itself. The symbol can be related to its object in a somehow more arbitrary way.

According to Husserl, there is an indeterminacy in the predictive content of the meaning in an intentional act. While it can prescribe certain properties of the act's object, it leaves open the full nature of the object it prescribes. Conversely, in favor of previous experiences and the indeterminacy of the meaning of the current act, further object properties can in a way be pre-delineated and consequently anticipated by the system. But limits are imposed here too. The range of the object's horizon must be compatible with what the meaning of the object prescribes. The whole structure of the system is furthered constrained by certain of its beliefs (stable, strong meanings). Thus, what the system can anticipate in a specific interaction is a combination of the object's horizon, the system's beliefs and the current meaning of the act.

The Inseparability of Meaning, Intentionality and Representations

Summarizing, it can be said that in all kinds of intentional act, there is a matter and a representative content. The latter is 'dead' by itself, but is indispensable in order the intentional act to take place and the object of the act to be experienced by the subject. The

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matter is responsible for giving the act its meaning (sense), by which the conception of the object in the subject's experience is formed. Their conjunction results in a certain form of representation, which determines the kind of the act and its content, due to which the act acquires its meaning and together its intentional character. In both cases, the matter of an act is related with the representative content, but it is so related in order to be able to reach the intentional object itself. Moreover, the representative content places certain constraints, or boundary conditions, on the meaning and what it can prescribe. The degree of this relation changes based on the type of the sign, thus it is related to the form of the representation of the act. In other words, representations, meaning and intentionality are inseparable.

In the described context, a representation represents its reference and does not represent its meaning, as the meaning belongs to the structure of the representation, not to the reference that is represented by its means. Meanings are abstract "contents" of intentional thoughts and experiences. They are the abstract properties which determine the representational structure that it needs to be activated in order to access an object in a way implied by this very meaning.

Luhmann's Socio-communicative System

Luhmann adopted quite early the concept of meaning. The concept was heavily influenced by phenomenology but without reference to system's representations or aspects of the current state of its environment that are of interest to it, together with a simultaneous reference to other possible states that are not currently instantiated. In this context, there are two types of systems operating over the medium of meaning: psychic systems and social systems. (Luhmann, 1995).

According to Luhmann, communication is a synthesis of three selections: information, utterance (Mitteilung), and understanding (Verstehen), hence, there are three ways in which information is represented: in the mind of the sender, in the mind of the receiver, and as an "utterance" in some kind of symbolic form so that a physical token is produced that allows the corresponding meaning to be conveyed from the sender to the receiver. Consequently, communications, as utterances, exist outside of minds but have, as symbols, only derived semantics. Meaning enables the psychic and social system formations to interpenetrate, while protecting their autopoiesis. Simultaneously, meaning enables consciousness to understand itself and continue to affect itself in communication. The characteristic of operational closure of communication enables it to be referred back to the consciousness of the participants.

(Ort and Marcus, 1999) have argued in favour of a completion of Luhmann's theory of meaning in human communications with the semiotic component and especially the Peircian triadic semiosis. It is evident that in a framework which we are discussing, where meaning and intentionality have a dynamic information-processing structure, which is based on the use of forms of representations there is a need of a theory to support the vehicle of the representation which carries internal information about an external state and that may be used in further interactions.

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Clearly, in order for a self-organizing system to exhibit meaning-based adaptation, there must be a mechanism to support and guide its interaction with the environment, formed by other systems. Regarding 2nd order cybernetic self-organizing systems, as much at the level of cognition (or the level of psychic systems), as for the level of communication, meaning structures must correspond to that described above. Additionally, the mechanism which will embed these systems in an information-based representational framework should also correspond and satisfy this structure. This way, the cognitive and the social system will preserve their phenomenological status and the respective properties (self-reference, operational and organizational closures), but they will also acquire a fruitful mechanism for interaction.

PEIRCIAN SIGN PROCESSES

Sign Constitution

Peirce describes a semiotic process by the following: “A sign, or representamen, is something which stands to somebody for something in some respect or capacity. It addresses somebody, that is, creates in the mind of that person an equivalent sign, or perhaps a more developed sign. That sign which it creates I call the interpretant of the first sign. The sign stands for something, its object. It stands for that object, not in all respects, but in reference to a sort of idea, which I have sometimes called the ground of the representamen” (Peirce, 1958).

The first thing that should be clarified is that sign is not a sort of static proxy standing in for an equal static thing. If it was a proxy, it could not evolve in other signs along the flow of semiosis. After all, with each new instantiation a sign becomes a difference, becomes a new sign. Secondly, as it will be shown below, the sign is partaking in mediation processes, which is the essence of its function. Especially, it is the way information is acquired from the system via the sign. Therefore, a mere proxy could never engage in such processes of mediation.

The sign bears a triadic irreducible relation and it is a genuine sign only if it is interpreted as one. If one examines how a sign is constituted as a genuine sign, then through this will be demonstrated the correspondence between the semiotic process between a system and a sign and Husserl’s constitution of experiential object.

Object Independence and Conception Dependence

The properties of object independence and conception dependence are preserved as any interpretation of a sign represents a certain perspective on an object and objects can be represented by different signs, and any sign can be interpreted quite differently.

Representamen – Sign-Vehicle

In the beginning, before the sign merges with an object through an interpretant there is, in contrast to the sign-relation, the *sign-vehicle*. The sign-vehicle is the representative element, the foundation over and above which, a relation arises. This relation is

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terminating at a *signified object* and it is in virtue of this relation that the representative element (sign-vehicle) is something other than itself. If the relation does not take place, the foundation is just a self-representation or *object*. The sign-vehicle can be either a physical or a psychical structure. In the first case the sign has a material structure which is accessible to sensation, while in the later case the sign has a psychological structure accessible only from the inside of an interpreter. In both cases it is the element responsible for the conveyance of the object signified to the observer. Eventually, Peirce calls the sign-vehicle a *representamen*.

Ground and Interpretant

In the presence of an observer, the sign-vehicle can be linked to its object signified through him. In this case there is an actualized triadic relation, which forms the sign itself. The sign itself does not stand for its object in all respects, but in reference to a sort of idea, which is called the *ground* of the representamen. The ground is that which is directly and immediately presented by a sign in its signified object, by reason of which whatever else is presented in the object as well is presented. It can be said that the ground is the *object signified as such and such* and consequently, a complete sign is the one in which a Representamen refers to a Ground, to a Correlate (sign-vehicle) and an Interpretant, which is itself a more developed sign. It should also be noted that as a sign-vehicle, the idea or 'mental image' exists only insofar as it guides an apprehension to the awareness of this rather than some other object. It is the constitution in the subject's experience that *forms* the idea as an idea *of* its object, as the rationale and form whereby an object is pre-cognized formally in a subject (Deely, 2001).

Peirce and Husserl

In both cases (Peirce and Husserl), the object of the experience is apprehended by the subject in a way that it is becoming part of the system's structures of experience. Due to the variety of system's representations (structures of experience) the new object has to be integrated by preserving the dynamic stability of the existing self-organizing system. So we can say that the formation of a new representation needed for the incorporation of the new meaning structure in the system is taking place based on previous experiences, anticipations and goals of the system. In addition, similarities can be drawn between the ground of the representamen in the semiotics process and the core meaning *X* in Husserl. There are both abstract structures that prescribe the object's properties. The same similarity exists between the sign-vehicle and the representative content. They both put (based on their very nature) constraints in the determination of the meaning. Although these inferences might seem improvised, the analysis which follow regarding the mediation of the sign and its transitive effect, should justify them.

Semiosis and Mediation – How the System Acquires Information from the Interaction

First of all it should be mentioned that in the semiotic process there is a two-way relation.

- the object "determines" the interpretant, mediated by the sign
- the sign and the interpretant "represent" the object (Parmentier, 1985).

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Thus, an interpretant will always be determined firstly by the kind of sign itself and, secondly, by the kind of the object relation to the sign.

The Effect of Transitivity

For information carriers to be properly integrated and inform the representations of an adaptive system, the whole process (the process of interaction!) must not be a mere sequential transmission, it must be a transformation. In (Liszka, 1999), Liszka by describing the transcription and translation processes of the DNA mechanism, explains that meaning can be generated from non-meaningful processes only if there are two basic type of algorithms realized in one process; one which produces *text* and one which can *read* it, while the reader-text relation must be a transitive one.

A transitive relation is a mediation in which, the form of the input of the text is included and simultaneously expanded into the form of the output of the reader by means of the form of the output of the text. Only by such a kind of mediation is an adaptive system capable of increasing its complexity and its meaning. Several such examples can be drawn from neuroscience, where it has been observed that auditory neural firing patterns are schematizations of the amplitude and frequency of the original sound waves and, by their means, retain the form or ground of that wave, yet transform it in a way that can address other higher processes in the brain (Freeman, 2000).

It is obvious that this is not the case in the Chinese Room where we have only substitution and not inclusion. There, the interaction process exhibits only identity and equality functions, hence there is no expansion of the meaning of the system above the one already given by its designer. In this view mediation is necessary to transitivity as it permits an indirect connection between two parts in a process and brings a certain degree of compression to it.

In the context of a semiotic process, the *dynamoid object* would be the source of transitivity, so, it would determine the interpretant. Due to the nature of the process and the existence of mediation, the determination cannot be direct. The determination is realized in a form and is the *ground* of the representamen. The ground should only be understood as form, as only as such can preserve the characteristics of the source, while allows it to be realized by a different process. Transitivity is much like the act of immediate giving in Husserl, based on which the object is expanded in the system's subjective realm providing the core meaning *X* upon which successive inclusions are established. Now the connection between ground and meaning core is clearer, it is this, which will determine the system's immediate interpretant.

Accordingly, the mediator (representamen) will exhibit this form or ground by means of some qualities, the properties and relations it has independently of whether it serves as a mediator. This means that it is the qualities, properties and relations of the sign-vehicle that determine the form of the ground. This is why Husserl's representative content is connected to the sign-vehicle, and this is why the latter constrains the form of the ground. In the case of a *qualisign* the mediator shares certain qualities with what it mediates (the sign-vehicle), when it realizes the form of what it mediates it is a *sinsign*, otherwise, it is

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a *legisign*. On the other side of the relation (its relation to the interpretant) the mediator can be schematized in either of the three following types: (Liszka, 1999)

Semes: can be considered to be at the threshold of meaning, or the most primitive level of meaning, since they represent the point in the process at which the mediator can address an interpretant, or can cause the interpretant to interpret it.

Phemes: mediator has been formed in such a way that it can become information-giving for interpretants or readers. Phemes are minimal units of information.

Delomes: mediator has been formed in such a way as to become inference.

Semiosis and Intentionality

The object given (by the inclusion of its form) is not apart from the whole relation, but its effect is to put the receiver and the giver into an intentional relation. In order the giving to be fulfilled, all three correlates must participate. The gift is not a mere vehicle, but on the contrary informs the whole construct of the system's representations so that they can accept information regarding the object. As soon as the system represents the object based on information gathered by the representamen, the intentional action is completed and the system has successfully interacted with its environment. There is nothing more effective for understanding the inseparability of the three relations than the fact that, in order for the system to be able to be intentionally related to its object there firstly must be a kind of interpretation for the mediator to be read as a representamen of its source. Otherwise, representation cannot take place, or if it takes, it may be a mere causal process. Afterwards, the system will be able to build a representation of the object. The result of the representation gives the system the kind of the representation –icon, index and symbol-that the mediator supports for its source. An icon is the case when whatever the type of sign-relations of the mediator, they are taken to be similar to its dynamoid object. In case of an index, they are read as being temporally connected with the source, while in case of a symbol, there is a conventional and habitual connection with its object.

Semiosis and Meaning

As it has been shown in the last section, interpretation must take place in order sign and source to be coordinated. When the mediator has been schematized so as to become a seme, the system will apprehend it as the immediate interpretant. For the mediator to mean something for the system, the latter must be able to correlate the mediator's schematization with the source (dynamoid object). Consequently, the system must maintain processes to reveal the meaning of the mediators (Liszka, 1999). In case the system does not co-evolve with mediators, it will be almost impossible to have intentional and meaning-based adaptation. If this happens, then the sign will always function as a cause.

The sense that the system earns from the rise of immediate interpretant, would be temporally tested, so that it can go from Firstness to Secondness and become real meaning. At this point, the immediate interpretant become a dynamical interpretant and it

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is this moment that information about the source begins to have a semantic effect on the system.

In case the system reveals the intentionality of the object at stake, then the final interpretant has been reached. One should note that after the formation of the dynamical interpretant the self-organizing system has undergone a structural coupling with its environment.

Semiotics and Communication

(Parmentier, 1985) has objections in considering the Peircian semiotic process as capable of communication. His negation is based on his view of the expressive vehicle as independent from the determination of the interpretant, which is obviously not the case. On the other hand, (Bergman, 2000) says that Peirce argues that form is not a singular thing, but possesses the being of a predicate, which in order to be communicated requires icons and indexes. Furthermore, as indexes and icons cannot argue on anything, they have to be developed in a symbol in order to be able to communicate meaning.

Considering the correspondence between object-sign-interpretant and utterer-utterance-interpreter some obvious but useful conclusions can be drawn:

- the utterance can be determined only by the utterer
- the utterance represents the utterer and that is why it is an utterer
- the utterance can only represent the utterer partially; it can represent it falsely
- to represent the utterer means that the utterance is able to affect a mind, that is, to produce a certain effect in it
- this effect is called the interpreter of the utterance
- the interpreter is immediately determined by the utterance and indirectly determined by the utterer, that is, the utterer also determines the interpreter, through the mediation of the utterance.

TOWARDS A FRAMEWORK MODELING MEANING-BASED INTERACTION

General Issues and Communication

In the described framework and especially by virtue of Luhmann's interpenetration between psychic and social systems, the horizons of meanings and objects are preserved and may exhibit an open-ended evolution. This is of course something that semiotic processes also satisfy. It should also be pointed that due to the closure of the framework, meaning structures that will emerge can be interpreted and used only in this system. They can expand by self-reference but they will never be able to function outside the system's boundaries. Their semantics are grounded into the system. Rather, they impose the system's semantic boundaries as they co-evolve with and within it.

Another important issue is that by the psychic systems' meaning-based evolution and interaction with the other systems in their environment, the rule-based syntactic level of

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their communication will start to add in a great deal of perplexity in the system (Viskovatoff, 1999). On the other hand, this perplexity will provide a background, which will decrease the uncertainty in cases of ill-defined epistemic cuts, which will probably be the case most of the time since in an artificial information environment interaction will be at a fairly high conceptual level.

In this context the divergence of meaning is not a failure but a natural property of communication. The framework should support the development and re-interpretation of signs that are representations of the system's environment. A meaning-based semiotic adaptation in a communication environment should have senders and receivers as objects (or utterers) and interpretants (or interpreters) respectively. Each time an utterer produces a message which communicates via a symbol, it is being held that a meaning have been produced. This meaning can be externalized or determined through interactions with the psychic systems. The system's entire environment is supposed to contain signs, which will represent meanings produced and provided by those very systems. The behavior of these psychic systems are interpreted as objects whose meaning is totally dependent on the intentionality of their utterers. These utterances are representamens, which would have to be interpreted, and which interpretation (or apprehension) will be based on the self-organized dynamics of the psychic systems.

Psychic Systems

Throughout this paper, we have maintained that meaning-based adaptation requires intentionality, forms of representations and informational openness. The systems with operational and informational closure, (i.e. autopoietic, emergent/dynamic systems) although they have a good degree of adaptive classification, they cannot exhibit open-ended evolution, as they cannot extend their attractor landscape. Meaning-based adaptation implies extension of structural representations, thus emergent classification of the system's environment. This is the case for anticipatory systems where they have the capacity to anticipate on its own. As Collier suggests (Collier, 1999), any foresight that an anticipatory system has is derived from its design, thus, it is design limited.

A system is meaning-based adaptive if it can respond with structural and functional change to both environmental and internal perturbations, by the use of its own information. This requires self-reference and operational closure since the system must refer to itself in order for unsuccessful structure modifications to be obliterated. In systems exhibiting high-level cognition, the meaning of a representation is given by the system's expectations involving its object. Collier (Collier 1999) argues that then the content of a representation is the information common to all these expectations and that this content provides the information needed to reason with the respective representation. As it has been stated, certain intentional representations may not be fulfilled by their objects, and this amounts to improper expectations. In the discussed framework, new meanings can be created by the assembly of old forms of meaning, usually with the incorporation of new structures based on the incoming information. In fact, manipulating meaning structures in terms and by means of forms, certain morphodynamical models can be incorporated in order to examine their interesting dynamics. Since it is the signs

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that inform the system's meaning structures, sign processes should be tested for their ability to harness the dynamics of forms. Meaning forms are not static, they always emerge and evolve in an interactive environment. As has been described, in every intentional act, the new representation –together with its meaning- should be 'apprehended' by the matter of the act, which is nothing else than the whole dynamic and continuously self-organizing construct of the system's experiences (consciousness). The sign and especially its mediator aspect provides a certain form based on the ground, and this form has to be 'processed' in order to adapt to the system's self-organizing dynamics. It is only by this view that self-organization and information come together in the system's meaningful interaction. One must not understand form as solely a schema or an abstract diagram. On the contrary, form must be conceptualised as a prior and necessary condition of natural interactions, thus form, has to do with how systems experience their external world. It is the quality of the part and the whole that come together through meaningful interactions, resulting in new forms, which are also ready to interact and be re-organized. As (Andrade, 2001) points out, form generates semiotic agency. And above all, form has several discontinuities and organizations. These are notions that seem to occur in every kind of form. The crucial point is to search the ways that meaning forms are reorganizing based on the interaction between the system's representation structures (which as noted have strong dynamics) and the -in a way- more stable representation structure of the signs used in the interaction. This is equivalent to the way an externally imposed form, which is given to the system by its semiotic interaction, manages to be incorporated in the system's dynamic by playing the very important role of stabilizing the system (with no matter what and how much complicated an attractor).

When the system has been informed by its interaction, in such a way, that its new dynamic state is compatible with the system's goals and intentions, then a meaningful interaction has been achieved. The compatibility is immediately connected to the fitting of the new form with the system's functions, anticipations and constraints. It is only under this view that a self-organizing system uses information from the environment (or of its own). The new forms will self-organize reaching certain levels of discontinuity, while new forms will come and carry on to new organizations, but with different structures. This is not just a mere self-organization which is based on the system's interaction in order to be selected or not. It is an interplay between signs and systems, where they are informing each other in order to co-evolve in a dynamic environment.

In the framework described, meaning is connected to the representations, but not in an absolute way. Since both of them have been formed and emerge by the system's interaction, there relations to the respective objects will present a great multiplicity and interconnectivity. This is something that the Peircian semiotic framework allows and fully supports. Although full representational autonomy will be an ideal situation for every psychic system, the combination between 2nd order cybernetics and Peircian semiotics calls for some constraints on the system's use of representations. This can be fruitfully explained if one sees the interaction between system and signs in the context of syntactics, semantics and pragmatics.

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As (Cariani, 1998) states, a syntactic procedure is one which only the sign's operational state (its type), determines the outcome of the procedure, while semantics is the open-ended relation of between signs and objects (material or not). The pragmatic aspect is responsible for the co-operation of them in order to reach in a purposeful and meaningful result. In our described framework, the syntactic or formal aspects of a sign are responsible for the amount of form (information) that will be passed into the system. As noted earlier, it is the sign-vehicle that constraints the determination of the meaning, and on the other hand, provides the structure in which meaning is possible. Of course, as has been said, relations between pure formal structures cannot determine and produce meaning structures. This is where semantics come into play. They make use of the given information in order to infer its meaning, but only in the sense of core meaning. The given information provided the tools for the object's discrimination, but as has been argued earlier, there will be many tests needed in order this core meaning to be temporarily stabilized into a dynamic interpretant. For this to be done, semantics must be tested against the pragmatics in order for the core meaning to be enriched with -not all possible- but only system's relevant and useful (at the specific moment) predicates. This is why system's representations must somehow be constrained, and they will be by virtue of the system's organizational closure. After this, it is clear that semiotics alone cannot give a pragmatic functional framework for meaning-based systems. On the other hand, self-organized systems need them as carriers of possible information, as meaning catalysers.

In the discussed framework, the pragmatic aspect is constituted dynamically and it is open-ended. It couldn't be otherwise, since it is a mixture of anticipations, memories and results of previous interactions, system's goals and most importantly, a well-described formal system of rules, which are being generated by the interplay between psychic and social systems. All these pragmatic aspects give the psychic system a great amount of meaning resources which should be tested in the interactions. These resources help the system in its interpretation of the object, while they enhance or minimize the constraints imposed by the formal aspects. It should never be forgotten that in purposeful interaction, there is always a great degree of interpretation and even more, as the level of interaction goes higher (full Peircian thirdness), the role of the given information becomes more difficult.

SUMMARY

In this paper a framework supporting meaning-based interaction has been investigated. Specifically, a semiotic interaction and communication of second-order psychic systems have been examined, in terms of the necessary elements and their relations. The structure of a meaning-based system calls for the inseparability of meaning, intentionality and representations, but if it is to be activated in a 2nd order psychic system, it is better to be in terms of information dynamics. As stressed, there is evidence that Peircian semiotics provide a very efficient mechanism for the structural coupling of these systems. It is believed that the richness of the combined frameworks can provide a grounded base for

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the design and implementation of meaning-based information systems. This is something that will be pursued in the future.

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