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Résumé de l'article

Le développement est un concept dont les fondements ontologiques incluent des phénomènes tels que les technologies, les institutions et les traits culturels qui incarnent les déterminants des différentiels de développement. Cette contribution soutient que la sémiotique est la science pour étudier ces phénomènes complexes de développement. Son approche s'appuie sur la sémiotique de Charles Sanders Peirce et sur l'analyse de la réalité sociale de John Searle. Les trajectoires de développement sont décrites comme des composés spécifiques d'institutions (signes), de technologies (objets) et de marchés (interprétants) qui créent des propriétés significatives en fonction de formes symboliques. Le développement est un phénomène socialement structuré et relatif à l'observateur. La sémiosis développementale dépend des pouvoirs symboliques qui structurent et assemblent l'intentionnalité collective. Le document met en avant deux conditions critiques essentielles au développement. Le premier est l'intra-cohérence sémiotique, qui est liée au rapprochement des fonctions dispositionnelles de manière coordonnée dans les réseaux d'artefacts et d'utilisateurs. La seconde est l'intercohérence. Elle prend place comme la causalité survenante des structures sociales et le caractère performatif des schémas de comportement habituels. L'un et l'autre s'imbriquent dans des formes syntaxiques et sémantiques évoluant dans le temps en forgeant le développement de trajectoires dépendantes du chemin.

The Semiotics of Development : Towards the Economics of Path Dependence

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1. Introduction

The evolutionary and institutional fields of economic inquiry advanced several important aspects of the analysis of development. Evolutionary thinkers tend to stress that development is the outcome of economic change that is emergent from behavioral proclivities, such as routines and habits of taught (Nelson & Winter 1982; Nelson 2008; Hodgson & Knudson 2010). Consequently, technology and productivity are depicted as the long-term drivers of income growth, and better living conditions, and both are consequential of systems of knowledge and information (Nelson 2002; Dopfer & Potts 2004). On the other hand, institutional analysis highlights the role of social coordination to economic efficiency, in the form of normative instances, such as the "rule of law", "property rights", and "individual liberties". All these instances are perceived as necessary outcomes of "inclusive societies" (North 1990, 1995; Acemoglu & Robinson 2012).

Indeed, both perspectives have correct epistemic claims, and are well-established in terms of the convergence and mutual reinforcement mechanisms that are supported by empirical scrutiny (Nelson 2002; Vromen 2004; Hodgson 2007; Potts 2007). However, on the grounds of ontological foundations of economics, the divergence is much greater. Evolutionary and institutional theoretical analysis are based on two non-congruent approaches of prior causation. First, the evolutionary analysis is undergirded upon biologic metaphors, such as mutation, selection and inheritance, which have been questioned in terms of their adequacy to represent social facts (Witt 1997, 1999; Foster 1997; Herrmann-Pillath 2001; For a counter-perspective see Hodgson 2002). Second, the institutional field is nowadays still ontologically related, with a semi-detached version of the *homo economicus*, on the principles of bounded rationality and individualistic causation, that are not well-fitted to non-equilibrium dynamics (Williamson 1985; Furubotn & Richter 2005; Ménard & Shirley 2008).

The outcome is that the lack of common foundations is a serious problem for the development studies. The selection of the specific mechanisms that are related with the epistemic causation requires the previous specification of the ontological design of social interactions. For instance, a common trait of the evolutionary and institutional perspectives is the claim that there are no *ex ante* recipes to be followed. Evolving social structures are co-emergent and entangled with power structures and historical contexts.

Thus, social facts are heavily ingrained in the endogenous cultural and historical trends. Path-dependence is, conversely, consequential and depended upon "mental models", the term coined by Douglass C. North (2005), that assemble collective modes of perception in social interactions. In sum, development is a subject relative complex phenomena.

Within this framework, the present article aims at supporting the view that the semiotic emergence is the key ontological property to development studies. Basically, semiotics is the science of causally integrating signs, objects, and meanings. It is enmeshed with the configuration of physical entanglements evolving from symbolical processes in social facts. This perspective is adjacent to the contributions of neuroscience and bio-semiotic approaches that support the view that human civilization and culture is emergent from the non-dualism of mind and body processes (see Dennett 2017; Damasio 2018).

Furthermore, in a social ontology perspective, social facts are structured by the syntax forms in which information and knowledge are decoded according modes of understanding. This is the baseline for semantics in the form of behavioral proclivities, such as consumer trends, organizational strategies, and jurisprudence. Thus, symbolic mechanisms are subject-dependent and constituted by functions that encapsulate mutual understanding that elicit epistemic evaluation (Searle 1995, 2004).

On these terms, the economic transactions are mechanisms by which knowledge and information are physically transmitted by means of signs of exchange spread along market interactions. In the forms of prices, contracts, or labels, they are the vehicles by which inter-subjectivity is shared along the diverse sets of economic institutions. Such semiotic mechanisms enable the emergence of economies of scale and scope in the form of specialized functions. Therefore, economic systems are evolving structured modes of interaction, intertwining networks of interpreters that constantly reassess the instrumentality of the behavioral proclivities forged historically.

The semiotic ontology proposed in this paper is based on the Charles Sanders Peirce's semiotics and its application to dialogic systems in economics (Herrmann-Pillath 2013; Marrais 2019; Macedo & Herrmann-Pillath 2019) and to social sciences more generally (Cobley & Randviir 2009). Furthermore, this perspective is adjacent to the "distributed cognition" framework of the relationship between the neuronal functions and artifacts (Clark 2011; Hutchins 1995, 2005; Sterelny 2004).

Following these general settings, the article is structured in the following order : the section 2 discusses the basic semiotic model, and the outcomes to the

ontological conception of development. Section 3 develops a blending articulation of the semiotic perspective in the networks of techno users. Section 4 concludes with an outlook of the semiotic implications to developments studies, and the properties of coherence to collective performance and dispositions.

2. Semiotics and the Emergence of Social Systems

2.1 A Contextualization of Charles Sander Peirce's Ontology

The Peircean ontology is the foundation of the pragmatist philosophical school and by extension of the evolutionary perspectives of the early institutional thinkers. The characteristic trait of Pragmatism is the contextual standpoint of the working out of the human mind and the emergence of behavioral proclivities. This relationship is clear-cut in the works of Charles Sanders Peirce, William James, and John Dewey regarding the pragmatist maxim, and the logical postulates of knowledge not mirroring factual reality. However, they diverged in terms of the truth implications of knowledge.

James stressed out a subjective and individualistic perspective of truth. On the other hand, Dewey postulated an approach based on well-verified social claims. Differently, Peirce validated truth claims solely as the outcome of the agreements in the scientific community. In this realistic and materialistic approach, a truth is not a common belief. A concept is assigned as true when validated by the empirical assurance of science. Thus, beliefs are the final outcome of the tendency towards the emergence of the laws in nature.

The influence of the Peircean pragmatism in Economics was heavily pregnant in the early institutionalism. The pragmatic reasoning may be clearly perceived, for instance, in the works of Thorstein Veblen and John Commons. Both applied Peirce's ideas to economics, specially when taking use of the evolutionary concepts of habits and the symbolical traits of social interaction (Brier 2008).

Admittedly, the evolutionary approach of Veblen is elaborated on the constitutive role of the relationship between institutions and technology on the formation and sedimentation of habits of taught (Veblen 1898). In his works the importance of symbolical contexts is a medium of status and meaning in social structures (Veblen 1994[1899]).

Also, Commons, who was later received as an important source to the new institutionalism, has been greatly influenced by Peirce. Commons' concept of *collective action* is ingrained in the pragmatist idea of the individual action emerging as the outcome of social coordination. For instance, in the analysis of the Common Law, normativity is convey as evolving from habitual patterns of behavior (Grinberg 2001; Defalvard 2005).

Nonetheless of this clear inheritance, Veblen and Commons did not leave sequiturs, and the Peircean ontology was forgotten by latter economic thinkers. In sum : the biological metaphor embedded in the "Generalized Darwinism" took the role as the main "open system" approach in economics. Indeed, the use of biological terms to explain social evolutionary traits of the human interaction requires

proper analytical formulation. (For these approaches see Ramstad 1994; Vromen 1995; Witt 1997, 1999; Foster 1997; Herrmann-Pillath 2001, 2004).

The application of "biologic and natural metaphors" such as from thermodynamics, biology, systems theory, complexity theory, cognitive science, and neuroscience to social facts creates an assemblage of analytical inputs that is too eclectic. All this diversity makes it difficult to understand the ontological meanings of these terms in the context of economics. Essentially, the depiction and understanding of the brain functions is not enough to the conceptualization of the interactive mechanisms of sociability in economic transactions. Salient epistemic grounds are related with the social semiotic networks of "extended minds" in the anthropic systems of knowledge and information.

Hodgson (2002), for instance, when advocating the view of a generalized Darwinian ontology to economics, rejected the idea of it being a form of biological reductionism. He correctly linked this approach to the long tradition of pragmatist philosophers, such as Peirce and James. He even admitted the need for a precise ontology of social facts in the economic framework :

> It is important to re-emphasise that devotees of Universal Darwinism do not attempt to explain everything in biological terms. The alleged universality of Darwinian mechanisms does not mean that the process involved is always that of genetic variation and selection. Furthermore, when genetic evolution does exist, this does not rule out additional evolutionary processes, acting on different entities, at additional ontological levels. (Hodgson 2002 : 271)

Markedly, the Peircean ontology is grounded on the attributes adjured by Hodgson. It is a non-reductionist evolutionary ontology well-suited to human acquired functions in social systems with several levels of emergence. Most importantly, signs are analytical tools to the interfaces between physical artifacts and symbolical performative exchanges in complex networks of users (in an adjacent view of Latour 2005).

The discussion on how common perceptions of the world are created, likewise, are eligible to the institutional framings of investigation. Douglass North pointed out at this in the discussion of the subject dependent attributes by which assessments of reality are built upon. The "mental models" are cultural forged on sets of meaningful criteria :

> Individuals possess mental models to interpret the world around them. These are in part culturally derived- that is, produced by the intergenerational transfer of knowledge, value and norms which vary radically among different ethnic groups and societies [...]. Consequently there is immense variation in mental models, and as result different perceptions of the world and the way it 'works'. (North 1995 : 18)

Thus, semiotics is the best way to understand the dispositions in the diversity of perceptions among social interactions. Most generally, semiotics is embedded in the roots of the institutional and evolutionary schools of economic taught. At the same time, neuroscience, genetics, and biology are increasingly taking foot on the attributes of complex systems, and providing important clues to a materialistic account of selective designs in human society.

Thus, it is not adventitious to claim that the quest for a biophysical explanation of the constitutive roles of the human mind is well-grounded on the footsteps of the early pragmatism. The next section will advance the theoretical perspective of the semiotic interaction in the economic system.

2.2 The Scheme of Semiotic Analysis

The core of the plea for a "semiotic turn" in economic analysis has affinities with the research paradigm of distributed cognition (Dennett 2017; Damasio 2018), and ii is profoundly related to the theory of social ontology developed by Searle (1995). Peircean semiotics is based on his three phenomenological categories of firstness, secondness, and thirdness. Firstness is the category of quality, feeling, spontaneity, and diversity. Secondness is the category of opposition exercised by resistance, characterized by the "brutal" facts of nature on the self. Thirdness evolves from the universal proclivity towards regularity, habit and law, inherent in the evolution of inanimate objects and as in the formation of habit in living beings (Ransdell 1977; Short 2007; Brier 2008).

Habits, according to Peirce, are an evolutionary phenomena. Peirce's categories have their evolutionary manifestation in chance and indeterminacy (tychism) as well as in continuity (synechism). In the latter respect, Peirce's evolutionary perspective is also based on the law of large numbers, and it evolves from empirical tendencies that warrant scientific generalization (Reynolds 2002). Action tends to lead to new habits, which are manifestations of the principle of continuity. In this respect, Peirce's evolutionary approach seems to have some affinity with the Lamarckian perspective of the acquisition of characteristics in time. With respect to the semiotic ontology of mind, three points are crucial :

> First, Peirce's metaphysical portrait of human consciousness is based on sign processes (semioses), which amalgamate, non-dualistically, external inputs into inferences, by the working-out of signs in pursuit of responses as functions. Most importantly, according to Peirce, all human proclivities are guided by purposes. The semiotic account of semiosis requires reference to the three Aristotelian kinds of causality, formal, mechanical (dynamic), and final causes.

Second, the semiosis which results in meaning and action depends upon the operation of the integrated relationship between the sign and the object. The sign by the mechanism of the formal causality induces a symbolic codification in the interaction with the object.

Final causality manifests itself in interpretants, in which sign and object create a semiotic effect. The appropriate response to the sign may be a mental or a physical response (Figure 1).

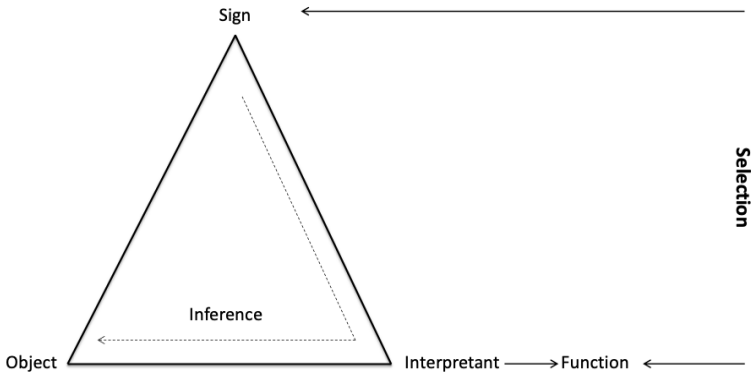

Figure 1. Semiosis and Function (Source : Macedo and Herrmann-Pillath 2019).

Let us now consider the semiotic perspective in relation to economic facts. Technical knowledge in this assessment is due to the scientific knowledge incorporated in the production system that makes specific physical features available to human use. The generalization of innovative gadgets, for instance, in compounded functional mechanisms, which encapsulate technological knowledge and information, provides novel modes of response according to feedback signals in the networks of users. (For a detailed description see Herrmann-Pillath 2013, ch. 4.)

Institutions are the signs that mediate technology and the network of users by the working-out of syntactic forms. In this sense, the normativity of the institutional arrangements has the role of enabling mutual understanding and social coordination. Consider, for instance, the sets of users intertwined via institutions in supply chains performing functions, such as consumers, suppliers, public officials, businessmen, and so on. These are the techno-users exchanging information and performing the constitutive roles of the social structures.

Most importantly, social actors are created by information flows emerging from signs, such as prices, standards and measures, language, software applications, to mention just a few, that are dispositional to selective drives of behavioral responses. These connections are forged in interactive networks. The performed practices accomplished in the markets are the combined sets of these patterns of signaling mechanisms. In this sense, design emerges in the functions in which actors are engaged by means of signs in the creation and selection of techno-properties assembled in goods and services in the exchanges within the networks.

Semiosis is hence the process that operates on response functions (causal and formal causalities) towards some goal, qua final causality. According to these criteria, inferential assessments collapse into behavioral dispositions, logical process termed by Peirce as “abductions”. Abductive inferences create behavioral dispositions that depend upon physical artifacts of syntactic forms – the institu-

tions. Hence, final causality is the resultant semantic form related to the process of meaning-making. The key point is that semiotics conveys the assemblage of information criteria according to the cognitive distributed input drivers of selection.

Semiotics also provides analytical tools for the understanding of learning processes, such as the technological development and the institutionalization of behavioral patterns. Both are essential determinants of economic growth and the functioning of markets.

3. Development as Semiotics Analysis

Development is conceived as the improvement of living conditions in the long-run, measured by indicators such as income, life expectancy, educational achievements, and individual liberties. Development is *path-dependent* in terms of historical trajectories and the relative assessment of the diverse sets of human intentionality. Markedly, following the ontology of social facts (Searle 1995), two points are essential to the semiotics of development.

First, development is an observer-relative fact. What is considered to be "developed" depends upon human reasoning. Today, there is a long discussion on how development should be measured, whether only by the *per capita* income and a limited number of education and health indicators or also by "sustainability", "happiness", and "spiritual well-being" proxies of additional targeted features (McGillivra & White 1993; Sen 1999; Meier & Stiglitz 2000). Development studies require addressing the interdependence between observers and social reality.

Let us give a drastic example to clarify the point. The Kamayurá are an indigenous people in the Brazilian Amazon forest, which has the tradition of committing infanticide of disabled children, offspring of single mothers, and of twins. In the relative assessment of that particular culture, infanticide is a legitimate practice to guarantee group survival (Oliveira 2018). Less drastically, a situation similar to the conflict between indigenous and the hegemonic culture of Brazil can be found in the respective assessments of the trade-off between inequality and pro-market policies in countries such as Germany and the United States.

Second, development is an intrinsic observer-invariant epistemic fact. Social facts assign causal powers to structure human actions. These positional attributes enable the scientific assessments of the social sciences and the humanities. For instance, the Kamayurá are linked together by their social structures, and the practice of infanticide is causally imposed over individuals. This is only possible because collective intentionality assigns functions that are performed according to accepted claims that the Kamayurá infanticide is necessary for group survival. Similarly, diverse sets of entanglements of pro-market policies and inequalities are expedient to scientific appraisal in relation to their causal effects to market economies.

The social point is that the constitutive attributes of social facts, such as development, are subject-relative phenomena. Within this framework, they are hence different from the observers' mappings of reality. Human intentionality determines which facts are perceived as development. Consider the diversity of

assessments in several branches of contemporary societies with respect to their developmental conditions. To what degree should their views concerning a "better life" be considered the foundation of economic systems? This idea has strong implications to be examined below, with respect to the degree by which common concepts of development can be coherently shared within and among networks.

The claim is that the bridging of the relative character of social facts and the emergence of social structures are conducive to development and operated by the working-out of specific symbolic representations. Distributed cognitive systems rely on external artifacts to gather information and to amplify processing capacities in in relation to environmental stimuli. This is possible at the expense of the semiotic functioning of the social structures.

At the core of the semiotic proposition lies the fact that economic systems evolve from information and knowledge flows that require integration. Social facts are mediated by signs in the selection and accomplishment of strands of collective intentionality. In this sense, linguistics is the prime mechanism of sociability. It provides important clues for the understanding of the semiotic intercourse.

According to Chomsky (1965), language performance is determined by the rational adequacy of descriptive and explanatory functions of syntactic forms. Any ordinary and healthy human being is able to make use of it. Conversely, Wittgenstein's conception of "language use" requires the matching of syntactic forms by the user as a form of representation. The point is that the stimulation by the input data is contextual to the collective *praxis* of the language. Hence, explanatory adequacy is not independent of the criteria used by the users' system. Meaning and action are interrelated.

Applying these premises to the semiotics of economic practice, the conclusion is that signs and technology are intertwined in mechanisms of production and transaction. Both are internalized in the strands of collective intentionality emerging from the operation of symbolic modes of interaction. Figure 2 summarizes these determinants.

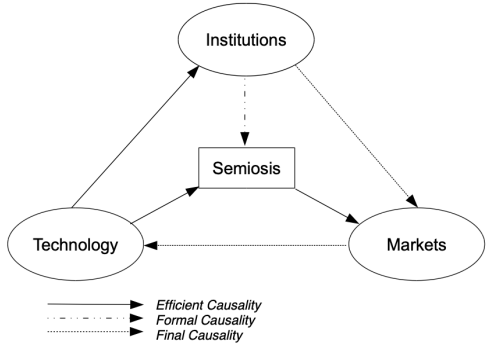

Figure 2. The Semiosis of the Economic System According to Herrmann-Pillath (2013 : 41).

First, the formal causality lies in the structure of language forms that enable the categorization of input data. The underpinning of causal powers depends upon the prior design of the operative rules related to the decoding of symbolic functions. Consider, for instance, the sign processes encoded in credit rating agencies with their standardized metrics of default risk. The criteria used by these ratings guides the financial analysts in their operations, which are gathered in labels embedded in specific modes of response, such as investment grades or speculative assets.

Above all, different syntactic forms are designed according to distinctive systemic functions, which are not directly congruent with specific niche applications. Consider, as an economic analogy, the non-compatibility among Mac, Windows, or Linux operation systems and the consequent adaptive requirements to the use of standard applications.

In the network of users in general, technology is related with processes of knowledge and information diffusion. These are adjacent not only to energy supplies on which mechanisms are operated (e.g., fossil fuels, electric energy, chemicals, etc.) but also to the syntactic information transmitted in social interactions. Hence, any system of applied knowledge requires the compatibilization of physical properties with the symbolical codification of technological functions.

Consider also the flows of energy and information exchanged in the global value chains. For each economic transaction, there is a link between physical and sign properties. For instance, when a good is sold, an intricate array of physical processes emerges simultaneously together with diverse sets of firms in the value chain, such as suppliers, transporters, financial intermediaries, and so on. Each of these functions is intertwined with the formal rules of interplay that elicit the exchange of meaningful information enabling the performance of functions in the form of transactions, such as accounting methods, software applications, and most fundamentally, the language in which technologies are symbolically embedded.

Second, the role of institutions is related with the operation of signs that enforce the coordination of modes of human intentionality by creating meaningful modes of interplay and understanding. Needless to say, signs are physical phenomena that also play their role technology. They are the normativity that makes meaningful decisions possible. This is where final causality comes in, understood as the pattern of performed functions evolving from the proclivity of responses shared collectively to environmental stimuli. Conversely, innovations and behavioral divergences are reinforced or not, in accordance with their instrumental performativity. In this sense, new functions derive from ongoing social beliefs grounded on justified claims.

Considering the criteria taken as the basis of desired outcomes, the justification of claims depends upon forging socially congruent logical assessments which abide in semantic forms. In this sense, institutions are the common ground by which decisions (final causality) are forged and socialized in the network of techno-users. Transactions result from instrumental cognitive mappings according to accounting rules, programming languages, financial indicators, and grammars.

In the network of users, each individual has their own proclivity together with

other individuals in networks eliciting drives of mutual engagement or disengagement. Hence, signs are functional representations elicited in the operation of institutions (rules and norms) forging behavioral proclivities (habits). The outcomes are perceived as feedback effects channeled into organizations as market trends.

In all of these processes, semiosis is an agent in the evolutionary entanglement of institutions, technology, and markets. Its interplay is an open-system phenomenon in which indeterminacy (tychism) and continuity (synechism) are at the core of path-dependence in economic systems. Each of the categories operates endogenously in relation to all others, and semiotic causality continuously frames the evaluation of economic development. The foundation of these mechanisms is evolutionary, without metaphors from other strands of inquiry, such as biology. The vector of relations that determine semiosis are subject-relative, and the outcome of their intrinsic attributes are the consequence of the collective acceptability of syntactic and semantic forms.

Likewise, changes and disruptions are embedded in behavioral patterns that depend upon the convergence of specific conditions to unbound and emerge. More precisely, in the semiotic perspective, development has emergent properties not reducible to the lower levels of the three categories. Semiotic convergence is the conduit by which a supervening downward causation emerges in the form of systemic coordinations. These are critical conditions of development studies that deserve more detailed analyses in the next section.

4. Implications for Development Studies

Greater income and better living conditions are the results of market extension and the specialization of labor. Since Adam Smith, productivity has been pointed out as the driving force of development, and it is correctly perceived as the bull's eye of economic policies. In the semiotic perspective, economic activities are emergent functions of the operation of signs. Markets are expressions of sign processes that depend upon the commonalities of meaningful behavioral proclivities.

Remembering Adam Smith's pin factory example, all the above described outcomes are derived from the division of labor – specialization and mechanization – and they may be described as emergent attributes of the working out of semiotic interactions. The advancement of the factory as an innovative organizational design in the early industrial revolution enhanced the productivity by applying novel technological mechanisms and by structuring social relations.

In today's integrated economic system, increasing coordination and strengthening knowledge and information flows have become crucial to the performance of the extended global economic semiosis. The role of integrating final causalities has become the prime assessing function of markets. This point is clearly confirmed by the different degrees of adequacy of the international community when addressing problems such as climate change or disease epidemics. Therefore, the analysis of semiotic interactions is able to frame the convergence of development studies, and the awareness of the ontological constituents of semiosis can extend markets and the feedback adaptations that induce greater productivity.

The first alignment is "intra-coherence". It is related to the formal mechanisms – norms and rules – that pervade and delimit the scope by which knowledge and information is shared and apprehended. Intra-coherence pervades the relationships in which syntactic modes operate in technological mechanisms via artifacts shared and enforced by institutions. Accordingly, intra-coherence is internalized in networks of users and it creates proclivities delivering coordination and mutual acquaintance.

The second alignment is "inter-coherence" in the *modus operandi* of performative behaviors among techno-users. It is worked out by the collective endorsements of meaningful purposes in different degrees of congruence. Inter-coherence is causally supervening to networks and is operated by modes of semantic understanding. The feedback of the semantic functions of inter-coherence are responsive to contextual conditions internalized in techno and institutional design as market conditions. Both alignments are responsible to path dependence in development trajectories which are the dynamic forces behind the operation of semiotic intercourse.

4.1 Intra-Coherence

Intra-coherence enables the assemblage of different systems of exchange of data in a coordinated way. This is an essential attribute of semiosis in the sense of enabling greater specialization and mutual dependence along systems of meaning. Each network of techno-users relies on specific modes of interplay between artifacts and coordinating mechanisms that require proper compatibility in order to amplify systemic instrumentality.

The challenges related to the diffusion of technological innovations along distinctive sectors of the economy are exemplary. They concern the degree to which each niche appliance of novelty depends upon the adaptation of old criteria in new modes of interaction. The sign forms are required to deal with the patterns in which the interplay of the novel technological mechanisms and the old behavioral proclivities are structured.

Consider, for instance, the case of the adoption of new agricultural practices in traditional communities in underdeveloped countries. Usually, new farming techniques are first developed and applied in developed countries. Hence, the ways in which novelties are introduced to agriculture tend to differ according to their contextual conditions. The signs in charge of combining and transmitting practices to techno-users have the form of specific patterns of traditional applications. As the new technology is implemented, new mechanisms of exchange are required to be performed in place of the old ones. However, the challenge, of course, is not the translation of the knowledge and information embedded in the new technology. The real task is that signs need to assert meaningful behaviors to users. Even if a government agency provides freely the new technology, without first advancing the ways by which the new mechanisms are to be implemented by the current functions of the productive system, the initiative will not be well succeeded. In this case, the enhancement of the procedural mappings with the novel applications requires the matching old and new efficient modes of causality.

Organizations like extension agencies or universities must provide an environment in which farmers find ways of participating in the processes of the diffusion of technology. Simultaneously, the assimilation and the assembling of symbolical functions is not an individually observer-relative phenomena. The acceptance of the meaning of a sign is depended upon the relative assessments that operate in the networks. Semiotic functions are enforced by the collective acceptance that emerges on the higher level of normative causality. In the first place, although requiring individual agreement, the matching of new functions is constitutive to the previously assigned powers emanating from the structured relations.

Things become even more complex when technological functions occur in common assembling paradigms in use on diverse sets of applications. In such situations, signs need to deal with the non-compatibilities manifested in several user networks operating simultaneously. This founding condition requires taking stock of contextual biases that influence the frames within which interactions are configured.

Hence, semiotic intra-coherence evinces five basic properties : (i) categorization, (ii) congruence, (iii) mapping, (iv) symbiosis, and (v) redundancy. These five properties are interactive in the sign mechanisms operated by the interfaces embedded in the institutional arrangements and the techno functions. In a directive way, semiotic intra-coherence operates in the flows of exchange from (1) formal, (2) to efficient and to (3) final causality (Figure 3).

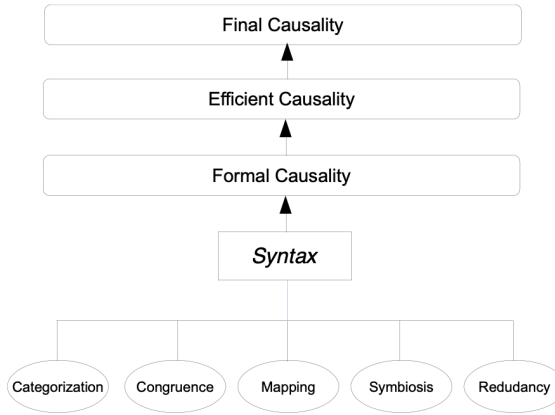

Figure 3. Intra-Coherence.

Categorization. Signs group phenomena together by *labels* that systematize meaningful information regarded as constitutive. Categorization makes it possible that functions are assessed according some indicators of *qualia* that match the elicited responses to the techno-users. Goods and services, for instance, are classified according to criteria that provides mappings of cognitive attributes, such as

the design of a car, or the texture of a cloth. However, this is only possible when symbolic interactions are developed on the grounds of the properties in use by efficient mechanisms. For instance, the modernization of agriculture practices requires that the labels in use by the techno-users, the farmers, can coherently systematize functional mechanisms according to their appliance. Labels such as fertilizers, livestock, farming activities, pesticides, and so on, are grouped together according to the practices in place. More clearly, each input data, such as a raw material of a specific chemical compound, is required to be categorized by the functions it performs (*i.e.*, the one of a fertilizer). Here, the compound of the semiotic input is the vector of combined knowledge and of the information concerning the mechanisms available for the techno users. The characteristics of each categorization in play influence the ways by which the meaningful criteria of the functions that will be performed. Therefore, the criteria depend upon the systemic design of the actual appliance in the field.

Congruence. The functions assembled in the categories of use need to be congruent with other factors. The symbolic design requires proper identification so that the users can recognize the mechanisms in which mutual entanglements occur and the ways in which properties are reinforcing or not. When successful, signs are operational in the ways of delivering synergic effects through properties of the system. Congruence is the key characteristic of innovative networks in which actors are combined by well-coordinated arrangements, as in research centers, universities, venture capitalists, and entrepreneurs. However, a particular design is usually not sufficient in all circumstances of congruence. Corporations' vertical integration or government planning are in principle also suitable ways to deal with the compatibility of formal requirements. Signs in the form of contracts, business plans, company amendments, government plans, and so on are instances of the ways of coherently dealing with diverse sets of group functions and coordination.

In developing countries, particularly, increasing network synergies tends to be difficult in face of the superposition of conflicting intentionality, such as from diverse ethnicities, high inequality, and the conflicts between the enforcement of law *vs*. traditional norms. The key point is that inter-coherence pervades the ontological property of delivering a congruent meaningful criteria to the entanglements of functions and the coordination of collective efforts.

Mapping. Signs in networks set up the emergence of recurrent patterns of social positioning. To the degree that such recurrences are sanctioned, they are reinforced and institutionalized. The mappings, likewise, are the structures embedded in the mental models according to the plethora of normative causal powers in the rule of the network. Decisions and ultimately instrumental behaviors are framed according to the mappings which users endorse as legitimate.

In the example of the challenges related to the modernization of traditional agriculture, rearranging meaningful instances of productive organization requires the matching of the old and the new modes of symbolic functions. The modernization takes place by rebuilding cognitive mappings that guide social interactions. For instance, social positions related to religious beliefs must be downgraded in favor of technical powers and scientific scrutiny. According to the same criteria, the

expansion of formal education and the specialization of the labor market change the roles of kinship and proximity. The consequence is that the reliance on personal relations based on affection are reconfigured into mappings based on abstract and impersonal normative instances.

As the integration of global supply chain increases, cognitive mappings get less diverse in terms of the ways in which networks are configured. On the one hand, greater procedural homogeneity facilitates communication, and coordination increasing the scope of the emergence of mutuality. But on the other hand, the decrease in the stock of diversity of mappings in use reduces the available degrees of change and novelty in face of new drives of selection.

Symbiosis. Distributed cognition systems are at the core of human extraordinary coordination skills and they are integrated by designs that blend biological with techno-attributes. Technology is pervasive in users' functions and it is conditioned by the design of artifacts. In this sense, symbiosis relies on the interfaces of organic and inorganic functions that are conducive according the intentionality if social structures. Consequently, the performance of the mechanisms elicited by the symbolical exchanges sanction causal powers.

In some extent, agency is not solely human because the endogenous matching of functions of artifacts with the brain are profoundly enmeshed. Neuronal plasticity is the vehicle by which the combination of semiotic applications and the scope of techno-design is accomplished. Learning, in this perspective, is a key function of the operation of symbolic interfaces not performed only by humans. Symbiotic performance is conducted by organic combined with inorganic functions, which are evaluated according bimodal instrumental criteria.

Consider, for instance, the expansion of primary education and the requirements of guaranteeing the quality of learning for students. Pedagogical practices are not only structured by the implementation of scientific knowledge in common patterns of social behavior. The ultimate outcome is the extension of plastic neuronal applications in networks of techno-users. Quality in education is achieved by means of "assignments" and "tests" in which students provide evidence of their ability to apply instrumental knowledge with the use of artifacts. Students are required to be proficient in the use of signs, such as grammar and algebra in mandatory applications. Likewise, artifacts are reassembled and redesigned in the process, for example, by constantly redeveloping new software applications and gadgets used in the pedagogic practices.

Redundancy. The semiotic system must allow degrees of freedom in the interfaces between users, artifacts, and sign representations. Redundancy emerges from the multiple structural configurations that are able to support the same compounded use of information. The outcomes of redundancy are greater efficiency and flexibility. The selection of distinct modes of interaction requires the prior existence of a plurality of cognitive channels of intercourse. As environmental conditions evolve, the system tends to use the excess of the potential diversity to modulate the flows of information according to the best available outcome.

For this reason the bimodal channels – symbolic and functional – can oper-

ate interchangeably as long the stabilization of the features of the system is not complete. As the network becomes more homogeneous in the scope of the alignment, the system faces a selective strain in terms of the degeneracy of inefficient routes. Otherwise, some degree of redundancy is maintained in order to foster the continuous cleavage of network conditions still unknown.

In the case of development policies, redundancy may be a source of opportunities to "leaping forward" as new technological paradigms emerge. Traits of the social structures perceived as dysfunctional, when paradigmatic conditions change, may provide new acquainted modes of interaction. For instance, multicultural societies embedded in the diversity of cultural inheritances, may be better equipped to facing the environment of increasing global interconnection. The redundancy of attributes that pervades flexible systems are better suited to delving into more complex routes of exchange and coordination that make greater innovation and social density possible.

4.2 Intercoherence

Inter-coherence provides the basis for mutual understanding and performative action in the networks. These collective instances of behavioral cleavages evolve from semantic forms pervasive in the contextual conditions of the clusters of artifacts and signs. In particular, I mean that semiosis is the way in which final causality collapses with actual behavior.

Habits are the instances in which behaviors are continuously assessed and vindicated on the grounds of instrumental scrutiny. Most generally, inter-coherence is delimited by the performative instances of the decision-making of actors, such as consumers, workers, public officials, and businessmen. All these social positions are entitled with rights and obligations and entangled functions in the networks. The semantic understandings pervading in the fluxes of exchange are the backing up for the specific performances required for each social position. Most importantly, behaviors are the feedback inputs for the technological design and the mechanisms in charge with the efficient causality.

Development is thus the combination of performances in the pursuit of specific outcomes of improved living conditions. These as well as freedom and social justice are mediated conditions in which actors in networks are embedded. Inter-coherence depends upon the working of beliefs that are the outcome of the human reflexive endowments. Decisions are nurtured in the semiotic operation of artifacts in the symbiotic relationship with human cognitive functions. In this terms, agency is a bimodal construct developed by the organic and inorganic features of the networks.

Consider, for instance, how patterns of sanctioned behaviors are interlocked with the mechanisms of artifacts. The ways in which users engage with technology determine how techno-mechanisms are used in actual performance. Likewise, cell phones and internet applications are devices used by local communities that can amplify their already ongoing exchanges, such as commercialisations or the search for job opportunities. Consequently, the technological appliances are assembled up with the practices interrelated with the contextual outcomes and the modes of

interplay already existent among actors.

Additionally, the feedback of responses by the users provide the basis for the design of new mechanisms and the refitting of the modes of exchange. In the case of the modernization of agriculture, the ways in which new inputs are combined and how technologies are applied are intertwined with the implementation of farmers' practices in the field. Conversely, the roles of the social positioning that mediate the adoption of practices with the patterns of behavior are at the core of performance. Design is undergirded on the performance of the mechanisms in which technology is assembled according the flows of entropy delivered. Hence, the important consequence of this perspective is that natural and cultural systems are integrated into users' modes of interplay.

Summing up, semiotic inter-coherence is structured, at its base, according to five properties as shown in Figure 4, (i) performativity, (ii) assertivity, (iii) identity, (iv) interactivity, and (v) reflexivity. These are assignedaligned with the performance mediated among users in networks of semiotic assemblage. Inter-coherence is furthermore defined by the flows of intercourse from final to efficient and then to formal causality.

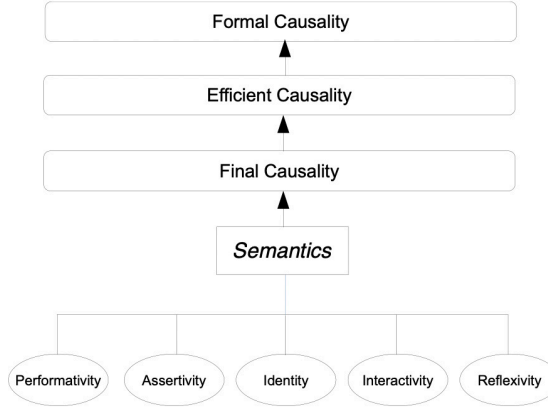

Figure 4. Inter-coherence.

Performativity. Actors in the networks deploy modes of mutual commitment to accomplish causalities. Functions are performed inducing the emergence of causal powers according to these agreements. Performativity in that sense is an outcome of a system of interpretation that is operational at endorsing beliefs in the contextual conditions of the networks.

Users' performance and techno-design are interlocked in this constant interplay. Performance may be contextualized as an attribute of "habits of thought", in the Venblenian context of the continuous assurance of the *modus operandi* of the practices. In a grand a perspective, features such as the endorsement of common beliefs in the founding principles of the democratic regime and the rule of law are

depend on the actual performance of the actors in the network.

In a more parochial framing, innovation and niche market segmentation rely on features of use that are not always incorporated initially by design. For instance, software applications are the outcome of the features of how users engage with the properties of systemic programming. In Facebook advertising was deployed initially by small businesses as a free tool to advance commercial opportunities not screened initially by the internet industry. Through interaction, on-line communities gathered by the social media in settings of common features that induced the blending of core interests and practices matching sellers and buyers. In this process, the role of traditional ways of connection and commercial interplay tend to be reassessed and changed into different relationships. In sum, performance and design tend to conjoin with several degrees of freedom.

Assertiveness. As networks engage pursuing objectives regarded as desirable, some guiding towards action is required. In this sense, the collective intentionality encapsulates common grounds of outcomes that are framed as *conditions of felicity*. Narratives have an important role to guide and coordinate performance and to provide simplified schemes of causal relationships. Therefore, assertiveness is the property of the semantic forms to assemble coherently distinctive roles in time and scope, according sets of outcomes. Business plans, government agency projects, central bank reports, and many more, are instances leading the way from measures to results. In sum, assertiveness bridges the gap between means and ends. In a semiotic perspective, the task of deploying a guiding scheme is to achieve common grounds of acceptance and to guarantee features of adjustment perceived as legitimate. This is only possible if the assigned roles are active at delivering behavioral proclivities that match with the planned schemes.

In a general perspective, development is a grand narrative that features collective action into the direction of reforms. Any successful attempt to implement policies to revamp social structures in order to foster greater productivity and social inclusion requires the assignment of assertive thrusting utterances. Deng Xiaoping's "reform and opening up" in China, the German "black zero" commitment to austerity, and the Trump's "America first" policy are examples of how assertiveness plays a crucial part at gathering collective acceptance and commitment.

Identity. Actors in networks perform roles that are assigned with defined rights and obligations. Identity is the outcome of the internalization by the individual of a position in the social structure. First, the attributes of the position enables the networking of resources and the causal powers that the actor is in disposition with. Second, the combination of different identities in pursuit of a common objective provides the specialization of capabilities and the extent of the synergies accomplished with the social intercourse.

Conversely, identities in networks are intertwined with artifacts. For instance, a government official is required to deal with functions such as financial reports, schooling plans, security surveillance, and preventive health schemes. Each of these assignments are combined with a collection of artifacts in which the specific identity is applied to perform with. As a result, artifacts are combined with the

identities and the functions performed to deliver causal powers. Equally, the role of this kind of symbolical reification is in charge of political leaders and business entrepreneurs during political crises and business unbalances. Hence, performance is the outcome of the internalization of these applications among actors, with the use of signs of status, to foster coordination and social order.

Interactivity. Interaction is the basis by which social intercourse is conducted in a coordinated way. Performance is a plural endeavor even if realized solely. Indeed, the mechanisms that make interactive behaviors effective are intertwined in the behaviors shared in the network. For instance, organizations make provisions and detailed arrangements to guarantee that practices are performed within acceptable margins of deviance. Nonetheless, innovation and non-conformance are also required attributes of interaction to the emergence of new proclivities and adaptive measures of flexibility.

Additionally, interactivity must deal with the patterns of information shared among actors in the network by the delimitation of the criteria of privacy and openness of disclosure. Cultural and technological biases are constantly reinforced or taken aside by the *modus operandi* of the practices regarding the pooling of information. Therefore, characteristics such the actors' engagement with others in their functions and performances depend on the contextual conditions framed in the intersection of the techno properties and the cultural endowments. Organizational cultures, and national or regional *ways of life*, are spread from more or less rigid acquaintance to rules and norms, for instance, and they determine the ways of how commitments to common objectives are bound together. All these phenomena result from a plethora of signs that are not only transmitted by formal causality. Body language, norms of etiquette, and memes in general are important determinants in the integration of individual performances into the borderline fringes of collective intentionality.

Reflexivity is the most unique attribute of human beings abiding on the constant flows of reassuring proclivities. It is a cognitive attribute of forging and abandoning habits of thought. The basis for the setting aside behavioral patterns entrenched in social structure requires the reassessment of the performed actions. Consequently, the openness to scrutiny and the exchange of diverse points of view qualify the emergence of the conditions for change.

Reflexivity is also a property of stability in terms of the instrumentality of the acquired modes of social positioning. This means that the conditions of exchange in the networks are reinforced when the techno-properties of artifacts are stable. Technology is the main efficient impetus of causality that operates in the framing by which actors measure the degrees of adequacy of the semiotic modes of interplay. For this reason, the development of new techno paradigms increases the incentives for the reconfiguration of functions in the social structure. As the pressures to abandon "old ways of doing" amount, new attributes are assured by reflexivity. In this perspective, closed regimes are not amid environments for change because the conduit of self-reflection is not linked with the free exchange of ideas.

Semiotic reflexivity is hence operated by the workings of habits and routines

intertwined with the structure of the social positioning. For instance, the advancement of the scientific knowledge is no clear-cut indicator for innovation in productive systems. The exchange of information and the internalization of economic gains increase the incentives to the appliance of research and development in the supply chains. Therefore, the scope of the operation of functions and the abandonment of stringent proclivities are magnified in open systems. The measures of applied reflexive means abound, as in recall campaigns or the sorting of group segments for advertisement and the data analysis of audiences. All these devices are ways by which organizations put forward reflexive forms of systemic scrutiny.

4.3 The Semiotic Integration of the Modes of Development

The semiotic scheme, to sum up, is the interplay of syntactic and semantic forms that structure niche dispositions into collective performance (see Figure 5). First, signs are the systems of information and knowledge that underpin the design of artifacts according the behavioral proclivities. Second, networks are in the role of the assemblage of the niche dispositions via normative systems of rights and obligations.

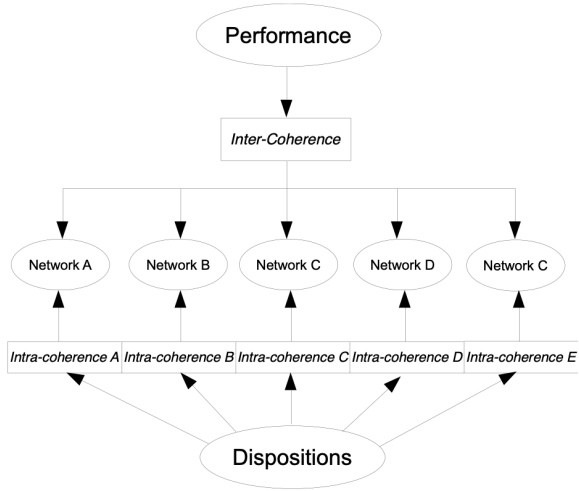

Figure 5. The Semiotic System of Intercourse.

On these grounds, intra-coherence is the causality of the symbolic attributes of the normative instances in the social structure. Thus, the meanings that abide in the syntactic interplay is at the core of the collective performance. These are the properties within the scope of the behavioral dispositions encapsulated in the semantic forms so that inter-coherence is the operation of the performative feedback inputs that drive the channels of path-dependence in semiotic exchanges. The selection of instrumental responses is adaptive and built upon the attributes

of the mutual reasonings elicited by the semantic forms of the system. In sum, the actual performance is the consequence of continuous assessments through the symbolic features of the techno-paradigm.

Hence, development in the sense of *life flourishment* is the integrated bimodal entanglement of the intra and inter-scopes of semiotic causation. A key outcome is that selection and adaptive capabilities are framed in the specific *conditions of felicity* in the networks. Underdevelopment, in these terms, is a collective observer-emergent state that makes evident how actors are assembled with the workings of the semantic properties. Most importantly still, the challenges to improving living conditions are deeply rooted in the attributes of symbolic exchanges.

5. Final Remarks

The current global civilization evinces greater diversity, which requires the strengthening of collective synergies. The task of delivering coordination via the bimodal semiotic coherence abides in the structure of the signs that encapsulate beliefs. Under these premises, three aspects of these entanglements deserve to be focuses in development studies :

(1) Dual societies with a high degree of inequality are badly equipped to face the challenges to induce the convergence of the modes of technological advancement and institutional reform. Policies that deliver income fairness are intertwined with common grounds of dispositions. This is a reason why to trigger symbolic features of civic participation is at the core of the collective performance.

(2) Multiculturalism in a semiotic perspective is not just the side effect of niche networks. Embedded diversity requires the emergence of the blended assemblage of systemic multicultural structures that refit the fabrics of the normativity of social positioning in society. Development in these terms is only possible when dispositions are combined and reasserted by the inclusiveness in the fluxes of knowledge and information.

(3) The environmental concerns and the challenges of the climate crisis are of great importance to the drives of change in the semiotic causation. Habits and behavioral propensities are learned and performed by artifacts that reconfigure already entrenched practices. Signs (institutions) and knowledge (technologies) are combined in the process of delivering sustainable attributes to the supply chains.

In all these challenges, the development of new modes of semiotic intercourse requires that intra and inter-coherence be reconfigured simultaneously. The niche arrangements and the relations among the dispositions in the networks are structured in parallel with the advancement of grand mechanisms of the geopolitical arena.

Homo sapiens has flourished during hundreds of thousands of years in small groups of nomadic hunt-gatherers. Fundamental profiles of the human semiotic interplay have been forged by specific cognitive proclivities of these long dated performances. It is not by chance that symbolic intercourse and compromise in small communities are better framed with the historic sociability of human kind.

The post-industrial civilization and the current digital connective era provide increasingly challenges and opportunities for greater diversity and complexity in coordinated global solutions. In this perspective, semiotics and convergent intentionality are at the core of the issue of delivering performances to enhance the human potential and the scope of collective endurance in development.

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Abstract

Development is a concept whose ontological foundations are include phenomena, such as technologies, institutions, and cultural traits that embody the determinants of development differentials. This contribution argues that semiotics is the science to study these complex phenomena of development. Its approach is based on Charles Sanders Peirce's semiotics and John Searle's analysis of social reality. Development trajectories are depicted as specific compounds of institutions (signs), technologies (objects), and markets (interpretants) that create meaningful

properties depending on symbolic forms. Development is a socially structured and observer-relative phenomenon. Developmental semiosis depends upon symbolic powers that structure and assemble collective intentionality. The paper advances two critical conditions essential to development. The first is semiotic intra-coherence, which is related with the bridging of dispositional functions in a coordinated way in networks of artifacts and users. The second is inter-coherence. It takes place as the supervenient causality of social structures and the performative character of habitual patterns of behavior. Both are intertwined in syntactic and semantic forms evolving in time by forging the development of path-dependent trajectories.

Keywords : Economics ; Semiotics; Development; Social Ontology; Collective Intentionality

Résumé

Le développement est un concept dont les fondements ontologiques incluent des phénomènes tels que les technologies, les institutions et les traits culturels qui incarnent les déterminants des différentiels de développement. Cette contribution soutient que la sémiotique est la science pour étudier ces phénomènes complexes de développement. Son approche s'appuie sur la sémiotique de Charles Sanders Peirce et sur l'analyse de la réalité sociale de John Searle. Les trajectoires de développement sont décrites comme des composés spécifiques d'institutions (signes), de technologies (objets) et de marchés (interprétants) qui créent des propriétés significatives en fonction de formes symboliques. Le développement est un phénomène socialement structuré et relatif à l'observateur. La sémiosis développementale dépend des pouvoirs symboliques qui structurent et assemblent l'intentionnalité collective. Le document met en avant deux conditions critiques essentielles au développement. Le premier est l'intra-cohérence sémiotique, qui est liée au rapprochement des fonctions dispositionnelles de manière coordonnée dans les réseaux d'artefacts et d'utilisateurs. La seconde est l'intercohérence. Elle prend place comme la causalité survenante des structures sociales et le caractère performatif des schémas de comportement habituels. L'un et l'autre s'imbriquent dans des formes syntaxiques et sémantiques évoluant dans le temps en forgeant le développement de trajectoires dépendantes du chemin.

Mots clés : Économie; sémiotique; développement; ontologie sociale; intentionnalité collective

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