

The processes of meaning making, starting from the morphogenetic theories of René Thom

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**Raffaele De Luca Picione and Maria Francesca Freda**

Department of Humanistic Studies, University of Naples Federico II, Napoli, Italy

Abstract

Each process of meaning making can be seen as a field of semiotic organization that shows a variety of continuities and discontinuities, rather than as a linear trajectory of accumulated signs, progressively articulated through syntagmatic chains. In this work, we address the idea that the sign is a discontinuous form within a field; it emerges where there are different trajectories of meaning, different epistemic positions, and different subjective or affective ways of experiencing a phenomenon. The central aspect of the paper is based on the idea that the sign is a *form* within a semiotic relational system that allows its emergence towards a “morphogenetic field of semiosis”. The starting point for this discussion is the philosophical, mathematical and semiotic work of René Thom, which addressed the relationship between continuity and discontinuity in natural human, social, and linguistic phenomena.

Keywords

Semiosis, cultural psychology, continuity and discontinuity, meaning making process, catastrophes theory, morphogenetic field of semiosis

Introduction

A common misconception about the process of meaning making is that it is a linear and continuous trajectory, consisting of an accumulation of signs, which are organized progressively and subsequently in syntagmatic chains. From this perspective, the signs are understandable only within a shared code, through which there is a

Corresponding author:

Raffaele De Luca Picione, Dipartimento di Studi Umanistici, Università degli Studi di Napoli Federico II Via, Porta di Massa, n.1, c.a.p. 80132, Napoli, Italy.

Email: raffaele.delucapicione@unina.it

precise relationship between the signifier and the signified. We find this perspective in the semiotic model of de Saussure (1977), or in the model of communication by Shannon and Weaver (Shannon, 1948), where everything that falls outside the selected transmission channels is no longer information, but only noise. Recent perspectives in the name of modularism (Fodor, 1983) seem to still maintain such a linearity in the succession of different steps of elaboration.

Already in Peirce (1932) we find a clear criticism towards such a narrow view of meaning making process, reduced to a dyadic relationship between signifier and signified. He proposed that semiosis is always an interpretive process (and not just a coding/decoding process), consisting of triadic relationships between the object, representamen, and interpretant. This process is potentially unlimited, but stops momentarily through the formation of habitus (i.e. habitual patterns of interpretation).

Yet, other different semiotic models, aimed at understanding the complexity and discontinuity inherent in the process of meaning making, are the dialogic models, at the base of which is the idea of conflict between different positions, perspectives, and trajectories of meaning. Consider the dialogism and multi vocalism of Bakhtin (1981) or the relationship between center and periphery in Lotman's semiosphere (2005). In these semiotic models, every possible process of signification occurs through the comparison between different perspectives and different points of view (both intrasubjective and intersubjective). The creation of novelty and the production of meaning are the result of dialogue and of the clash of two different positions, generating asymmetry and conflict.

In this paper we intend to discuss a dynamic perspective of sensemaking according to which the sign is considered as a discontinuous form within a field. Such a field consists of many different trajectories of meaning, several epistemic positions, and different idiosyncratic and subjective ways to experience it. We discuss the relevance of the concept of form and its usefulness in order to consider the sign as a form emerging from a "semiotic morphogenetic field", in which both continuous trajectories of meaning and discontinuous ones are active (De Luca Picione & Freda, 2014, 2012). In this sense, we view the form as the emergence of a dialectical process of semiotic mediation between different temporal (continuous and discontinuous) and spatial (background/foreground, in/out, part/whole) relationships (De Luca Picione & Freda, 2014).

Form and morphogenesis

The form is never stable, but always emerges from forces that are present and acting in the field. A form is the result of continuous dialectical tension from different development trajectories. Dialectical development means that the form is not a fixed entity, but rather a process that shows continuous mediation and comparison between the opposing forces of similarity and difference, generalization and specificity, conservation and innovation, which are generated in the field. Whenever a form is constituted as a closed gestalt, it exerts an effect in the field,

and this creates a never-ending circle of tension between the figure and the background (Metzger, 2006).

In regard to our interests in this contribution, the idea of field assumes the function of mediation and space/time connection (Valsiner, 2001), in which it is possible for different subjects to be in a semiotic relationship.

The *morphogenetic field* (De Luca Picione & Freda, 2014) is a space/time relationship, in which there is a recursive relationship between discontinuities and the continuity of the phenomena that takes place inside. Only within a field, defined spatially and temporally, the discontinuity is possible, as each possible transformation occurs over time, causing change and movement.

This perspective on the morphogenesis as the temporal development of the field relations is not new. The study of nature and biological phenomena in the past has given rise to reflections and very interesting hypotheses about morphogenesis. It is worth mentioning, for example, that even Goethe displayed a strong interest in morphogenesis, for whom the study of the forms was a rigorous way of synthetically studying nature, compared to aseptic mechanistic approaches, considered to be atomistic and reductionist. In the *Metamorphose der Pflanzen zu erklären* (1790), von Goethe explains how the entire structure of the plant is derived from the transformation of a seed and how the process of metamorphosis creates many diverse forms of the same organ (in the case of plant, this organ is the leaf). The morphogenetic process, as explained by Goethe, would be a temporal process of phases of expansion and contraction. Although his naturalistic and biological studies were strongly contested and overshadowed, through his morphogenetic approach Goethe contributed significantly to this science, as is evidenced by his discovery of the intermaxillary bone in the skull of man.

Other significant morphogenetic studies include those conducted by zoologist D'Arcy Thompson, who posited that the form is the product of a diagram of forces (in this perspective, however, the forces are exclusively physical). The form is the product of both the forces from which it was generated and those that keep it in time. D'Arcy Thompson's study emphasizes the importance of growth in the concept of the form (1942), and focuses on the study of forms, utilizing mathematical grids and patterns suitable for the understanding of the development and comparison of living organisms. Although he speaks of growth and maintenance over time, the perspective of Thompson is basically static, because the form is studied as a linear mathematical transformation (Di Napoli, 2010).

With this background, we move our focus to the form and its relationship between continuity and discontinuity, stability and change, within the confine of a field. We consider this issue to be central to the development of any process of meaning making.¹ In that respect, we consider some questions posed by the mathematician and philosopher René Thom (b.1923-d.2002) about 'his theory of catastrophes, particularly his handling of the concepts of "*pregnancy*" and "*salience*". Although his influence has had both moments of great diffusion and periods of decline, his contributions have led to the birth of chaos theory (Gleick, 1987; Li & Yorke, 1975; Lorenz, 1963; Mandelbrot, 1977), dissipative complex structures

(Prigogine, 1961, 1980) and dynamic systems (Alligood, Sauer, & Yorke, 2000; Valsiner, Molenaar, Lyra, & Chaudhary, 2010; Wiggins, 2003), and retain important insights for research and scientific epistemology, as well as holding promise for future developments in semiotics.

Catastrophe theory (CT)

CT (Thom, 1972) was developed within the philosophical scientific paradigm of Chaos Theory, which emerged simultaneously. Chaos theory is concerned with the mathematical modeling and study of the behavior of non-linear dynamical systems, which present a series of specific characteristics. In fact, chaotic dynamical systems show an exponential sensitivity to initial conditions. Systems of this kind are governed by deterministic laws, but are able to present with empirical randomness in the evolution of the dynamical variables.

In other words, the system has a behavior that is overall regular, but, in detail, irregular, and therefore it is impossible to predict its development in future moments.

This random behavior is only apparent when we compare the asymptotic temporal trend of two systems with initial configurations that are arbitrarily similar. The evolution of a system in time is described by the phase space. Many non-linear dynamical systems have the fascinating ability to evolve over time toward definite trajectories, which are termed *attractors*. The evolution of the system is described by the “phase space”, which is an abstract mathematical space in which each point describes the entire system. While the system changes, the point describes a trajectory in the phase space. Each variable is represented by a coordinate in a different dimension of the phase space. When the system changes, the point representing its state in the phase space will move within that particular space, describing a trajectory. Different initial states correspond to different starting points in the phase space and generally give rise to different trajectories (Gleick, 1987).

An attractor is a set toward which a dynamic system evolves after a sufficiently long time. In order for such a set to be defined as an attractor, the trajectories that come close enough to it must remain close, even if slightly disturbed. The trajectories can be periodic, chaotic, or of any other type. From a geometric point of view, an attractor can be a point, curve, variety, or even a more complicated set with a fractal structure (strange attractor) (Gleick, 1987).

In this innovative theoretical landscape of the nascent paradigm of complexity, Thom conceives the morphogenetic principles of CT. The French mathematician in fact initiates a general, in-depth, and fruitful comparison between the notions of transformation and form.

In the words of Espinoza (1995): “Thom makes an effort to combine the theoretical tools of the theory of dynamical systems (dynamic genesis of forms) and differential topology (static genesis of forms) to explain catastrophes or discontinuity of the regions where they produce abrupt changes of state, of the edges or

boundaries of solids, phase transitions, etc. [...] The form organizes the matter, giving it unity. Nothing that exists is reduced to the actual being, since the actual being comes out of the virtual world. The potentiality is interpreted geometrically as a singularity. In a topological sense, a singularity appears when the points of a surface are projected on top of one another, while the surfaces are topologically deformed (in a few words, topology is the study of the properties of the objects that are invariant by a continuous transformation). The being-in-action is interpreted, in turn, as the development that stabilizes the description of a singularity” (p. 322. Our translation from Spanish).

Thom considers nature to be a “*catalog*” of forms, which have their own cycle, arise, come into conflict with each other, die and experience constant evolution. Any particular form (such as that of a leaf, a stone, or any living being), in order to be identified, must have a certain stability; small perturbations cannot change the essential characteristics. Thus, the forms have their own continuity and relative stability. As Rossi (2011) says: “Reality would then show itself through the borders which delimit it, the distinguished forms it assumes, so giving rise to geometrical notions linked to concrete experience” (p. 96).

At the same time, situations can be observed in which small changes lead to big events. According to Thom, the interest of morphogenesis as a discipline is merely to study these processes and changes in forms, or catastrophes.² The classification of elementary forms is possible by tracking the stability of the forms, as well as that stability in the process of change.

CT aims at explaining and providing a description of abrupt changes or sudden changes of state between situations of structural stability (i.e. the insensitivity of the system to small perturbations). CT is based on Heraclitus’ philosophical assumption that conflict is the source of all things, and that every form has its origins in a conflict (Kirk, 1954). Through the efforts of Thom, CT took a mathematical guise, in which a catastrophe is defined as the critical and degenerated point of a smooth surface (everywhere derivable), defined in a Euclidean space of n dimensions, since, in this space, radical bifurcations correspond to the behavior of the system.

Each discontinuity is then understood as a critical phenomenon induced by a singularity of the underlying dynamical system.

In the summarizing thesis at the end of his book “*Structural Stability and Morphogenesis*” (1972), Thom states six points:

1. Every object, or any physical form can be represented by an attractor, C , of a dynamic system in a space, M , of internal variables.
2. This object shows stability, and therefore can only be perceived if the corresponding attractor is structurally stable.
3. Each creation or destruction of forms, each morphogenesis, can be described with the disappearance of the attractors representing the initial forms and their replacement for capture by the attractors representing the final forms. This process is defined as catastrophe (and may be described on a space of external variables).

4. Each structurally stable morphological process is described by one (or a system) of the structurally stable catastrophe(s) on a space of external variables.
5. Every natural process decomposes into structurally stable islets, or chreods.³ The set of chreods and the multidimensional syntax that supports their respective positions is a semantic model.
6. If you consider a chreode, *C*, to be a word in this multidimensional language, the meaning of this word is nothing more than the global topology of the associated attractors and that of the disasters that it undergoes. In particular, for a given attractor, the meaning is defined by the geometry of its domain of existence in *P* and by the topology of disasters, adjustments to which limit that domain.

(Thom, 1972, our translation from Italian Edition, pp. 361–362, Torino: Bollati Boringhieri, 1975)

Therefore a catastrophe is an unstable, discontinuous and unstoppable phenomenon, it is a jump from one stable state to another. Thom's epistemic interest lies in overcoming "formal models"—that are aimed at the description of states—, preferring dynamic models that are attentive to the evolution in time of the form developed within the system. The CT model explicitly waives explanatory and etiological positions, recognizing itself as purely qualitative, without predictive power and possibility even pragmatic (Fabbri, 2006). Thom posits that the relevance of CT lies in its use of "metaphysical", rather than quantitative, verifiable and testable means, in opposition to controversial applications of CT in a variety of disciplines including biology, economics, sociology, psychology, and neurology, by the English mathematician Zeeman (1977).

In fact, CT is free of the material substrate and requires the invariant forms that would occur in nature to be in every process of discontinuity. In the original formalization of CT, seven discontinuous forms are identified, seven elementary catastrophes (fold, cusp, swallowtail, butterfly, elliptical umbilic/pyramid, hyperbolic umbilic/wallet, and parabolic umbilic/fungus—see Appendix for more detail). Thom's relevance centers on the qualitative differences of behavior that are assumed by the system in its specific regions. These differences are not reversible, and show a non-linear behavior, not subsumed by mere quantitative difference. From a topological point of view, there are regions of instability (i.e. the areas in close proximity of a bifurcation, or a catastrophic event in the system), in which certain phenomena may occur, including hysteresis,⁴ bimodality, divergence, sudden jumps from one point to another, areas of inaccessibility, abnormal changes, or non-linear responses. These behaviors of the topological space, according to Gilmore (1993), are indicators of the presence of catastrophic behavior. However, the identification of seven basic forms of catastrophe has led to fierce scientific and philosophical debate on the ontological nature of these forms (which Petitot call "archetypes"), because it seems that the forms freeing themselves from the material substrate assume values of absolute Platonic ideal entities. In this perspective, Petitot (1985) appeals to the Aristotelian concept of "*ilomorphism*", namely, the aspiration of matter to become form.

However, Thom does not deny the importance of matter and its constraints, rigidity, invariance of volume, etc. His interest lies in the productivity of the relationship between force and form, between the constraints proposed by matter and the forms that it takes on a phenomenological level, giving rise to singularities. Thom posits that the observed forms in nature number more than seven, because relational systems cannot be reduced to a few exclusive dimensions. However, he admits that there are certain invariances in morphogenetic processes and the focus of CT rests precisely on the relationship between discontinuity and continuity in the development of a system (in the ontogeny of an organism, for example) and between the singularity and invariance of some forms present in natural phenomena.

The second Thom: Semiophysics (SF) and the concepts of salience and pregnancy

Thom further addresses Aristotle and his theory of genres⁵ when he coins the neologism “*Semiophysics*” (Thom, 1988), and the concepts of *salience* and *pregnancy* in a new epistemological context of research and reflection, creating new ways to characterize discontinuity and continuity.

Thom’s semiotic interest in SF represents the second period of his intellectual production, and, recognizing the predictive inability of CT, he also rejects the mathematical formulation of human phenomena, although CT maintains its hermeneutic value of qualitative descriptions of the detection of discontinuities in phenomenal languages.

As pointed out by Bundgaard and Stjernfelt (2010), Thom’s main interest is the interdependency or fundamental correlation of discontinuity and continuity: meaningfulness implies morphological detachment and saliency, which is, in turn, a detachment from, and thus an articulation of, a continuum.

Although some tend to identify clear boundaries between the structuralist theoretical period of CT (with a Heraclitean emphasis on conflict) and the post-catastrophe period (with a Parmenidian emphasis on the continuum and the slow flow of “*pregnantial*” meaning), Thom never renounces the interdependence of continuity and discontinuity. Even as he prepares to assign an ontological primacy to the continuum, the distinction between regular and irregular, and between the concept of continuity and discontinuity, remains central and indispensable (Bundgaard & Stjernfelt, 2010).

SF is a morpho-dynamic study of the expression and contents of language. It is a project that seeks to bind physics and language, through bold examples of isomorphisms between physical processes and those of linguistic significance. With this renewed interest in semiotics, the *actanciality* becomes a key concept of Thom’s journey. Through the “semiotic square” of Greimas (1986), he observes that the oscillation of values is a process within a dynamic model, in which discontinuous catastrophic jumps (hysteresis) occur. This allows the search for a syntax of actants, leading to an understanding of the process of signification as one of conflict

and antagonism between different forces. Again, forms and forces are two inter-related aspects of phenomenal processes (including linguistic). Force and form are intended to be in reciprocal presupposition.

The central idea of SF (also influenced by Tesnière's structural grammar, 1959) is that, in the center of each sentence, there is a heavy kernel (the verb), around which lighter elements (nouns and nominal phrases) are turning, in a gradient-dynamic model (Bundgaard & Stjernfelt, 2010).

In this view, language is thought to simulate the syntactical structure of the events to which it refers. Through linguistics of sentences, Thom proposes a general theory of the interaction of spatial objects and space-time processes, describable as complex semantemes (i.e. "catch", "break", "tie", etc.) (Fabbri, 2006). Thom proposes a universalist hypothesis, in which the great syntactic structures (and narrative) are derived from the formal structure of the major interactions of biological regulation (Thom, 1988). He constructs the representations of stable forms ("*logoi*") and their morphogenesis through a universalist assumption that crosses different biological processes, such as life and death, eating, playing, waking, dreaming, etc. It is this hypothesis that introduces the concepts of pregnancy and salience.

The idea is that any ontological domain must possess concepts of two types: simple, stable, spatially well-defined forms (saliencies) and meaning-bearing forces that are able to propagate between saliencies and to inhabit and modify these saliencies in stable and characteristic ways (pregnancies)—namely forms and forces (Bundgaard & Stjernfelt, 2010). The concepts of pregnancy and salience are built on the semiotic model of reciprocal presupposition between signifier and signified. Thom, however, builds on the assumption of arbitrary signs, by introducing a dynamic point of view and taking into account the specific constraints of space and time (Fabbri, 2006).

Salient (S) forms are discrete forms that are detached from a continuous background, which recalls a subjective discontinuity with short and transient value in the perceiving organism. Pregnant (P) forms are those soaked in intense biological valencies (i.e. hunger, fear, sexual desire, etc.), eliciting the deep and longstanding "thymic" effects of attraction and repulsion. These pregnancies propagate as continuous fluids, investing and infiltrating salient forms. The latter, in turn, emit other pregnancies or "figurative effects", which are also intended to elicit new saliencies in a generalized polysemy. According to Thom, language articulates a pregnant predication of utterances, saliently indicative of enunciation.

Additionally, linguistics is described as the way in which a meaning, associated with a morpheme, interacts with a particular pregnancy, to which the salient forms are referring. The interplay of pregnancies/saliencies extends from the signals of social animals to the grammatical structures of languages, from technologies (seen as an extension of organs) to the social ritual, and from the ratiocinative activity to the magical and religious. In humans, these cognitive and affective representations ("the affectivity in the form of pleasure or pain is the engine of the propagation of pregnancies", Thom, 1988, p. 27) would not be genetically predetermined, but

related to cultural acquisitions, such as social organization, family, or community» (Fabbri, 2006, pp. 15–16, our translation from Italian).

It seems important to note that, although Thom draws his semiotic model in close connection with biology, he is careful to preserve the subjectivity of man from a strictly natural, genetically determined perspective. Thom recognizes the importance of culture and intersubjectivity as the foundation of the study of man, a biological being, who has to subjectivise itself. Thom argues that one cannot parameterize the human being nor reduce humans into an algorithm consisting of a defined number of variables that can predict their development and activities. We believe this issue is of central importance, since it leads us to consider the most varied human activities as processes, not rigidly defined by biological instincts, but as productions of meaning, hermeneutic activities, and constant symbolic creativity, all realized through interpersonal relationships and supported by cultural development. Although human interactions lead to the development of habits, and they are aimed at the establishment of stable relationships (social organizations, institutions, belief systems, etc.), a deterministic and reductionist approach fails in the intent of its knowledge. In this sense, the typical activities of the human being, such as games, language, the experiences of pleasure and pain, the arts, etc., are processes that always take place through intersubjective interactions and through the development of an individual's own subjectivity within his cultural background, although the biological matrix always remains the necessary substratum.

An example of semiotic morphogenesis

Hereafter, we show the catastrophic reconfiguration that assumes semiotic, dynamic, and temporary process with a very simple example. The focus is placed on the emergence of the sign as a process of adjustment, a dialectic relationship of continuity and discontinuity, of different trajectories of meaning (with different levels of generalization) within an intersubjective relational field.

The relationship between the context and the emergence of the sign can be observed through a simple experiment that involves the use of the “*cadavre exquis*” technique. The term is derived from a game played in the 1920s, prompted by the surrealist movement in France. It is a non-competitive game that consists in the composition of a text through the progressive addition of words in turns, but the participants can only see the last written word. The name comes from the first sentence that was achieved, “*le cadavre exquis boira le vin nouveau*” (“*The exquisite corpse will drink the new wine.*”)

We performed the experiment several times with groups of people engaged in a common and shared task discussion of a specific topic—during a match on TV, during the celebration of a marriage, during a conversation, etc.

The most preliminary interesting finding was that the choice of words and the shared production of a text reflect constant processes of semiotic reconfiguration and, at the same time, a generalized continuity oriented by an intersubjective context.

We observed that the emerging words were very different, heterogeneous, and connected by very different associative links. However, the set of words that emerged had a continuity of meaning with respect to the topic of the discussion, the affective climate (e.g. of the match, marriage, topic of conversation, etc.). The choice of words somehow shows continuity with respect to higher-levels of meaning that were structured during the group's activities. Obviously, the emerging signs were quite varied, but they show their semiotic/semantic interconnection in a contextual intersubjective dimension (De Luca Picione & Freda, 2012; Freda, 2011; Neuman, 2003; Salvatore & Freda, 2011; De Luca Picione, 2014; Esposito & Freda, 2015).

This leads to the consideration of context as a "morphogenetic field of semiosis" (De Luca Picione & Freda, 2014), namely a topological space intersubjectively created, within which the signs (produced by subjects) emerge and make sense through a continuous, catastrophic dynamic of reconfiguration. This field feeds a certain activity of recursivity through the emergence of signs (in fact, signs that emerge always have a bond of pertinence with hypergeneralized fields). The sequence of emerged signs is not a linear and syntagmatic accumulation of signs, but a catastrophic movement of continuous reconfiguration. This acquisition of new configurations is chaotic, sudden and unpredictable. Semiotic production is, in this sense, a complex dynamic organization of signs, rather than a syntagmatic linear chain. The semiotic setting proceeds through topological re-configurations when unstable areas of the field are crossed.

Following, we show one of some word strings that we achieved by the game:

"Breast → breastfeeding → mom → father → sister → cretin".

We asked to perform, according rules that we illustrated above, some people who participated in the discussion about women with breast cancer. The round was conducted about half an hour after that discussion was terminated. One of the authors gave instructions in the game, trying to be very clear and concise, without providing any suggestion.

Returning to the example, subjects were asked to write the first word that they associate with the word just read. There is no explicit topic that organizes the choice of terms according to a semantic criterion. The pertinentization of the semiotic field (context) implicitly reflects the dynamics that the group was experiencing. The sign (the word the subject writes in the game) is a sign that emerges through the semiotic hierarchy temporarily activated (Valsiner, 2001, 2007) by the memory of an inter-subjective morphogenetic field, by subjective memory and by the last present sign (the last readable word). The last word works as trigger.⁶

The verbal associations are a semiotic development in a process of temporal irreversibility. They create a micro-pertinentization (as a subclass of the wider context). The discretization and the semiotic delimitation by a sign (in this case the word) imply non-discretization (Kibrik, 2012). According to the semiotic perspective that we are using, this is achieved by the collaboration of two semiotic processes: the contextual pertinentization, which is aimed at delimitation and

definition, and generalization, which addresses homogenization and loss of clear and well defined boundaries. Each new sign generates an area of instability. It is regularized, stabilized, or pushed, through semiotic mediators, accelerating the process towards catastrophe, or the reconfiguration of a new attractor (new hierarchy semiotics).

Discussion

When referring to CT and to the use of pregnancy and salience in SF, Thom argues that his interest lies in the possible “metaphysical” use of the results, rather than their quantitative verifiability. In fact, according to the criterion of verifiability (Schlick, 2008)—for which a statement is meaningful only if it is verifiable on the basis of empirical experience, CT and the relationship between pregnancy and salience are not strictly scientific. But this does not prevent it from being fruitful as a “metaphorical theory”, and furthering the development of epistemology or the creation of new perspectives aimed to grasp at the discrepancy of the development of phenomena.

We believe that Thom’s studies encompass a wide field and can be of great interest for understanding the processes of signification.

In fact, the semiotic process of meaning making is, at all times, a process that deals with the change, discontinuity, difference, and state transitions between different balances. This leads us to ask how the discontinuities arise when a human being, struggling with the organization of his relationship with his environment, develops new capacities, new skills, new ways of acting, thinking and behaving.

Between the human being and his culture of origin, there is a dynamic relationship created through the mediation of the tendencies towards conservation/stability and transformation/innovation. Culture provides symbolic systems and semiotic devices for the relationships between people. However, the symbolic cultural repertoire, while ensuring and providing stable conditions for the ontogenetic development of higher mental function (Vygotsky, 1978), is not a rigid structure of pre-defined meanings, ready for use. Culture is not simply a conglomeration of symbols, signs, and information that is transmitted from one person to another. It is a process of semiotic mediation between humans and their environment (Valsiner, 2007). Culture is therefore constantly changing and the appropriation and use of cultural semiotic devices by its subjects is not a linear, regular or peaceful dynamic, but is, rather, a transformation and is contingent, contextual, and intersubjective. A new process of semiosis is established through the reversal, the crisis, the rupture of continuity, and the disruption of equilibrium (Hoffmeyer, 2014; Kull, 2014; Lotman, 2005). In each intersubjective relationship, by means of the dialogic form (discontinuous by its nature), there is a transition from the virtual to the actual, from possibility to facticity, from generalization to singularity, and from pregnancy to salience.

Although CT and the concepts of pregnancy vs. salience are subject to a process of ontology and reification, they are useful if they are read as complex dynamics

between continuity and discontinuity. In fact, the intellectual work of Thom renounces neither of the two dimensions, since the one presupposes the other. In this sense, in CT, the attractor state is understood as a dimension of relative stability and a catastrophe is understood as a moment of sudden transition to another attractor state. The catastrophe marks a difference, a reconfiguration that is “perceptible”. The development of the mind, through experiences and the use of their related signs, is continually needed in order to configure the person–environment interaction, in terms of both continuity and discontinuity.

This echoes the thoughts of Bateson (1979). A system, such as the mind (according Bateson, the mind is a system of relationships between the organism and the environment), functions on differences. It is developed through recursivity and the production of these differences, which generate information as they activate the system. The perception of difference in terms of a mental process is made possible by discontinuity, which can manifest as a change in time or as differences between the parts of the same system. However, discontinuities can exist only when the operation of a continuity precedes them. The system progresses through the relationship between continuity and discontinuity that allows the realization, not only of learning, but of “learning of learning” (*deutero-learning*). To be able to consider differences suggests that a process of change is always something that occurs within a context or framework of meaning that defines relationships and ensures the continuity and survival of the organism by modulating the changes. The contextual frame constitutes the continuity of a semiotic field, within which it is possible to give rise to discontinuous and singular phenomena. Essentially, discontinuity (change that produces a discernable difference) is possible within a continuous semiotic field (Freda & De Luca Picione, 2014; Freda, De Luca Picione, & Martino, 2015).

Similarly, a comparison between Thom and Lotman can be very fruitful. We think of Lotman’s *semiosphere* (2005), defined as a semiotic space, outside of which there is no possibility of semiosis. It is a semiotic continuum dealing with transformations of different types, located at different levels of organization. The semiosphere is still circumscribed with respect to the space that surrounds it, which is external or belonging to another semiotic sphere. According to Lotman (2005), the semiosphere must have some kind of consistency or continuity in order to distinguish something from what it is not. The processes of transformation occur on its borders as translations. Such translational processes allow a transformation function that assumes a catastrophic nature for the instability and structural irregularities between the *periphery* and the *core* (center) of the semiosphere.

In fact, Lotman (2009) distinguishes explosive and gradual processes. It is precisely this idea of explosion that assumes the function of propulsion in the search for meaning. Interrupting a relationship of continuity, the explosion makes the future uncertain. This triggers a process of signification, since “ignorance of the future allows you to assign a meaning to everything” (Lotman, 2009). The moment of explosion is an abrupt increase of meaningful information from the whole system. The time it takes to achieve exhaustion of the explosion is a turning point in the process (Lotman, 2009). The speed difference of change between the

slow and stable core and the fast and unstable periphery produces further changes and a constant reconfiguration of the semiosphere. Lotman posits that in any semiosphere, there is double tension between homogenization and differentiation, defining this idea as a *structural paradox*. This paradox does not immobilize the development of a semiotic system; on the contrary, it is the promoter of development (or even extinction). On one hand, the homogenization process provides continuity and unity between the parties, but on the other hand, differentiation enables the development of new capabilities, functions, and units.

So we have these processes of catastrophic transformation that are related to both spatial dimensions between the center and the periphery, and to the temporal dimensions of different transformation speeds. To use Thom's words, translation processes occur in regions of intense instability of the topological space of a system.

In referring to the human experience, a person is dealing with the interconnection of processes of different temporal connotations (memory, perception, and creativity) and those of different spatial/topological connotations, being at the same time a semiospheric (subjective) core and a boundary in the intersubjective relationship within social processes. From a semiosphere perspective, we observe that the transformation of culture takes place right in the border regions. The boundaries of these regions are characterized by greater topological instability. Each semiotic activity is accomplished through the identification and delineation of a boundary that allows a new relationship within the field and between the semiotic field and the extra-semiotic "undifferentiated" space. From a topological point of view, we observe that the core of the semiosphere has higher stability and is more gradual, ensuring the continuity and conservation of typical relationships in a specific cultural system. The periphery of the semiosphere, in opposition, is characterized by explosion and by a catastrophe of the processes of signification, generated by contact with diversity. Such a phenomenon permits change, innovation, and creativity, ensuring the evolution of the cultural system. The translation process (the central activity of the semiosphere) is a process that simultaneously activates two opposing tendencies of the topological semiotic field: the stability of the central areas that ensure the preservation of identity and the catastrophic instability of border regions, which introduce constant novelties into the system.

Conclusion

A sign can be understood as the emergence of phenomena within the relational field. The quality of an emerging sign enables new processes, dictated by catastrophic jumps from one configuration of the system to another. A sign is a form. The form is not a fixed entity, but is a process, showing a dialectical progress in virtue of the mediation and the comparison between the opposing instances of similarity and difference, generalization and specificity, and conservation and innovation that are generated in the field. Each time a form is constituted as an ongoing closed gestalt, it also exerts effects in the field, and this generates a never-ending circle of tension between the figure and the background.

As in Lotman's concept of the semiosphere, the morphogenetic field of semiosis is an area of development and sign production, in which each sign is not just a product, but it is a semiotic emergence of a dialectical tension between opposing trajectories of meaning within a relational field. René Thom's theories maintain their allure and invite reflection on the concept of form, as the phenomenal dimension that any semiotic process takes in time. The form does not belong to the boundaries of an object, but to the dynamic relationship between the forces in the field, whereby the continuity of a form is not a stagnation of the field, a fixed and motionless dimension, but the continuous maintenance of a tension, or the balance of a dynamic.

Catastrophes, namely stages of transition, maintain their interest because they force to grasp the morphological transformation in the development of a system.

Anyway many more efforts must be made to develop and implement a morphogenetic semiotic model and there are many difficulties to overcome. Many of these have already been revealed by reflection on the work of Thom. For example, the problem of dealing with the study of wider human contextual variability in one model is difficult to address. From a methodological point of view, difficulty also arises in following temporal developments of a morphogenetic model in its various phases.

We think it is important to develop possibilities and ways to observe and detect in a contextual perspective those signs that work as *threshold-like signs*, which namely are able to perturb the semiotic field, to make it unstable and lead *subject–environment form* toward a catastrophe. These are just a few essential issues that the study of morphogenetic semiotics must address in the future.

Notes

1. Even in a cybernetic perspective, particularly in Magoroh Mayurama's cybernetics of the second generation (1963, 1978), there is a fundamental development of morphogenetic epistemology. Morphogenetic processes are considered characteristics of open systems that are able, not only to preserve their identity through negative feedback (*morphostasis*), but also to start the processes of change in system/environment relations in entirely new and creative ways (termed *discontinuous changes* by Dell & Goolishian, 1981).
2. The etymology of the word is from ancient Greek and means "turn down", "change", or "overturning".
3. The *chreode* was introduced by physiologist and geneticist CH Waddington in 1957 in his book "*The Strategy of the Genes*" to indicate an obligatory path of development. This neologism is the result of a combination of two Greek words, *Khrè* (necessary) and *Oidos* (path). With this concept, Waddington means the canalized path of the development of an organism that, despite being disturbed, is able to return to an ordinary trajectory of development. The famous depiction used by Waddington was that of a ball rolling down the side of a hill following a pre-dug channel. Considering the many paths that the ball could take to get to the valley, Waddington envisioned the network of chreods as an "epigenetic landscape".
4. The *hysteresis* is the characteristic of a system that reacts with a delay to applied stresses, in dependence on its previous state. It is a phenomenon in which the state of a system at

any given time depends on its past history. Graphically representing the phenomenon, we observe that two different curves are necessary to achieve the two states of the system, according to the direction from one to another.

5. Aristotle considers the world to be made up of individuals (substances) that belong to specific natural genera. Every individual possesses, in itself, a precise model of development, and grows, trying to realize its natural end (purpose). Development, purpose and direction are thus intrinsic to the nature of each individual. Aristotle defines “genus” as that which is essentially composed of many that differ specifically. The genus is placed above the species and the species, extensively, over the individual. According to Aristotle, science is devoted to the identification of fundamental genera, but these can be grasped only by studying the experience of the individual substances. This requires the balance of empiricism (observation and sensory experience) and formalism (rational deduction).
6. We are studying this process more carefully in order to observe and describe the way and the kind of verbal associations in semiotic terms of continuity and discontinuity. We anticipate some of the observations that we are conducting on the results that emerge time to time by the realization of the game. The verbal associations are constructed through bonds of *semantic contiguity* or *semantic opposition*, and by means of *metonymic relations* (“the part for the whole”) and *metaphorical relations* (relation of similarity and analogy between the starting term and the metaphorical term). We can obtain several possibilities and results crossing these different semiotic ways of associating. We also observed that participants—without realizing it—often create short “association islets”, consisting of three, four or five words related by a strong related topic until they are overturned and transformed by the rupture of a sign, which introduces a new discontinuity.

References

- Alligood, K. T., Sauer, T. D., & Yorke, J. A. *Chaos. An introduction to dynamical systems*. New York, NY: Springer Verlag.
- Bakhtin, M. M. (1981). *The dialogical imagination*. Austin: University of Texas Press.
- Bateson, G. (1979). *Mind and nature: A necessary unity (advances in systems theory, complexity, and the human sciences)*. Cresskill, New Jersey: Hampton Press.
- Bundgaard, P. F., & Stjernfelt, F. (2010). René Thom’s semiotics and its sources. In W. Wildgen, & B. Per Aage (Eds.), *Semiosis and catastrophes. René Thom’s semiotic heritage*. Series: European Semiotics/Sémiotiques Européennes (Vol. 10). Bern, SW: Peter Lang.
- De Luca Picione, R., & Freda, M. F. (2012). Senso e significato. [Sense and meaning]. *Rivista di Psicologia Clinica*, 2, 17–26.
- De Luca Picione, R. (2014). The Case of Neuman’s “Computational Cultural Psychology”: An Innovative Theoretical Proposal and Welcomed Toolbox Advancements. *Europe’s Journal of Psychology*, vol. 10, pp. 783–791, ISSN: 1841-0413, doi: 10.5964/ejop.v10i4.806.
- De Luca Picione, R., & Freda, M. F. (2014). Catalysis and morphogenesis: The contextual semiotic configuration of form, function, and fields of experience. In K. R. Cabell, & J. Valsiner (Eds.), *The catalyzing mind. Beyond models of causality. Annals of theoretical psychology* (Vol. 11). New York, NY: Springer.
- de Saussure, F. (1977) *Course in general linguistics* (W. Baskin, Trans.). Glasgow, UK: Fontana/Collins.

- Dell, P. F., & Goolishian, H. A. (1981). Order through fluctuation: An evolutionary epistemology for human systems. *Australian Journal of Family Therapy*, 2, 175–184.
- Di Napoli, G. (2010). *I Principi della Forma: Natura, Percezione e Arte [The principles of the form: nature, perception and art]*. Torino: Einaudi.
- Espinoza, M. (1995). Rene Thom: De la Teoria de Catastrofes a la Metafisica. *Themata*, 14, 321–348.
- Esposito, G., & Freda, M.F. (2015). Evaluating training context competence of use: productive and unproductive models of use. *Evaluation and Programm Planning*, 2, doi: 10.1016/j.evalprogplan.2015.02.003.
- Fabbri, P. (2006). Introduzione a Morfologia del semiotico di René Thom. [Introduction to René Thom's morphology of the semiotic]. In R. Thom, & P. Fabbri (Eds.), *Morfologia del semiotico*. Roma: Meltemi.
- Fodor, J. (1983). *Modularity of mind: An essay on faculty psychology*. Cambridge, MA: MIT Press.
- Freda, M. F. (2011). Understanding continuity to recognize discontinuity. *Integrative Psychological & Behavioral Science*, 45(3), 335–346. DOI: 10.1007/s12124-011-9169.
- Freda, M.F., & De Luca Picione, R. (2014). The identity as a system of translation of the boundary between subject and context. In: S. Salvatore, A. Gennaro, J. Valsiner (Eds.), *Multicentric Identities in Globalizing World. Yearbook of Idiographic Science* (Vol. 5). Pp. 179–183. Information Age Publishing, Charlotte (NC).
- Freda, M. F., De Luca Picione, R., & Martino, M. L. (2015). Time of illness and illness of time. In L. M. Simão, D. S. Guimarães, & J. Valsiner (Eds.), *Temporality: Culture in the flow of human experience*. Charlotte, NC: Information Age Publisher.
- Gilmore, R. (1993). *Catastrophe theory for scientists and engineers*. New York, NY: Dover.
- Gleick, J. (1987). *Chaos: Making a new science*. London: Cardinal.
- Greimas, A. J. (1986). *Sémantique structurale [Structural semantics]*. Paris: Presse universitaires de France.
- Hoffmeyer, J. (2014). Semiotic scaffolding: A biosemiotic link between Sema and Soma. In K. R. Cabell, & J. Valsiner (Eds.), *The catalyzing mind. Beyond models of causality. Annals of Theoretical Psychology* (Vol. 11). New York, NY: Springer.
- Kibrik, A. (2012). Non-discrete effects in language, or the Critique of Pure Reason 2. In: *Paper presented at the Fifth International Conference on Cognitive Science*, Immanuel Kant Federal University, Kaliningrad, June 2012.
- Kirk, G. S. (1954). *Heraclitus: The cosmic fragments*. Cambridge: Cambridge University Press.
- Kull, K. (2014). Catalysis and scaffolding in semiosis. In K. R. Cabell, & J. Valsiner (Eds.), *The catalyzing mind. Beyond models of causality. Annals of Theoretical Psychology* (Vol. 11). New York, NY: Springer.
- Li, T. Y., & Yorke, J. A. (1975). Period three implies chaos. *American Mathematical Monthly*, 82, 985.
- Lorenz, E. N. (1963). Deterministic non-periodic flow. *Journal of the Atmospheric Sciences*, 20(2), 130–141.
- Lotman, J. (2009). *Culture and explosion*. Berlin: De Gruyter Mouton.
- Lotman, J. (2005). On the semiosphere. *Sign Systems Studies*, 33(1), 205–229.
- Mandelbrot, B. (1977). *The fractal geometry of nature*. New York, NY: Freeman.
- Mayurama, M. (1963). The second cybernetics, deviation-amplifying mutual causal process. *American Scientist* (June 1963), 51, 164–179. 250–256.

- Mayurama, M. (1978). Heterogenistics and morphogenetics: Toward a new concept of the scientific. *Theory and Society*, 5(1), 75–96.
- Metzger, W. (2006). *Laws of seeing*. Cambridge, MA: The MIT Press.
- Neuman, Y. (2003). *Processes and boundaries of the mind: Extending the limit line*. New York, NY: Academic/Plenum Publishers.
- Peirce, C. S. (1932). Collected papers of Charles Sanders Peirce (Vol. 2). In: C. Hartshorne, & P. Weiss (Eds.). Cambridge, MA: Harvard University Press.
- Petitot, J. (1985). *Morphogenèse du Sens. [Morphogenesis of the sense]*. Paris: Presse universitaires de France.
- Prigogine, I. (1961). *Introduction to thermodynamics of irreversible processes*. New York, NY: Interscience.
- Prigogine, I. (1980). *From being to becoming*. San Francisco, CA: Freeman.
- Rossi, A. (2011). René Thom: Forms, catastrophes and complexity. *Logic and Philosophy of Science*, IX(1), 95–101.
- Salvatore, S., & Freda, M. F. (2011). Affect, unconscious and sensemaking: A psychodynamic, semiotic and dialogic model. *New Ideas in Psychology*, 29, 119–135.
- Saunders, P. T. (1980). *An introduction to catastrophe theory*. Cambridge, UK: Cambridge University Press.
- Schlick, M. (2008). *Meaning and verification* (pp. 701–749). Vienna: Springer.
- Shannon, C. E. (1948). A mathematical theory of communication. *Bell System Technical Journal*, 27, 379–423. 623–656.
- Tesnière, L. (1959). *Eléments de syntaxe structurale [Elements of structural syntax]*. Paris: Klincksieck.
- Thom, R. (1972). *Stabilité structurelle et morphogenèse [Structural stability and morphogenesis]*. New York, NY: Ediscience.
- Thom, R. (1988). *Esquisse d'une semiophysique [Outline of a semiophysique]*. Paris: InterEditions.
- Thompson, D. W. (1942). *On growth and form* (revised ed). Cambridge: Cambridge University Press.
- Valsiner, J. (2001). Cultural developmental psychology of affective process. Invited Lecture at the 15. Tagung der Fachgruppe Entwicklungspsychologie der Deutschen, *Gesellschaft für Psychologie*, Postdam, September, 5.
- Valsiner, J. (2007). *Culture in minds and societies*. New Delhi: Sage Publications.
- Valsiner, J., Molenaar, P. C. M., Lyra, M. C. D. P., & Chaudhary, N. (Eds.) (2010). *Dynamic process methodology in the social and developmental sciences*. New York, NY: Springer.
- Vladimir, I. A. (1992). *Catastrophe theory* (3rd ed.). Berlin: Springer-Verlag.
- von Goethe, J. W. (1790). *Versuch die Metamorphose der Pflanzen zu erklären*. Gotha: Carl Wilhelm Ettinger.
- Vygotsky, L. S. (1978). Mind in society: The development of higher psychological processes. In: M. Cole, V. John-Steiner, S. Scribner, & E. Souberman (Eds.). Cambridge, MA: Harvard University Press.
- Wiggins, S. (2003). *Introduction to applied dynamical systems and chaos*. New York, NY: Springer.
- Woodcock, A., & Davis, M. (1978). *Catastrophe theory*. New York, NY: E. P. Dutton.
- Zeeman, E. C. (1977). *Catastrophe theory: Selected papers, 1972–1977*. Reading, Massachusetts: Addison-Wesley.

Author biographies

Raffaele De Luca Picione, PhD, graduated first in Political Science and then in Clinical, Dynamic and Community Psychology, he deals with meaning making processes within healthcare relationships through a semiotic and dynamic psychological perspective. He is interested in the processes of subjective meaning making in a cultural field and particularly of affective semiotic processes, in reference to the relationship between thought, emotion, and language. In his writings, there is great attention to the issues of temporality and dynamics of the processes of transformation of meaning. He wrote several international works about emotion/intersubjectivity/reflexivity as well. Moreover, he is interested to semiotics, paradigms of complexity, and connections between Cultural Psychology and Clinical Psychology. Some of his works: *Catalysis and Morphogenesis: The Contextual Semiotic Configuration of Form, Function, and Fields of Experience*. In K. R. Cabell & J. Valsiner (Eds.). (2014). *The catalyzing mind. Beyond models of causality. Annals of Theoretical Psychology, 11*. Linguistic markers of subjectivity: a semiotic and psychological perspective of analysis of sensemaking of the disease, applied to the case of disorders of sexual differentiation (DSD) (in press).

Maria Francesca Freda is Professor of Clinical Psychology at the Department of Humanistic Studies at the University of Naples Federico II, Italy. She belongs to the directive team of the Italian Health Psychology Association (SIPSA) and Italian Psychological Association (AIP). Her scientific interests, expresses in numerous research works, publications, and participation to conferences, are focalized in the last years on: (a) action-research methodology, oriented to clinical and psycho-social model of intervention; (b) narratives as construction processes of experiences and as intervention device; (c) the focus on the qualitative–quantitative methodology of research of texts and discourses analysis. Her predominating application areas are the psychological intervention in educative organizations and the action-research within social systems. She is the scientific coordinator of the Erasmus Multilateral Project INSTALL (INnovative Solution to Acquire Learn to Learn). Some of her publications in the field are: *Understanding Continuity to Recognize Discontinuity (Integrative Psychological and Behavioral Science)* (2011), *Affect, unconscious, and sensemaking. A psychodynamic, semiotic, and dialogic model (New Ideas in Psychology)* (2011); *Narrazione e Intervento in Psicologia Clinica [Narration and intervention in Clinical Psychology]* (2008) (Naples: Liguori Editor).

Appendix

In the classification theorem of Thom, such topological models describe continuous and discontinuous variation and are stable in the maintenance of their qualitative structure, regardless of small quantitative changes. Thus, there is a paradox: each model summarizes the appearance and disappearance of stability, but does so in a

stable manner (Saunders, 1980; Vladimir, 1992; Woodcock & Davis, 1978). This is made possible because the equilibrium points for the usual classes of equations can be seen as configurations of topological singularities, and because, for each of the seven simple topological singularities, there is only one stable configuration. Other configurations are possible, but collapse with the smallest disturbance when in the more stable form (Woodcock & Davis, 1978).

The classification theorem states that, in any system regulated by a potential, and whose action is determined by no more than four different factors, only seven types of discontinuities are possible. This assertion is true, regardless of the geometric size of the object, or the matter of which it consists (Woodcock & Davis, 1978).

The topological types of catastrophes (i.e. forms) depend on the number of space control dimensions. When this number is equal to or greater than three, the topological types depend on the number of dimensions of the state space. According to Thom, there are only seven elementary catastrophes, since catastrophes that appear in the lower dimensions of space control are also present in its larger form (for example, a 4-dimensional control space, equivalent to the usual space-time).

We observe that three aspects are essential. Such elementary catastrophes have no scale, or rather, we have no quantitative information about them. Each catastrophe surface has a canonical and standard structure. Such models are considerably idealized and, in a certain sense, static. All the same, Thom stresses that complex phenomena may exhibit a certain behavior at a given time according to a certain model and then abruptly evolve to another catastrophic model (Woodcock & Davis, 1978).

More accurately, Thom's theorem has been extended to the description of a system with five control factors, thus creating four other catastrophes, much more complex than the original seven. For catastrophes with more than five control factors, an infinite number of singularities exist, without a single configuration. When this occurs, it is no longer possible to distinguish the different surfaces of possible catastrophes (Woodcock & Davis, 1978).