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FRACTAL THEORY AND LANGUAGE: THE FORM OF MACROLINGUISTICS

GABRIEL PAREYON

Nombre: Gabriel Pareyón, compositor y musicólogo (n. Zapopan, Jalisco, México, 1974).
Dirección: Departamento de Musicología, Facultad de Artes, Universidad de Helsinki, Vironkatu 1, 00170 Helsinki, Finlandia. *E-mail*: gpareyon@yahoo.com
Areas de interés: musicología, lingüística y filosofía de la ciencia.
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Abstract: *This lecture proposes that language as a whole, belongs to the group of what we recognize as "natural fractals"; the consequences of this involve a new definition of language, as well as the construction of new tools for its investigation. Although the concept of fractal was used for the first time in 2000 as an application to sociolinguistics by Irvine and Gall, the association of the fractal theory to linguistics has been rather poor. This one seems to be an attempt for a general frame of language investigation, coming directly from the fractal principles.*

1 INTRODUCTION

I would like to start my lecture looking at some intriguing images representing what mathematicians call fractals. Here you can see very different objects like fern fragments, a literally burned DVD, animal vessels and tissues, electric storms, the Moon surface, flowers and cauliflowers. These forms are so different among them, that we could presume that practically any object can be displayed here as an example of what a fractal is. Nevertheless, not every object is a fractal.
A fractal is a shape whose basic form reappears in different scales and it is defined by a recursive process that generates autosimilar structures, independently on a specific scale, combining at the same time structural irregularity and consistency. The term was coined by the mathematician Benoît Mandelbrot in 1975 (I like to think that it combines the concepts of fragment and total, but actually the term came from Latin fracturatus, broken or fragmented). We can add to this, that scientists distinguish two big different kinds of fractals: the natural and the artificial ones. Although personally I do not believe that natural and artificial is a valid categorization of things, but a very provisory interpretation, I use this separation just to quickly depict the kind of fractals which are found in what we call "nature", and the fractals discovered within mathematical models.

Whether fractal theory became popular since the beginning of the 90's in succesful applications explaining the nature of dynamic systems, I wonder why its use in linguistics still being not developped. I assume that its same success should motivate a comprehensive scepticism among semioticians and language experts, but at some point we need to start a discussion on this issue. Actually, one may say that there is a necessity of the semiotic studies to better understand what a fractal is. As well, there is a necessity of a more complete research about the linguistic structures as fractal patterns. From this perspective, a closer cooperation between mathematicians, philosphers and linguists sharing interests, shall lead to a renewing of the strategies for language investigation.

Conceptualization

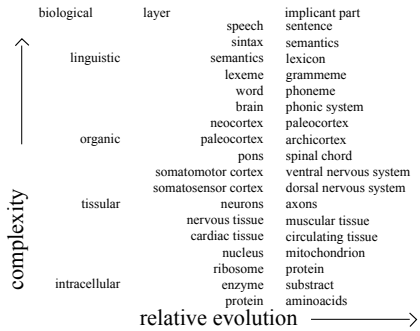
Now… how can we be sure that this is a correct conceptualization for linguistics? In principle, it is important to point out that the features of verbal languages match very well to the five main qualities or requisites to be a fractal. This close affinity between language and fractal qualities explains why it should be interesting using a referential frame for measurement, comparison and representation of the linguistic matter considered as fractal.

I	**structural autosimilarity**	Irvine and Gall identify this feature into pragmatics, as a "sociolinguistic recursivity". However, structural autosimilarity is also present in modular iteration in syntactic and semantic levels. This suggests that words and sentences repeat basic models in all languages, independently of the scientific paradigm we use, dealing with linguistic universality (e. g. the chomskian one, matrical, or the Terrence Deacon's autonomism of language). There are many examples of this in linguistic cases, conjugation and declination, that follow some structuration like (prefix)root-addition-suffix, in the paradigmatic form, and (suplement)subject-verb-complement, in the sintagmatic one.
II	**scalar relativity**	Sequential development. Languages are composed by arrangements that gradually are more complex: sign projection into phonemes, phonemes into words, words into sentences, sentences into speech, speech into cultural systems. Rush Rhees proposed also another kind of scalar structuration, according to grammatical contents: name-rule-correct-incorrect-concept-intention-comprehension-communication-laguage institution-social life. This one, like the previous organisation, can be described by their cyclic composition.
III	**surface irregularity**	Irregularity into verbal sequences, considering speech as a continuum (everything in time and space can be considered as continuum or discontinuum. For example, a straight line can be conceived as a indivisible-infinite line, or as a sequence of specific points. It depends on the focus to the subject, as analysis or synthesis). This means that if we represent verbal language as a set of connected items, the final shape of the whole would expose an arrangement of irregular patterns stochastically structured. This applies particularly to intentional and pragmatic patterns of language.
IV	**formal consistency**	This concerns to grammatical functions as consistency of the construction rules. While verbal sequences are irregular in their continuum representation, at the same time they are consistent because of their grammar and their pragmatic constrictions.
V	**fractal dimension**	As every linguistic complex in use has a irregular, continued surface, there is a particular dimension for every complex, that should be measurable considering the different constructive parameters of each linguistic object. However, as the linguistic matter is dynamic, it is very plausible that the fractal dimension of languages is constantly changing.

Looking for an equivalent affinity between fractals and the non-verbal languages, we can observe that their level of structural complexity matches with their potential development as fractal objects. This means that in a long term construction, fractal qualities also arise here. Some examples could be the use of gestures in apes communication, and the sound patterns in whales and dolphins, as well as the employment of haptics, hastics, oculesics or paroxemics used by different living communities. Although this is a very attractive line of research, I shall stop in two imminent questions: where the fractal properties come from?, and where the fractal properties of language come from?

In mathematical models, fractal complexity comes from the recursive association of values (series), with a particular dimension resulting from a collection of elements (points) which are not forming part of a linear system represented by integers. In models coming from nature, for example, a Romanesco broccoli, fractal structuration comes from the molecular layers in relation to the cellular plot, following general laws of structural economy and efficiency towards the environment.

Then, where the fractal properties of language could come from? Probably they come from a similar path that other natural fractal follows. In general, living organisms reveal elements that commonly are related to specific funcions interacting with the environment. These elements are close to be fractal structures, and this can be noticed even for any observer not involved to modern mathematics or physics. Friedrich Engels, for example, described the vertebrate organisms mainly as a form of life grouping the limbs around the nervous system. The nervous system is an excelent image of fractal structuration, specially considering the formal relationship between axons, neurons and limbs. Some theorists believe that the shape and the functions of the nervous system are unrelated, and even they believe that this shape would be far away to do something with language. I believe, however, that the relationship between the nervous system and the brain, together with their response to the environment, are responsible of most of the linguistic structure. Apart from such discussion, there is another level of coincidences between the nervous system and the languages that can be accepted as a combination of structural autosimilarity, scalar relativity and superficial irregularity. This level is engaged to "hierarchical agreements" between implicant and subordinated components in biological structures. In the middle of the 19th century, Engels already imagined this sort of subordination that was later confirmed by clinical studies pubilshed by Ramón y Cajal, Sherrington and Lloyd. However, this hierarchies or succesive subordinations seem to be more complex than a linear chain of progressive tasks, because they are present in very different manifestations of biology, from intracellular to tissular and organic correspondances, as the following scheme shows. This common subordination or "collaboration" –like biologist Lynn Margulis prefers to call it– could be relevant also linking fractals to biosemiotics, because it comprises an iterative pattern of signification, bonding endosigns to exosigns in very different levels of information. Relations between implicant and subordinated seem to have an active-passive character, but not by a simple sense in which one element imposes rules and the other one follows them. On the contrary, the link between each other occurs in a functional way, in order to systematically achieve and complete excitation-inhibition processes which are indispensable to the development and transmission of biological models. Actually, there is no any submission from any element to the other, but a simbolic "understanding" for coordination. This is a core issue that, coming from the symbiotic theory, can also contribute to the enrichment of biosemiotics.



CONCLUSION

According to the biosemiotician B. C. Goodwin, genetic material and tissular structure are of a simbolic nature. The meaning of the relationship between implicant and subordinated is the process itself of complex and ordered development against entropy. And this process directly participates in the construction of the biological structure. Then we can conceive a "symbolic understanding" between nucleus and mitochondrion within a endosymbiotic cohabitation inside a same cell (as Margulis suggested in 1998). This sort of Understanding or coordinative agreement contrary to entropy, characterizes living processes in their wider variety. Thus, there would be not just one presimbolic level of language, but a complex stratification of presimbolic relationships ordering the structures of molecular information, and performing the transmission of genetic information being developed through "simbolic understanding". The organizing biostructure would use, by this means, its accumulation of energy to liberate or retain it, working into estimated processes of excitation-inhibition, as a constructivistic principle. In general terms, I would say that linguistic structures would not be formed by levels of disorder, like in Markov chains, but they would be formed by iterative order and structural consistency. Mandelbrot explained that "Basically, a fractal is any pattern that reveals greater complexity as it is enlarged. Thus, fractals graphically portray the notion of 'worlds within worlds' which has obsessed Western culture from its tenth-century beginnings" (cf. New Scientist : 2473). I would like to finsh my participation with a question: are not languages worlds within worlds?

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