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# Diversity in complexity in communication sciences: epistemological and ontological analyses

## Book section

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# DIVERSITY IN COMPLEXITY IN COMMUNICATION SCIENCES: Epistemological and Ontological Analyses

The problem of complexity in any science — its existence and characteristics — can be addressed via two main philosophico-methodological routes. I) Stressing the role of the reality considered, where the relevance of the "complex systems" is highlighted,[1] which leads to the "sciences of complex systems" and their analysis.[2] This involves pondering metaphysical and epistemological issues in complex systems.[3] II) Highlighting the use of categories and concepts, where the focus is on the sciences themselves as complex. Thus, the epistemological and methodological components of the scientific undertakings are emphasized. This second path — with contributions from the first path — is the core of the analysis here regarding communication sciences.

Accordingly, the route starts from a general angle in order to reach progressively details on the topics discussed. The analysis of diversity in complexity in communication sciences and their possible characteristics is made through four steps: 1) the levels, dimensions, and modes of complexity in science; 2)

1 Cf. C. Hooker (ed.), *Philosophy of Complex Systems*, Elsevier, Amsterdam 2011; and K. Mainzer, *Thinking in Complexity: The Complex Dynamics of Matter, Mind, and Mankind*, Springer, New York 1994, 5th ed., 2007.

2 Cf. M. Strevens, *How Are the Sciences of Complex Systems Possible?*, "Philosophy of Science", v. 72, n. 4, (2005), pp. 531-556; and H. A. Simon, *Can there Be a Science of Complex Systems?*, in Bar-Yam, Y. (ed.), *Unifying Themes in Complex Systems: Proceedings from the International Conference on Complex Systems 1997*, Perseus Press, Cambridge, MA, 1999, pp. 4-14. See also H. A. Simon, *How Complex Are Complex Systems?*, in F. Suppe, P. D. Asquith (eds.), *Proceedings of the 1976 Biennial Meeting of the Philosophy of Science Association*, vol. 2, Edwards Brothers, Ann Arbor, MI, 1977, pp. 507-522.

3 Cf. R. C. Bishop, *Metaphysical and Epistemological Issues in Complex Systems*, in C. Hooker (ed.), *Philosophy of Complex Systems*, Elsevier, Amsterdam, 2011, pp. 105-136. In principle, a system can be ontologically complex in its objects or components (phenomena, events, etc.), the processes that they develop, and the results that they obtain. The epistemological categories and concepts should be in tune with such reality.

the traits of the presence of complexity in communication sciences; 3) the structural modes of complexity with epistemological and ontological varieties; and 4) the dynamic modes of complexity, including kinds of change and the means-ends relations. We can find these features of complexity today in cases of communicating phenomena (DTT programing, social TV, etc.).

## 1. *Levels, Dimensions, and Modes of Complexity in Science*

Complexity in science can appear at three main *levels*. (i) There is complexity in science as a human undertaking that includes several interrelated elements (language, structure, knowledge, method, activity, ends, and values).[4] Their interrelation involves an "internal" perspective (the "scientific activity" as such) and an "external" viewpoint (science as one human activity among others). (ii) There is complexity in the groups of sciences validated through empirical grounds: natural sciences, social sciences, and sciences of the artificial.[5] Each group is open, in principle, to the existence of interconnections in different ways than the disciplines involved, including multidisciplinarity, interdisciplinarity, and transdisciplinarity. (iii) There is complexity within the specific sciences, such as biology, economics, or pharmacology. Frequently, they can be considered in three spheres: basic science, applied science, and application of science.[6]

In addition to this diversity in complexity in science, there are two relevant *dimensions* of complexity — structural and dynamic — that are crucial for our analysis.[7] These dimensions can appear in the three levels of

4 These constitutive elements of science also are the key components for its conceptual distinction from technology, see W. J. Gonzalez, *The Roles of Scientific Creativity and Technological Innovation in the Context of Complexity of Science*, in W. J. Gonzalez (ed.), *Creativity, Innovation, and Complexity in Science*, Netbiblo, A Coruña, 2013a, pp. 11-40; especially, pp. 15-17 and 21-23.

5 These sciences of the "human-made" include the sciences of design. See H. A. Simon, *The Sciences of the Artificial*, 3rd ed., The MIT Press, Cambridge, MA, 1996 (1st ed., 1969; 2nd ed., 1981). The presence of artificiality opens new doors for complexity, cf. K. Schredelseker, F. Hauser (ed.), *Complexity and Artificial Markets*, Springer, Berlin 2008.

6 An eloquent example is economics, cf. W. J. Gonzalez, *Philosophico-Methodological Analysis of Prediction and its Role in Economics*, Springer, Dordrecht 2015.

7 Cf. W. J. Gonzalez, *Complexity in Economics and Prediction: The Role of Parsimonious Factors*, in D. Dieks, W. J. Gonzalez, S. Hartman, Th. Uebel, M. Weber (eds.), *Explanation, Prediction, and Confirmation,* Springer, Dordrecht 2011, pp. 319-330, especially, pp. 321-325; and W. J. Gonzalez, *The Sciences of Design as Sciences of Complexity: The Dynamic Trait*, in H. Andersen, D. Dieks, W. J. Gon-

complexity indicated: science, in general; a group of sciences; and specific sciences. *De facto*, complexity may be in any of them, either in the configuration of the scientific undertakings or in the changes over time.

Moreover, structural and dynamic features of complexity can be considered from an "internal" perspective (the scientific articulation of the components) or from an "external" viewpoint (the connection of scientific elements with other aspects of human experience: social, cultural, etc.). Furthermore, structural and dynamic features are open to a set of *modes*: semantic, logic, epistemological, methodological, ontological, axiological, and ethical. Among them, two seem to be more relevant: epistemological and ontological modes.

This diversity in complexity is increasingly motley, and it can be considered in communication sciences. Although the study of diversity here is primarily at the third level — specific sciences — it supposes the previous levels: complexity in science and in a group of sciences. The second level is also important insofar as communication sciences are dual sciences: social and artificial. In addition, the study has to take into account features of diversity in the two main dimensions — structural and dynamic — as well as the internal perspective and the external viewpoint. Furthermore, the epistemological and ontological modes are central for the philosophical consideration of diversity in complexity in communication sciences.

## 2. *Presence of Complexity in Communication Sciences*

First, the features of complexity in these disciplines are related to their dual scientific status as social and artificial.[8] a) Communication sciences are social sciences insofar as they deal with human needs for communication. Thus, they research the origin, development, and consequences of human actions related to communication as a social necessity, which requires sociocultural settings.[9] b) Communication sciences are sciences of the ar-

zalez, Th. Uebel, G. Wheeler (eds.), *New Challenges to Philosophy of Science,* Springer, Dordrecht 2013b, pp. 299-311; especially, pp. 301-307.

8 Cf. W. J. Gonzalez, *La televisión interactiva y las Ciencias de lo Artificial*, in M. J. Arrojo, *La configuración de la televisión interactiva: De las plataformas digitales a la TDT*, Netbiblo, A Coruña 2008, pp. xi-xvii.

9 Cf. R. C. Bishop, *The Philosophy of Social Sciences*, Continuum, London 2007.

tificial insofar as they expand and upgrade human capacities of the human beings, which make them able to reach new possibilities.[10]

Furthermore, this social-artificial duality is closely connected to the need for technological support, which is another trait of complexity in the communication sciences. Indeed, they are highly dependent on technology,[11] which transforms reality in a creative way, and whose innovations allow us to measure social and artificial phenomena. The existence of appropriate technology is also vital for the development of these sciences, because there is a constant feedback between scientific creativity — new models of communication — and technological innovation (new artifacts). Consequently, technology is a twofold — structural and dynamic — source of complexity in communication sciences.

Secondly, there are features of complexity in communication sciences that stem from their empirical status, insofar as they have a configuration as applied sciences of design,[12] which is closely linked to the realm of application of these sciences.[13] (i) Like sciences of design, communication sciences develop solutions according to designs oriented towards aims, which eventually are followed by processes and results. (ii) Like applied sciences, they are involved in solving concrete problems,[14] may be new problems which can also change frequently in the present world of global "knowledge society."

Besides applied science there is application of science, which is the use of knowledge by the agents to solve concrete problems at stake in given circumstances. Between the applied science and the application of science

10 Cf. W. J. Gonzalez, *Las Ciencias de Diseño en cuanto Ciencias de la Complejidad: Análisis de la Economía, Documentación y Comunicación*, in W. J. Gonzalez (ed.), *Las Ciencias de la Complejidad: Vertiente dinámica de las Ciencias de Diseño y sobriedad de factores*, Netbiblo, A Coruña 2012, pp. 7-30.

11 Cf. M. J. Arrojo, *Communication Sciences as Sciences of the Artificial: An Analysis of the Digital Terrestrial Television*, in H. Andersen, D. Dieks, W. J. Gonzalez, Th. Uebel, G. Wheeler, G. (eds.), *New Challenges to Philosophy of Science*, pp. 325-336.

12 Cf. M. J. Arrojo, *La investigación de la comunicación en el marco de la Ciencia Aplicada de Diseño: Nuevos parámetros epistemológicos y metodológicos*, "Informaçao e Sociedade", v. 25, n. 1, (2015), pp. 13-24.

13 The application of science involves the use of scientific knowledge in the diverse circumstances of the social milieu, cf. I. Niiniluoto, *The Aim and Structure of Applied Research*, "Erkenntnis", v. 38, (1993), pp. 1-21, especially, pp. 9 and 19; and W. J. Gonzalez, *The Roles of Scientific Creativity and Technological Innovation in the Context of Complexity of Science*, in W. J. Gonzalez (ed.), *Creativity, Innovation, and Complexity in Science*, pp. 17-18.

14 Cf. I. Niiniluoto, *The Aim and Structure of Applied Research*, pp. 1-21; and I. Niiniluoto, *Approximation in Applied Science*, "Poznan Studies in the Philosophy of Sciences and the Humanities", v. 42, (1995), pp. 127-139.

there should be some feedback (as it is the case in economics or even more clearly in medicine).[15] This is another source of complexity for the communication sciences, not only in the epistemological and ontological modes of complexity but also in the axiological and ethical modes. Many of the problems in this sphere are related to the prediction of the possible future and to the prescription of the patterns to solve the issues at stake.[16]

Thirdly, there are additional features of complexity in communication sciences that come from their internal-external duality. Here "internal" is the realm of "communication activity" (undertakings in press, radio, television, Internet, smartphones, etc.), when the focus is on the aims, processes, and results of the communicative phenomena as such. Meanwhile "external" is the sphere of "communication as activity," which is when the attention goes to the set of contextual factors (at least legal, economic, and social), i.e. those around the communicative phenomena themselves.

Among these "external" factors some are very important: a) legislation regarding social media (international, national or regional); b) the organization of the business firm related to communication;[17] and c) the relation with the public that uses the media.[18] It seems clear that these external aspects as well as the internal ones have a structural dimension (a configuration) but also a dynamic dimension, because they change over time. Their changes can be in two main directions: variations of the external elements in themselves and variations in their relations with the internal aspects.

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15 There is an increasing interest in the relations between research (applied science) and professional practice (application of science). It is a two-way relation, which allows us to understand the origin of communication sciences (as a process of "scientification" of the patterns used by professionals) and recent advancements (mainly in connection with the use of the Internet).

16 Cf. W. J. Gonzalez, *Análisis de las Ciencias de Diseño desde la racionalidad limitada, la predicción y la prescripción*, in W. J. Gonzalez (ed.), *Las Ciencias de Diseño: Racionalidad limitada, predicción y prescripción*, Netbiblo, A Coruña 2007, pp. 3-38.

17 The configuration of the organizations in terms of complexity was a central issue in Simon's research in this regard. See H. A. Simon, *Complex Systems: The Interplay of Organizations and Markets in Contemporary Society*, "Computational and Mathematical Organizational Theory", v. 7, (2001), pp. 79-85. His position ended up in the search of "parsimonious factors," see H. A. Simon, *Science Seeks Parsimony, not Simplicity: Searching for Pattern in Phenomena*, in A. Zellner, H. A. Keuzenkamp, M. McAleer (eds.), *Simplicity, Inference and Modelling. Keeping it Sophisticatedly Simple*, Cambridge University Press, Cambridge 2001, pp. 32-72.

18 Technology is initially "external" to communication sciences, but it may become "internal" insofar as the viability of the communicative path — aims, process, and results — needs technology to have effectiveness or to be efficient.

### 3. *Structural Modes of Complexity: Epistemological and Ontological Varieties*

Any science is conceived as an organized complexity, even when it needs to deal with anarchy, volatility, or chaos. Its scientific configuration as science requires structural components, which may be decomposable or near-decomposable. These structural components can be related to diverse modes of complexity: semantic, logic, epistemological, methodological, ontological, axiological, and ethical. Epistemological and ontological modes are particularly important and Nicholas Rescher has paid special attention to them following a broad approach.[19]

Rescher's general account can help to see the diversity in the structural complexity in communication sciences. His "epistemic modes" are conceived in terms of formulaic complexity. Thus, he distinguishes three options of epistemological formulation: descriptive, generative, and computational, [20] which can show characteristics of complexity in the realm of communication:[21]

(i) Contemporary phenomena of communication need descriptively more complex concepts than past events (e.g., an adequate description of the Digital Terrestrial Television [DTT] requires a longer length in the account than analogical television). (ii) New patterns given on how to produce a novel phenomenon (e.g., a new kind of television programing with interaction with the public from their homes) is generatively more complex than already existing instructions. (iii) The amount of time and effort in resolving now a novel communicative problem (e.g., in the use of the Internet for television in social TV)[22] is commonly comparatively greater than the computational task before (in the traditional analogical programing).

Regarding the "ontological modes" of complexity, Rescher offers three forms related to the actual configuration of complex systems: compositional, strictly structural, and functional. [23] His characterization is thought

19 Cf. N. Rescher, *Complexity*: *A Philosophical Overview*, Transaction Publishers, New Brunswick, New York 1998, pp. 1-24; especially, pp. 8-16.

20 Cf. N. Rescher, *Complexity*: *A Philosophical Overview*, cit., p. 9.

21 Rescher's account is useful to grasp "internal" aspects of the epistemological complexity in the communication science. But they should be "complemented" with an array of "external" aspects in order to get the whole picture.

22 On social television, see M. J. Arrojo, *La televisión social revoluciona la televisión tradicional: Hacia un nuevo modelo de televisión participativa*, "Cuadernos Artesanos de Comunicación", v. 64, (2014), pp. 29-44.

23 Cf. N. Rescher, *Complexity*: *A Philosophical Overview*, cit., p. 9.

of in general terms rather than in scientific ones, with a preference for examples from the natural sciences and ordinary life. Although his focus is on the perspective of the complexity itself existing in the reality, his ideas can also be considered from the scientific angle of the communicative sciences.

1) Compositional complexity is diversified between two options: constitutional and taxonomical. Constitutional complexity can be seen in the new designs of an increasing number of components (e.g., the 24 hours of television programing have a set of direct components for the audience with the complements of contents for social networks, the webs of the channels, etc.). Taxonomical complexity can be detected in the variety of constituent elements, both in the "internal" realm (the heterogeneity of the different kinds of components involved in the communicative phenomena with the technological support) and in the "external" sphere (rules to be implemented, economic goals to be achieved by the business firms, the responses of the public to be obtained, etc.).

2) Strict structural complexity is also twofold in Rescher's approach — organizational and hierarchical. Organizational complexity has been a central concern in Herbert Simon's conception,[24] which is also hierarchical in his configuration of the complex systems.[25] First, there is a wide variety of possible ways of arranging communicative components in different forms of interrelationship. In this regard, besides the genuine communicative phenomena (with its aims, processes, and results), there is an important set of factors (legal, economic, social, etc.) to organize a vast number of forms of interrelationship.[26] Second, the relationships can be conceived in terms of inclusion and subsumption, around a central axis (where the complex system can be disaggregated into subsystems).[27] But it may be the case of a poly-hierarchical complexity, where there is a set of axes working at the

24 Cf. H. A. Simon, *The Architecture of Complexity*, "Proceedings of the American Philosophical Society", v. 106, n. 6, (1962), pp. 467-482 (reprinted in P. E. Earl (ed.), *The Legacy of Herbert Simon in Economic Analysis, Vol. 1*, E. Elgar, Cheltenham and Northampton, MA 2001, pp. 485-500).

25 Cf. H. A. Simon, *The Organization of Complex Systems*, in H. H. Pattee (ed.), *Hierarchy Theory*, G. Braziller, N. York, NY, 1973, pp. 3-27 (reprinted in H. A. Simon, *Models of Discovery*, Reidel, Boston 1977, pp. 245-264).

26 The case of DTT in Spain, besides the technological support, shows the large variety of components to organize a new kind of television (cf. M. J. Arrojo, *La configuración de la televisión interactiva: De las plataformas digitales a la TDT*, Netbiblo, A Coruña 2008). The following step was a new organization of television programing in this novel digital setting.

27 According to Rescher, in hierarchical complexity the higher-order units are "always more complex than the lower-order ones," N. Rescher, *Complexity*: *A Philo-*

same time (e.g., in a complex system, such a large corporation, that works almost completely in parallel in different branches).[28]

3) Functional complexity also appears in Rescher two options: operational and nomic.[29] On the one hand, there is a variety of ways of operation or types of functioning, which can be seen in the realm of communication, where social and artificial components intervene.[30] On the other, there are rules of very different kinds (e.g., international laws, national regulations, regional dispositions, norms of the business firm, etc.) that can govern the communicative phenomena at issue. Moreover, the rules concerning these phenomena are not merely "communicative:" there are also economic rules, social restrictions, regulations on the technological support, etc.[31] Thus, the "internal" and "external" factors can be available in the functional complexity of the communicative phenomena.

## 4. *Dynamic Modes of Complexity: From Kinds of Change to the Means-Ends Relations*

Although many thinkers, such as Rescher or Simon,[32] have commonly focused complexity on the structural dimension, the dynamic dimension is also crucial, especially in the field of communicative sciences. In this regard, two steps are needed: first, the development of categories that can prop-

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*sophical Overview*, p. 9. This can be seen in the case of some corporations with multi-media platforms and presence in multiple countries.

28 There are contributions made in the realm of economics: R. Sah, J. Stiglitz, *The Architecture of Economic Systems: Hierarchies and Polyarchies*, "American Economic Review", v. 76, (1986), pp. 716-727.

29 His examples point out very broad uses of the terms "operational" and "nomic," cf. N. Rescher, *Complexity*: *A Philosophical Overview*, p. 9.

30 Multi-channel programing in the DTT and the use of some social networks of the Internet for communicative purposes can exemplify the combination of social and artificial operations, where the performance of the public and the elaboration of designs end up in operational complexity.

31 In this regard, an aspect to be discussed is whether increasing the level of freedom of a system makes it more complex from an operational viewpoint. Cases for study might be the big communicative corporations developed in recent decades.

32 Certainly, Simon is not unaware of the existence of complex dynamics, insofar as he "explores the dynamic properties of hierarchically organized systems and shows how they can be decomposed into subsystems in order to analyze their behavior." H. A. Simon, *The Sciences of the Artificial*, 3rd ed., p. 184. Cf. H. A. Simon, *Near Decomposability and the Speed of Evolution*, "Industrial and Corporate Change", v. 11, n. 3, (2002), pp. 587-599.

erly reflect the kinds of change related to complexity as well as the types of means-ends relations of the complex systems; and, second, the presence and characteristics of the kinds of change detected in the field of communication as well as the means-ends relations in the case of communicative sciences.

### 4.1. *Dynamic Categories and Kinds of Changes in Communication*

The dynamic categories related to the scientific undertakings are mainly three: process, evolution, and historicity.[33] These categories, proposed by Wenceslao J. Gonzalez, have a general character. The initial framework of the discussion here is scientific change: "evolution" (changes over time somehow shallow) versus "revolution" (changes clearly deep) in science. These include two main kinds of changes: continuous or discontinuous. Thereafter, Gonzalez analyzes them in a second framework: the dynamics of complexity in terms of process, evolution, and historicity, which receive special attention for the case of the sciences of design.[34]

I) "Process" is a quite general term, but it is certainly needed for the analyses of complexity in sciences related to communication. The term has a metaphysical basis,[35] which can be used for "internal" and "external" facets of communication. Concerning complex dynamics in general, Rescher's approach to *process* seems useful for contextual aspects of communication sciences (e.g., those related to technological innovations). He distinguishes between "product-productive processes" and "state-transformative processes."

For Rescher, the first type is the process that produces what can be characterized as something tangible, a thing or "substance" (e.g., the manufacturing processes that produces a medicine). Meanwhile, the second type is the process that merely transforms states of affairs, paving the way for further processes without issuing in particular things or states thereof (e.g.,

33 Cf. W. J. Gonzalez, *Conceptual Changes and Scientific Diversity: The Role of Historicity*, in W. J. Gonzalez (ed.), *Conceptual Revolutions: From Cognitive Science to Medicine*, Netbiblo, A Coruña 2011, pp. 39-62.

34 Cf. W. J. Gonzalez, *The Sciences of Design as Sciences of Complexity: The Dynamic Trait*, pp. 299-311. In the case of sciences of design, such as economics, complex dynamics receives frequent attention, mainly in the sphere of macroeconomics (e.g., market mechanisms, business cycles, economic growth, economic development, etc.), where there are commonly more factors involved than in the realm of microeconomics.

35 Cf. N. Rescher, *Process Metaphysics*, State University N. York Press, Albany 1995, pp. 60-62.

windstorms).[36] In addition, he recognizes the existence of *owned* and *unowned* processes, where the former is connected with agents (which is frequently the case of communication sciences), whereas the latter does not represent the activity of actual agents (e.g., the fluctuation of a magnetic field).[37]

II) Habitually, the dynamics of complex systems is thought of in terms of evolution.[38] Certainly "evolution" is not incorrect in this realm. But it seems that evolution is insufficient to cover the whole field of dynamic complexity related to the communication sciences as social as well as artificial sciences. Obviously, there is a strong influence of evolutionary biology. In this regard, there was wide acceptance that evolution had produced complexity. But Daniel McShea has studied the claim that complexity increases in evolution, and he considers "that not enough evidence exists to make an empirical case either for or against increase." [39] Furthermore, he recognizes that "complexity" and "progress" are different concepts. Thus, he asks that "the reader do[es] not equate complexity with progress."[40]

Beneath the idea that complexity increases in evolution seems to be both the structural and dynamic domains of complexity. Thus, the question is how complexity increases in evolution. Within evolutionary biology, there are three general lines to characterize the mechanisms for increasing complexity in biological systems: (i) internalist mechanisms, (ii) externalist mechanisms, and (iii) undriven mechanisms (i.e., theories invoking no

36 Cf. N. Rescher, *Process Metaphysics*, p. 41.

37 Cf. *Process Metaphysics*, p. 42. In addition to "process," Rescher has also developed a set of ideas regarding evolution, cf. N. Rescher, *A Useful Inheritance. Evolutionary Aspects of the Theory of Knowledge*, Rowman and Littlefield, Savage, MD 1990. But "process" seems a more basic notion in his approach, insofar as he discusses the *Varieties of Evolutionary Process*, pp. 5-12.

38 See, for example, J. P. Crutchfield, E. Van Nimwegen, *The Evolutionary Unfolding of Complexity*, "Proceedings of the National Academy of Sciences of the United States of America", v. 92, n. 23, (1995), pp. 10742-10746; and V. V. Kryssanov, H. Tamaki, S. Kitamura, *Evolutionary Design: Philosophy, Theory, and Application Tactics*, "CIRP Journal of Manufacturing Systems", v. 34, n. 2, (2005). Available in *http://arxiv.org/pdf/cs/0606039.pdf* Accessed on 22.5.2015.

39 D. W. McShea, *Complexity and Evolution: What Everybody Knows*, "Biology and Philosophy", v. 6, (1991); reprinted in D. Hull, M. Ruse (eds.), *The Philosophy of Biology*, Oxford University Press, Oxford 1998, p. 626.

40 D. W. McShea, *Complexity and Evolution: What Everybody Knows*, in D. Hull, M. Ruse (eds.), *The Philosophy of Biology*, p. 626. This is the case even though evolutionary trends are frequently related to an increasing adaptability and a growing control by organisms over their environment, Cf. G. G. Simpson, *The Meaning of Evolution: A Study of the History of Its Significance for Man*, Yale University Press, New Haven, CT 1949.

driving force at all).[41] But the approaches based on "mechanism," biological as well as philosophical, do not cover the terrain of dynamics complexity of communicative sciences. They cannot grasp the depth of historicity that scientific creativity and technological innovations involve, and which are crucial in the sphere of communication sciences as social and artificial.

III) Historicity is an important feature in three successive philosophico-methodological stages: science, agents, and the reality itself researched, which is mainly social and artificial,[42] and is particularly relevant for communication sciences. 1) Historicity (*Geschichtlichkeit*/*historicidad*) is a trait of science, in general, a group of sciences, and specific sciences. This facet has an "internal" perspective, which can be found in the whole set of constitutive elements of science (language, structure, knowledge, method, activity, ends, and values), and an "external" one (the relations with the milieu: social, cultural, etc.).[43] 2) Historicity configures the agents involved in the advancement of scientific research, insofar as they are human beings within a historical context. Furthermore, historicity is in the relation between the agents themselves (e.g., in their relations in their research centers) and in the connections of the agents with the world (natural, social, or artificial). 3) Historicity is also a characteristic of the reality itself that is researched (above all, in the social and artificial worlds).

Concerning communication sciences, historicity is what actually fits with communicative factors: as a science (social and artificial), as regards the agents (doing science, organizational components, and relation of the changeable phenomena), and the features of the reality researched (where novelty is a constant ingredient). Certainly there are processes to produce some communicative phenomena (such as transmedia) or to change some state of affairs available (by doing social television). In addition, there are also cases of evolution, especially in terms to adaptation. But the richness of

41 Cf. W. J. Gonzalez, *Prediction and Prescription in Biological Systems: The Role of Technology for Measurement and Transformation*, in M. Bertolaso (ed.), *The Future of Scientific Practice: 'Bio-Techno-Logos'*, Pickering and Chatto, London 2015, pp. 133-146 and 209-213; especially, pp. 136-138.

42 Cf. W. J. Gonzalez, *Conceptual Changes and Scientific Diversity: The Role of Historicity*, in W. J. Gonzalez (ed.), *Conceptual Revolutions: From Cognitive Science to Medicine*, p. 43.

43 These constitutive components of science can be considered in the relations with technology as well as their nexus with society, see W. J. Gonzalez, *The Philosophical Approach to Science, Technology and Society*, in W. J. Gonzalez (ed.), *Science, Technology and Society: A Philosophical Perspective*, Netbiblo, A Coruña 2005, pp. 3-49; especially, pp. 10-11.

the amount of variability in communicative phenomena, where to see backwards and forward is a common practice, requires the category of historicity.

### 4.2. *Dynamic Complexity and the Means-Ends Relations*

Commonly, complex systems are seen in terms of holism (relation whole-parts), where there is an interaction of the parts, which can many times be considered as a relation means-ends. Thus, Michael Strevens characterizes a complex system as "a system of many somehow autonomous, but strongly interacting, parts."[44] But he also recognizes that systems that are usually considered complex are those "in which the actions of the individual parts are carefully coordinated, as in a developing embryo."[45] In addition, we can think of a complex system as "a collective whole that creates patterns, uses information, and, in some cases, evolves and learns."[46] This characterization suggests that in complex systems many parts are entwined. One of the ways to be entwined is through the means-ends relation.

Even though the functional complexity — mainly through operational complexity — is open to the means-ends relation, it seems clear that a dynamics of complexity goes beyond mere "functions" where the relations means-ends are at stake, especially in social sciences and sciences of the artificial. Moreover, the sciences of design are embedded in the relations between means and ends, because they are conceived of in terms of aims, processes, and results. There is a large number of variations that go beyond merely functional relations, such as the case in the impressive communicative developments related to the Internet since the beginning of the use of the web for this purpose. New communicative phenomena (such as on-line newspapers, YouTube, social TV, Alternative Reality Games, etc.) are unthinkable without the means-ends relations, which generate an interaction of "internal" and "external" parts leading to an increasingly more complex social and artificial events.

Philosophically, the means-ends relation of the communicative phenomena cannot be reduced to mere "behavior," which includes an instinctive component (e.g., in zapping). There are many factors that belong to

44 M. Strevens, *Bigger than Chaos: Understanding Complexity through Probability*, Harvard University Press, Cambridge, MA 2003, p. 7.

45 M. Strevens, *Bigger than Chaos: Understanding Complexity through Probability*, p. 7.

46 M. Mitchell, *Complexity: A Guided Tour*, Oxford University Press, Oxford 2009, p. 4.

the sphere of "activity:"[47] a) the need for evaluative rationality — the rationality regarding ends — where decision-making is involved; b) the motley "internal"-"external" relations that are included in the distinction between "communicative activity" (the intentional undertaking that involves the transmission of some content) and "communication as activity" (the undertaking whose performance is related to social, cultural, economic, etc., factors); c) the constant feedback between communicative sciences as applied sciences and the application of these sciences in the variable settings impinged of historicity.

As a matter of fact, complex dynamics related to the nexus between means and ends in communication sciences cannot be completely isolated from the context (at least legal, organizational, and social). Thus, communicative complexity may be "isolated" at a given moment (a possible pure "communicative activity") but it is commonly a "communication as activity", where the means-ends relation includes a set of variables that, in principle, are not purely communicative (with their technological support) because they are also social, cultural, economic, etc. The presence of multi-media corporations and multi-channel televisions shows this complex reality.

To sum up, the existence of diversity in complexity in communication sciences is clear. Their characteristics are related to their dual status — social and artificial — as well as the twofold domain of complexity — structural and dynamic — that can be grasped through internal and external aspects. Among the main characteristics are the epistemological and ontological ones, but they are not enough to cover "communicative activity" and "communication as activity." Some other aspects are also needed (semantic, logic, methodological, axiological, and ethical) for the structural dimension. In addition, the dynamic dimension requires "historicity" more than "process" and "evolution." Moreover, the means-ends relation is needed to overcome the limitation of the functional complexity. Also the notion of "activity" is required to grasp all the aspects that "behavior" cannot show. Features of complexity in cases of today communicating phenomena can be seen in DTT programing, social TV, or transmedia.

47 On the differences between "behavior" and "activity," see W. J. Gonzalez, *The Sciences of Design as Sciences of Complexity: The Dynamic Trait*, pp. 310-311.

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p. 306 Università di Edimburgo, Scozia: attribuzione a Fabio Minazzi dell'*Edinburg Gadda Prize* per un suo studio *Sull'abbozzo di una (non ordinaria) tesi di laurea,* concernente la formazione filosofica di Carlo Emilio Gadda, pubblicato da Dante Isella ne «I quaderni dell'ingegnere. Testi e studi gaddiani» (n. 4, Giulio Einaudi Editore, MMVI, pp. 219-45). (*Foto di Laura Zanlorenzi*).