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9 Media Evolution

Abstract: Since the emergence of the World Wide Web the media ecology has gone through deep transformations. While the broadcasting paradigm was displaced from its hegemonic position by the networking paradigm, the "old media species" are constrained to compete with the "new" ones and must adapt to the new conditions of the media ecology. Never in the long history of Homo sapiens has our social-technological network gone through such an accelerated and unpredictable shift. In this context the chapter reflects on the possibilities of a new discipline – media evolution – in grade of dealing with past, contemporary, and future transformations of the media ecology. After introducing how the Darwinian model was applied in the analysis of technology evolution, the chapter presents a general overview of approaches that should be part of any theoretical conversation about media evolution: Levinson's anthropotropic theory of media mutations, Logan's reflections of media evolution from the perspective of language, complexity, and emergent phenomena, and Manovich's contributions around the computer metamedium and its hybridizations. The chapter concludes with a map of interlocutors for the construction of a media evolution theory and presents a first list of possible methodologies to apply in this emergent field.

Keywords: media evolution, media ecology, anthropotropic theory, media theories, actor-network theory, social construction of technology, cultural analytics, distant reading

Since the emergence of the World Wide Web in the early 1990s the media ecology has gone through deep transformations. In a few words, the old broadcasting paradigm was displaced from its hegemonic position by a new paradigm based on networking. The "old media species" are constrained to compete with the "new" ones and must adapt to the new conditions if they want to survive (Scolari 2013).[1] At the same time, the burst of new devices and media production / consumption experiences introduced a dynamics never seen in media environments. Never in the long history of *Homo sapiens* has our social-technological network gone through such an accelerated and unpredictable paradigm shift.

Many scholars are struggling to contextualize and explain the deep transformation of the entire media ecosystem. Media history, a consolidated discipline and research field, deals with the past transformations of the media and, in general,

1 According to Natale "it becomes increasingly difficult to establish if a media artifact is 'new' or 'old.' Media operate in circuits of value where their attributes and qualities, including newness and oldness, are constantly renegotiated" (Natale 2016: 588).

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proposes lineal narratives based on sequences of media (i.e. Briggs & Burke 2009). Other approaches, like media archaeology (Huhtamo & Parikka 2011; Parikka 2012), refuse that kind of historical storytelling and focus instead, as Zielinski put it, on the "deep time of media" (2008).

Do we need an integrated theory of media evolution to explain past, contemporary, and future changes to the media ecosystem? If the answer is yes, then we can start thinking in media evolution terms. Many scholars are using the metaphor of media evolution in their theoretical and analytical discourses (i.e. Lehman-Wilzig & Cohen-Avigdor 2004; Stöber 2004; Neuman 2010; van Dijck 2013; Olesen 2016). This chapter pretends to contribute to the construction of a media evolution theory that goes beyond the application of Darwinian metaphors.

Let's think about a theory of media evolution in conversational terms. Who are the main theoretical interlocutors of media evolution? What can it talk about with related disciplines like media history or media archaeology? Can this new theory recover concepts, categories, or models from them? Should media evolution open a conversation with other approaches like the Social Construction of Technology (Bijker, Hughes & Pinch 1987), the Actor-Network Theory (Latour 2005), or Social-Ecological Systems (Glaser et al. 2012)? What about media ecology? Media ecology, born in the 1960s from the contributions of McLuhan (2003) and Postman (1998, 2000), has included a reflection on the evolution of media. Researchers like Levinson (1979, 1997, 1999) and Logan (2004a, 2004b, 2007) have developed useful contributions for understanding media ecosystem transformation. On the other side, any scientific reflection on media evolution should include the works of media ecology pioneers like Mumford (1934) and Innis (1950, 2003 [1951]).

Clearly, the network of possible interlocutors is broad. The main objective of this chapter is to reflect on the possibilities of a new discipline – media evolution – in grade of dealing with past, contemporary, and future transformations of the media ecology. The first section of the chapter introduces a conception of "theories as conversations" and focuses on the theory construction process. If media are technological tools, then we must start with a general overview of technology evolution theories before focusing on media evolution. Thus, the second section introduces the Darwinian evolutionary model and its applications in social sciences, with a special interest in the evolution of technologies. As it is almost impossible to describe all of the scholars applying an evolutionary metaphor to media change, the third section just introduces a basic selection of approaches that should be part of any theoretical conversation about media evolution: Paul Levinson's anthropotropic theory of media mutations, Robert K. Logan's reflections of media evolution from the perspective of language, complexity, and emergent phenomena, and Lev Manovich's contributions around the computer metamedium and its hybridizations. Finally, the chapter concludes with a map of interlocutors for the construction of a media evolution theory and presents a first list of possible methodologies to apply in this emergent field.

1 Theoretical conversations[2]

What is a theory? In the context of this chapter theories are understood as conversations performed by scientific speakers and writers. If, as Austin (1999) said, we can make things with words, then scientists make theories with words. Language is a basic element for the construction and survival of organizations and scientific institutions (Flores 1997; Winograd and Flores 1987; Shotter 1993; Scolari 2009). Scientific conversations emerge from an organizational environment made up of universities, research centres, journals, conferences, and books. In these spaces researchers exchange information, discuss ideas, litigate, arrive at agreements and take on obligations – for example, to respect a scientific methodology and a series of publishing rules like blind peer review – inside a network of linguistic speech acts (Austin 1999; Searle 1969). In other words, researchers activate and hold conversations. To understand the dynamics of a scientific domain – for example, the theoretical production around the evolution of media – it is necessary to map its discursive territory, identify the interlocutors that participate in the conversations, and reconstruct their exchanges. Analysing theoretical conversations about the transformation of media through time is essential for understanding this scientific domain and supporting the creation of a theory of media evolution.

Communication theories have been classified in different ways, based on their originating discipline (sociology, psychology, anthropology, etc.); their explanatory system (cognitive, systemic, etc.); their organizational level (interpersonal, group, institutional, mass, etc.); their epistemological premise (empirical, critical, etc.) or their implicit conception of communicational practice (rhetoric, semiotic, phenomenological, etc.) (Craig 1999). Communication theories can also be classified into generalist theories and specialized theories. Although a theory that explains everything is unimaginable, it is obvious that some theoretical constructions tend towards integration and generate an explanatory model of greater scope. Specialized theories focus on one particular aspect or process of communication and leave others outside their explanatory model. Theories of limited effects, agenda-setting, or semiotic-textual models are a type of theoretical construction that attempts to explain a smaller area of the communication universe. On the other hand, scientific discourses on communication have always shown a tendency towards speaking about the mediums in an isolated way: studying television, radio, cinema, etc. Semiotics has also followed the same route; this is why there is a semiotics of television or a semiotics of cinema. In this context, any theory of media evolution should be oriented towards a generalist approach. It should go beyond a specific theory of television or blogs evolution: the proposal is to create a broad-spectrum theoretical construction to deal with past, contemporary, and, if possible, future mutations of the whole media ecosystem.

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2 This section is based on Roncallo-Dow and Scolari (2016), and Scolari (2008, 2009).

2 Beyond Darwin: From biological species to media species

It was not until the Renaissance that European philosophers began to draw parallels between the organic and the mechanical realms. George Basalla's reflections on the use of metaphors are very useful for framing the emergence of media evolution in the context of contemporary media studies and social sciences:

> Initially the flow of organic-mechanical analogies moved from technology to biology. Structures and processes in living organisms were described and explained in mechanical terms. In the middle of the nineteenth century occurred a movement of metaphors in the opposite direction. The counterflow of metaphor was of critical importance; for the first time the development of technology was interpreted through organic analogies. (Basalla 1988: 15)

The first scientific conversations about technology and evolution took place in the nineteenth century, when a revolutionary conception of biological change was exported to social sciences.

2.1 On the origin of technical species

The application of Charles Darwin's evolutionary model to cultural and technological processes started the day after the publication of *On the Origin of Species* in 1859 (Darwin 1975). Only 1,250 copies of the first edition were printed, and they all sold in one day (Angus 2009). When Marx read *On the Origin of Species* he defined the volume as a "book which contains the basis in natural history for our view" (Marx & Engels 1975: 232). The second edition of the first volume of *Capital: Critique of Political Economy*, published in 1873 (the first edition was published in 1867), included a direct reference to Darwin's "epoch-making work" (Marx 2011: 375):

> A critical history of technology would show how little any of the inventions of the 18th century are the work of a single individual. Hitherto there is no such book. Darwin has interested us in the history of Nature's Technology, i.e., in the formation of the organs of plants and animals, which organs serve as instruments of production for sustaining life. Does not the history of the productive organs of man, of organs that are the material basis of all social organisation, deserve equal attention? (Marx 2011: 406n)

However, the acceptation of Darwin's model by Marxists was not so smooth. In a letter to Lavrov sent in 1875 Engels recognized Darwin's theory contributions but considered them a "first, provisional, and incomplete expression of a newly-discovered fact." Engels suspected that the struggle of existence was not the only possible dynamics of biological systems: there was also co-operation in organic nature. "Both conceptions have a certain justification within certain limits, but each is as one-sided and narrow as the other. The interaction of natural bodies – whether animate or inanimate – includes alike harmony and collision, struggle and co-operation" (Engels 1936: paragraph 3). Beyond these critical notes, Marx and Engels retained the highest regard for Darwin's scientific work for the rest of their lives. In 1883, at Marx's funeral, Engels said, "Just as Darwin discovered the law of development of organic nature, so Marx discovered the law of development of human history" (Engels 1883: paragraph 3).

Even if it is not the aim of this section to analyse in depth the introduction of evolutionary ideas in social sciences, it would be useful to recover the transdisciplinary spirit of these nineteenth century researchers and philosophers. In a field characterized by "productive fragmentation" (Craig 1999), the exchange of concepts, metaphors, and models is a powerful tool for the development of more integrated general theories. Once again, it should be remembered that theories have always been conversations, sometimes friendly, sometimes polemical, and always charged with passion for the construction of new knowledge.

2.2 Evolution and technology in the twentieth century

The application of Darwin's model to society and technological evolution was a natural movement for late nineteenth and early twentieth century scholars. Darwinism contributed to the development of generalist visions of human-made tools evolution and of the relationships between society and technology. For example, Mumford's *Technics and Civilization* (1934) provided an integrated picture of humanity's technological evolution from the *eotechnical* phase (craft traditions) to the *paleotechnical* (industrial society based on steam machines) and *neotechnical* (society based on electricity). Mumford suggested a parallelism between the organic and the technical, making him a pioneer in proposing an ecological vision of technological culture based on the concepts of life, survival, and reproduction (Strate & Lum 2006). Even if the concept of "evolution" was practically absent in *Technics and Civilization,* it could be said that Mumford was thinking in evolutionary terms.

A century after Marx and Engels' first review of Darwin's theory, social science scholars had identified many more differences between natural and technological evolution. According to Maynard Smith, an aircraft engineer turned biologist,

> In the organic world, once two lineages have diverged for some time, they cannot rejoin. In engineering, two inventions, first developed to perform different functions in different kinds of machine, can be brought together in a single machine; the trolley-bus is a 'hybrid' between a bus and a tram. (1993: 309)

Researchers like van del Belt and Rip agreed that "in technical evolution, as against species evolution, there is indeed much room for processes of creative combination and synthesis" (1987: 139). In his classic *The Evolution of Technology*, Basalla proposed a "conscious utilization" of the evolutionary metaphor to deal with technology history. For Basalla the history of technology, a discipline that "focuses on the invention, production, and uses of material artefacts, benefits from the application of an evolutionary analogy as an explanatory device" (1987: 2). Evolutionary metaphor, in this context, is considered the best theoretical tool to understand the "diversity of things made by human hand" (Basalla, 1988: 1). However, the evolutionary metaphor "must be approached with caution because there are vast differences between the world of the made and the world of the born. One is the result of purposeful human activity, the other the outcome of a random natural process. One produces a sterile physical object, the other a living being capable of reproducing itself" (Basalla 1988: 2–3).

One of the deepest applications of Darwin's model to technology evolution was developed by the researchers of the Epistemology Group (Ziman 2000). This field, called evolutionary epistemology, tends to interpret the entire story of human social, intellectual, and material development as the continuation of organic evolution by other means. Ziman starts with the following reflection:

> Go to a technology museum, and look at the bicycles. Then go to a museum of archaeology, and look at the prehistoric stone axes. Finally, go to a natural history museum, and look at the fossil horses. In each case, you will see a sequence, ordered in time, of changing but somewhat similar objects. The fossils, we know, are sampled from the history of a family of biological organisms. They are similar because they are related by reproductive descent […] Can technological innovation be explained in similar terms? (2000: 3)

According to Ziman and other members of the evolutionary epistemology school it is easy to find structural analogies between certain biological processes and the technological processes involved in artefact innovation. Material artefacts undergo *variation* by *mutation* or *recombination* of characteristic traits. Many different variants arrive to the market; they are subject to *selection* by users. In this context "the entities that survive are *replicated*, diffuse through the population and become the predominant type" (2000: 4). Ziman also mentions the *mutualistic* relationships between technologies (pens and inks, bombers and radar systems): "technical innovations in an industry such as car manufacture are so interrelated that one might describe it as a whole ecological system of coevolving artefacts" (2000: 4). The most obvious difference between technological and natural evolution is that novel artefacts are not generated randomly: they are almost always the products of conscious design.

Many researchers and intellectuals, from different perspectives and degrees of acceptance of Darwin's original approach, have adopted evolutionary models to explain the accelerated transformations that human-made artefacts have gone through in the last two decades. For example, in *The Nature of Technology: What It Is and How It Evolves*, Arthur (2009) proposed a post-Darwinian model based on complexity, emergence, and self-organization. From the perspective of this interpretative frame "technology creates itself out of itself. It builds itself piece by piece from the collective of existing technologies" (2009: 176). According to Arthur, technology "[…]

evolves by a process of self-creation: new elements (technologies) are constructed from ones that already exist, and these offer themselves as possible building-block elements for the construction of still further elements" (2009: 167).

Arthur defined his approach as "combinatorial evolution" (187), a process that goes beyond the traditional Darwinian vision:

> In biology, combinations do form, but not routinely and by no means often and not by direct mechanisms we see in technology. Variation and selection are foremost, with combination happening at very occasional intervals but often with spectacular results. In technology, by contrast, combinations are the norm [...] In technology, combinatorial evolution is foremost, and routine. Darwinian variation and selection are by no means absent, but they follow behind, working on structures already formed. (2009: 167)

One hundred fifty years after Darwin first developed his biological evolutionary model and Engels and Marx applied it to technological change, their exchange remains on researchers' agendas.

2.3 From media ecology to media evolution

The consolidation of an ecological vision for media and communication ran parallel to the diffusion of ecologist ideas from the 1960s (Scolari 2012, 2015). Although the concept of "media ecology" was officially introduced by Neil Postman in a talk given to the National Council of Teachers of English in 1968, Postman himself recognized that Marshall McLuhan had used it at the beginning of that decade, when the Canadian's brilliance was at its brightest. (*The Gutenberg Galaxy* published in 1962 and *Understanding Media* in 1964.) However, some researchers prefer to award the distinction of semantic coining to Postman. In any case, we should acknowledge that it was McLuhan who updated and integrated within one approach the ideas of some of his predecessors, including Lewis Mumford (1934), Harold Innis (1950, 2003 [1951]), Eric Havelock (1963, 1986), and Casey Man Kong Lum (Lum 2006).

Media ecology can be synthesised into one basic idea: technologies generate environments that affect those who use them. Some media ecologists such as Postman developed a moral interpretation of the new forms of communication, for example criticising the advance of television over the practices of writing, while others such as McLuhan ignored these concerns to a certain point in favour of analysing the perceptive and cognitive transformations that media users undergo. Other members of the media ecology tradition, such as Innis (1950, 2003 [1951]), preferred to link the evolution of the media with socioeconomic processes, for example the simultaneous development of the telegraph and the railways, within the context of a systemic view of society. In some of his famous aphorisms, McLuhan also drew attention to another dimension of the ecological metaphor: the media only gain importance when related to other media. From this perspective, the media would be like "species" that coexist in the same "ecosystem" of communication. As McLuhan wrote in *Understanding Media*, "No medium has its meaning or existence alone, but only in constant interplay with other media [...] Radio changed the form of the news story as much as it altered the film image in the talkies. TV caused drastic changes in radio programming, and in the form of the thing or documentary novel" (2003: 43, 78).

This idea can also be identified in McLuhan's tetrads (McLuhan & McLuhan 1992) and in many other passages of his books and articles. Nystrom (1973) reaffirmed this perspective when she wrote that "no medium of communication operates in isolation. Every medium affects every other medium" (130). This interpretation of the ecological metaphor is the intermedia dimension of media ecology, in which media are like "species" that live in the same ecosystem and establish relationships between each other. Postman also worked around this idea. In *Amusing Ourselves to Death*, he described the synergies and conflicts between different media in the United States (i.e., telegraph/press) and the central role of television in the media ecology: "through it [TV] we learn what telephone system to use, what movies to see, what books, records and magazines to buy, what programs to listen to" (1985: 78).

One of the biggest influences on McLuhan's ideas was Innis's conception of media and society change. For Innis (2003 [1951]), the relation between media was a basic component of his conception of the communication system in past and contemporary societies. The competition between media (books/newspapers, newspapers/radio, etc.) was central to his reflections, for example, when he wrote that "the monopoly of knowledge centering around stone and hieroglyphics was exposed to competition from papyrus as a new and more efficient medium" (2003: 35).

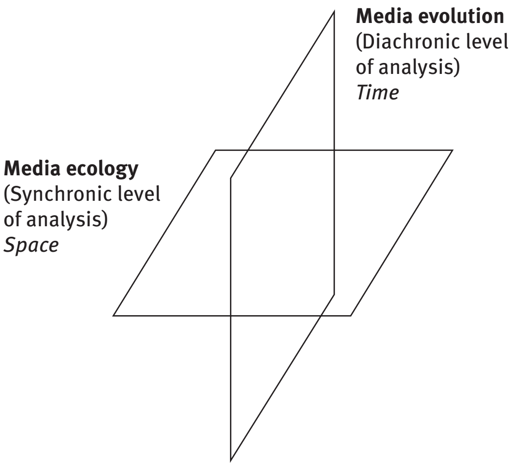

Figure 1: Media ecology and media evolution as complementary approaches (Scolari 2013).

If the ecological approach studies the network of relations between organisms *at the same time*, then the evolutionary approach investigates the diversification of these organisms into new species, the extinction of species (macroevolution), and the smaller changes such as adaptations (microevolution). In other words, while the ecologist reconstructs webs of organisms, the evolutionary scholar draws trees of life. Or, in another sense, ecology thinks in space and evolution thinks in time. Both conceptions – ecology and evolution – are complementary and can be reorganized following the traditional linguistic opposition between diachronic/synchronic levels (Scolari 2013). (See Figure 1.) It is in this context that we can start developing a theory of media evolution and thinking how "media species" evolve.

3 Media evolution: an on-going theoretical conversation

As already indicated, many researchers close to the media ecology tradition have been reflecting on the evolution of media in the last decades. This section will describe a series of contributions that should be integrated in any theoretical conversation about media evolution. As this new approach is still a work in progress, in this phase of the theoretical construction no interlocutor, perspective, or approach should be excluded. Any of them could bring new concepts, conceptions, or analytical tools to the fledgling field.

3.1 The anthropotropic theory of media evolution

At the end of his career Marshal McLuhan developed with his son Eric the *laws of media*, a series of four principles (also called "tetrads") that synthesized his vision of the dynamics of the media ecosystem (McLuhan & McLuhan 1992). The tetrads were a simple means of explaining the social processes underlying the adoption of media:
1. Enhances: Every medium or technology enhances or extends some human function.
2. Obsolesces: In doing so, it obsolesces some former medium or technology, which was used to achieve the function earlier.
3. Retrieves: In achieving its function, the new medium or technology retrieves some older form from the past.
4. Flips into: When pushed far enough, the new medium or technology reverses or flips into a complementary form.

Many scholars have been inspired by McLuhan's tetrads. In his PhD thesis – supervised by Neil Postman – Paul Levinson developed an "anthropotropic" theory of the evolution of media (1979) later expanded in books like *The Soft Edge* (1997) and *Digital McLuhan* (1999). Levinson believes that media "constantly undergo evolution under pressure of human usage and invention" (1999:108) and sees media increasingly selected for their support of "'pre-technological,' human communication patterns in form and function" (41). According to Levinson media evolve "in a Darwinian manner, with human beings acting not only as their inventors (obviously) but their selectors (i.e., the selecting environment, in Darwinian terms)" (52). Users make their selections based on two criteria:

1. They want media to *extend* their communications beyond the biological boundaries of naked seeing and hearing (*media as an extension* was McLuhan's first law of media).
2. They want media to recapture elements of that biological communication which early artificial extensions may have lost (*retrieval* was the basic principle behind McLuhan's third law of media).

To clarify this double conception Levinson worked on an "anthropotropical" approach to media evolution:

> Indeed, as I discuss in my 'anthropotropic' theory of media evolution – *tropic* = towards, *anthropo* = human – the overall evolution of media can be seen as an attempt, first, to fulfill the yearnings of imagination by inventing media that extend communication beyond the biological boundaries of hearing and seeing (thus, hieroglyphics and the alphabet and the telegraph each in its way extends words thousands of years and/or thousands of miles), and, second, to recapture elements of the natural world lost in the initial extension (thus, photography recaptures the literal image lost in writing, and telephone, the phonograph, and radio recapture the voice). From this vantage point, the entire evolution of media can be seen as remedial. And the Internet, with its improvement of newspapers, books, radio, television, et al. can be seen as the remedial medium of remedial media. (1999: 179)

The second criteria, although it encompasses McLuhan's notion of retrieval (Third Law), goes beyond it in specifying what elements of communication are most likely to be retrieved: telephone replaces telegraph under a human evolutionary pressure for retrieving the lost element of voice, colour photos replace black-and-white photos because subjects yearn to see the colours of the natural world in their technological reproductions of it, talking motion pictures replace silent (now called "speechless") motion pictures, etc. (Levinson 1999: 52).

Levinson's approach to media evolution includes a series of reflections on predicting future media mutations. A scientific prediction is, of course, a rigorous statement, based on empirical data, forecasting what would happen under specific conditions. Levinson believed his anthropotropic theory might help researchers in the difficult task of predicting the future of communications, but doing so is not easy in the face of an "open, unpredictable, imprescriptible, future" (185):

> Unlike inorganic reactions, the results of which are almost as predictable as two plus two equals four, living processes are animated by dollops of unpredictability. On the individual level, this unpredictability can of course lead to death as well as success; for life as a whole, this noise in determinism serves as a source of novelty via mutation, and is thus one of the cutting edges of evolution. (201)

From a different theoretical approach, Dimmick (2003) also agrees on the unpredictable future of media systems:

> Like the biologist, the researcher interested in the […] media cannot appeal to universal laws like those of chemistry or classical physics […] Like the biologist, who also studies complex living systems, the social scientist inhabits a world where prediction is difficult at best, and explanation must be won without recourse to causal laws. (2003: 1)

If researchers consider media ecology as a complex system and media evolution as an emergent phenomena, as Robert K. Logan does, then the properties of that system "cannot be derived from or predicted from the properties of the components of which it is composed" (Logan 2007: 19). In the next paragraphs media evolution will be approached from the perspective of complexity, emergence, and self-organization theories, a conception very close to Arthur's (2009) analysis of technology evolution.

3.2 The biological foundation of media ecology

According to Robert K. Logan, a former collaborator of Marshal McLuhan, the evolution of technology "follows a pattern similar to that of living organisms as has been pointed out by a wide variety of authors" (Logan 2013: 85). Beyond McLuhan, Logan's conception of media evolution has been inspired by researchers already cited in this chapter (i.e., Basalla 1988), and experts in complexity and self-organization (Kauffman et al. 2008):

> Cognitive tools and physical technology are two resources at the disposal of human innovators, and the needs or demands of society are often the motivating force. Necessity is the mother of invention, yet invention does not occur in a vacuum. All of the previous innovations in a culture provide the resources, both cognitive and physical, for the next level of innovation. (Logan 2004b: 125)

As with many other researchers mentioned in this chapter, Logan confirms the central role of previous innovations in any change within the socioeconomic system. Each new invention, technological innovation, or discovery gives rise to new technical capabilities, new cognitive abilities, and new social conditions. These then "interact with the existing economic, political, social, cultural, technical, and cognitive realities of the culture to set the stage for the next round of innovation" (Logan 2004b: 125). Technological change, from this perspective, is part of an ongoing iterative process.

According to Logan, biology and culture "can no longer be studied separately because human evolution is a combination of biological and cultural evolution" (2007: 5). Logan proposes to go beyond the metaphoric use of the term "ecology" in the phrase "media ecology":

> [It] has been used more in its metaphoric sense than in the strict biological sense. This observation, which also pertains to my own media ecology work, is not meant to critique or disparage the efforts of media ecologists but rather to suggest that perhaps interesting insights might emerge if we take the term ecology at its face value and consider communications and media from a biological perspective. (Logan 2007: 5)

In this new context the hypothesis to be explored is that "media are emergent phenomena and may be regarded in a certain sense like organisms that propagate their organization and interact with each other like living biotic agents in an ecological system" (Logan 2007: 5). Most of Logan's research has focused on the evolution of language, understood from a broad conception that goes far beyond the traditional linguistics. Logan considers "speech, writing, mathematics, science, computing, and the Internet as six distinct modes of language, which form an evolutionary chain of development" (2013: 55). Each one of these modes of language shares a distinct communications and informatics methodology, and provides a unique framework for viewing the world.

Logan (2004b) tackles the evolution of media following the notion that "one technology or medium leads to another," as first formulated by McLuhan in *Understanding Media* (2003). Logan's study of the evolutionary chain of six languages suggested a model for the development of information-processing and communication systems based on the idea that all innovations have a cognitive, social, and technological component. In other words, the six languages can be considered as basically conceptual technological tools, but each one requires one or more physical artefacts:

> The development of speech required the evolution of a biological artefact – namely, the physical human speech apparatus including the lowering of the larynx and the emergence of the fine motor skill of the tongue. The other forms of language, writing, mathematics, science, computing, and the Internet all required some kind of man-made tools whether they be clay tablets and a wooden stylus, paper, pen, and ink, the printing press, or the computer. The development of the six modes of language resulted from the interplay of human cognitive tools, physical technology, and socioeconomic factors all at work in the culture. (Logan 2010: 85)

This model – in which the technology, the cognitive impact it produces, and the changed social environment all interact – provides an alternative to the simplistic notion of *technological determinism*, a charge which has often been levelled at McLuhan's work. Surely, "technology plays a role in determining social outcomes, but not in an exclusive manner nor in a linear cause-and-effect manner either" (Logan 2010: 86). Simultaneously, the same McLuhan's laws applied by Levinson in his anthropotropic approach (extension and retrieval) have been integrated by Logan into a single formulation: *a new medium is the extension of some older medium*:

> The fact that technologies and media evolve from one form to another and that media are "extensions of man" gives rise to the notion of cascading technologies or media. As an example, the printed book is an extension of the written word, which is an extension of the spoken word,

> which is an extension of a mental process or the mind. Thus we have a cascade of media from thought to the spoken word to the written word to the printed word. We can even extend the cascading process further to the library whose content is books and journals and hence is an extension of the printed word. (Logan 2010: 89)

As we can see Robert K. Logan, one of the most multifaceted disciples of Marshall McLuhan, jumps from media ecology to biology, from technological innovation to linguistics, complexity, and culture evolution. According to Logan, "media ecologists have not studied biology, evolution and emergence in depth nor have biologists paid much attention to media ecology." From his perspective "the marriage of these two interdisciplinary fields will yield many interesting results to both fields of study" (2007: 23). If we consider theories as a conversation, then Logan occupies a central node in the network of exchanges about media ecology and media evolution.

3.3 When software takes command (and evolves)

In *Software Takes Command* (2013) Lev Manovich starts his analysis recovering Alan Kay's contributions, who in the early 1970s defined computers as the first *metamedium* because their content was "a wide range of already-existing and not-yet-invented media" (44). According to Manovich, at first sight the computer metamedium evolves through a series of addition and accumulation processes (version 1.0, 2.0, etc.). However, he thinks that these are not the key elements of its evolution:

> I believe that the new period that began in the late 1970s represents a fundamentally distinct second stage in the development of a computer metamedium, a stage that follows the first stage of its invention and initial practical implementation. This new stage is media hybridization [...] Once computers became a comfortable home for a large number of simulated and new media, it is only logical to expect that they would start creating hybrids. And this is exactly what has been taking place at this new stage in media evolution. (2013: 163)

Text, hypertext, still photographs, digital video, 2D animation, 3D animation, navigable 3D spaces, maps, location information, and social software tools are "building blocks" for many new media combinations. For example, Google Earth is a media hybrid that combines aerial photography, satellite imagery, 3D computer graphics, still photography, and other media to create a new representation defined by Google as a "3D interface to the planet."

Manovich proposes to compare the computer metamedium's development to a biological evolution so that we can think of a particularly novel *combination of media types as new species*. If in biological evolution the emergence of new species is a slow and gradual process that requires many generations, new "media species" can emerge overnight, as "it only requires a novel idea and some programming" (2013: 177). Software libraries facilitate the work of programmers/designers and accelerate the testing of prototypes and experimentation of new “media species.” As with many other scholars, Manovich also identifies differences between biological and technological evolution. In evolutionary biology, species are defined as groups of organisms. In media evolution

> [...] things work differently. Some novel combinations of media types may appear only once or twice. For instance, a computer science paper may propose a new interface design; a designer may create a unique combination for a particular design project; a film may combine media techniques in a novel way. Imagine that in each case, a new hybrid is never replicated again. This happens quite often. (2013: 177–178)

In the context of the media ecology some “media combinations that emerge in the course of media evolution will not be *selected*. Other combinations, on the other hand, may survive and will successfully *replicate*” (178). These successful hybrids may fix a new standard in media design and be recognized by a common convention in media design. In other words, they may become “new basic building blocks of the computer metamedium that can now be combined with other blocks” (178).

Media hybrids are all around human subjects: in user interfaces, on any screen, inside the smartphones, in museums, and in videogames. Users interact with them at any moment and actively participate in their evolution. The concept of *interface* is basic for the media evolution process and appears as a key category in Manovich’s work:

> I am interested in how software appears to users – i.e. what functions it offers to create, share, reuse, mix, create, manage, share and communicate content, the interfaces used to present these functions, and assumptions and models about a user, her/his needs, and society encoded in these functions and their interface design. (2013: 29)

From the perspective of this chapter, Manovich’s focus on interfaces and media hybrids add more “food for thought” in the theoretical conversations about media evolution.

4 Conclusions: The future of media evolution

This chapter introduced a series of authors that should be part of any theoretical conversation about media evolution. In the last 150 years, many scholars have made important contributions for the understanding of technology evolution. The development of a theory of media evolution should start mapping these interlocutors and their textual production. Like any new technology, theories are hybrid constructions that emerge from a process of combinations inside a network of conversations. Metaphors, analogies, and comparisons are always present in these first steps of any new theoretical building.

The chapter reconstructed a first and limited conversation network that includes founding fathers like Darwin, Engels, Marx, and Mumford; media ecology referents such as Innis, McLuhan, Postman, Levinson, and Logan; and Manovich's reflections on the computer metamedium evolution. Each one of them proposes concepts (coevolution, selection, replication, extension, retrieval, hybridization, etc.) that could be consider the basic blocks of a theory of media evolution. To continue with this theoretical building, researchers need to develop more blocks, blueprints, and construction (methodological) protocols.

Even if the tradition of media ecology should be one of the main references of media evolution, this emerging field should not discard other interlocutors from traditional fields like media history, or new ones like media archaeology. Other approaches passingly mentioned in this chapter, such as Social Construction of Technology and Actor-Network Theory, should be part of the same conversation. (See Figure 2.)

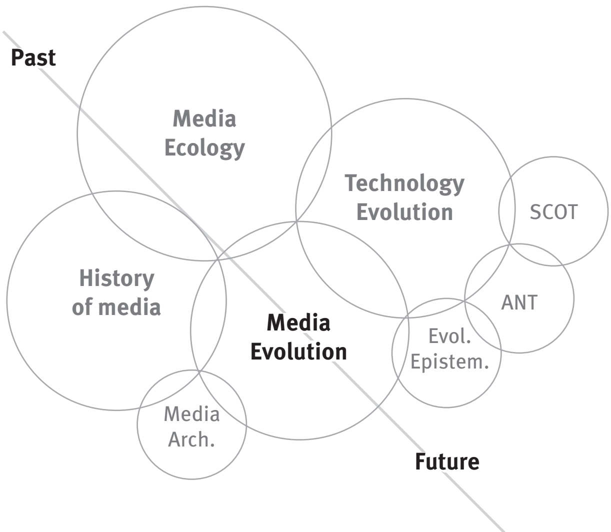

Figure 2: Media Evolution as a theoretical conversational field.

Future dialogue between media evolution and fields working on the integration of human and natural realms, like the Social-Ecological Systems Analysis, should be considered, even if it seems premature now (Glaser et al. 2012). In the short term the main efforts of media evolution should focus on two issues: the construction of a solid theory beyond the simple metaphorical application of the biological dictionary, and the definition of a set of methodologies to support and consolidate the theoretical building.

4.1 Beyond the metaphor

Many of the authors cited here recognize that the transfer of concepts, categories, and hypothesis from the biological to the technological realm is not automatic. The differences between biological and media species are so broad that, at a certain point, the metaphor is a limit for the theoretical construction. As Manovich warned, "[…] remember that I am evoking the biological model only as a metaphor, and that no claims are being made that the actual mechanisms of media evolution are similar to the mechanisms of biological evolution" (2013: 178). However, at the current state of the art, researchers can still "exploit" the biological metaphor while remembering that it is just a useful tool for proposing working questions and hypothesis. The use of the organic metaphor offers a great lexicon of concepts that, conveniently adapted, could be the basis of a future dictionary of media evolution (Scolari 2012, 2013, 2015).

4.2 Methodologies

From a methodological perspective, exploration of media evolution opens the door to the application of qualitative and quantitative methods (Scolari 2013). From the perspective of qualitative research, both media history (i.e. Gitelman 2006; Gitelman & Pingree 2003; Briggs & Burke 2009) and media archeology (i.e. Huhtamo & Parikka 2011; Parikka 2012) offer an interesting set of techniques that, conveniently adapted, could be adopted by media evolution researchers. The experience of researchers working in fields already mentioned, such as Actor-Network Theory (Latour 2005) and Social Construction of Technology (Bijker, Hughes, & Pinch 1987), or the morphological approaches of researchers like Basalla (1988), should also be considered as an indispensable reference for media evolution.

Regarding quantitative methods, media evolution should recover the analytical experience of evolutionary economics (Nelson & Winter 1982), evolutionary epistemology (Ziman 2000), literary criticism (Moretti 2005), and cultural analytics (Manovich 2009, 2013). For example, the analysis of 44 genres in British fiction between 1740 and 1900 allowed Moretti (2005) to identify patterns, isolate major bursts of creativity (genre emergence), and describe genre extinction. The same approach could be adapted to media evolution research. If pattern recognition was one of the favourite analytical tools of McLuhan (Moretti talks about "distant reading"), now it is possible to recover this approach working with data sets coming from media content, media devices, and digital traces left when people discuss, create, publish, consume, share, edit, and remix these media. Researchers should recognize the common traits of the evolution of media species, improving and deepening the field drafted in the *Laws of Media* (McLuhan & McLuhan 1992).

Media evolution should be considered a work-in-progress, an on-going conversation about the mutations of media species in the context of media ecology. As the mutation has accelerated and expanded along the whole media environment, it is important to develop concepts, analytical categories, and methodological tools to understand these technological changes that, never forget it, are social changes.

References

Angus, Ian. 2009. Marx and Engels...and Darwin? The essential connection between historical materialism and natural selection. *International Socialism Review (ISR)* 65. http://isreview.org/issue/65/marx-and-engelsand-darwin. (1 August, 2017.)
Arthur, Brian W. 2009. *The nature of technology: What it is and how it evolves*. New York: Free Press.
Austin, John L. 1999 [1955]. *How to do things with words*. Cambridge, MA: Harvard University Press.
Basalla, George. 1988. *The evolution of technology.* Cambridge, UK: Cambridge University Press.
Bijker, Wiebe E., Thomas P. Hughes & Trevor Pinch (eds.). 1987. *The social construction of technological systems*. Cambridge, MA: The MIT Press.
Craig, Robert T. 1999. Communication theory as a field. *Communication Theory* 9(2). 119–161.
Craig, Robert T. 2015. The constitutive metamodel: A 16-year review. *Communication Theory* 25(4). 356–374.
Briggs, Asa& Peter Burke. 2009. *Social history of the media: From Gutenberg to the Internet*, 3rd edn. Cambridge, UK: Polity Press.
Darwin, Charles R. 1975 [1859]. *On the origin of species by means of natural selection, or the preservation of favoured races in the struggle for life.* Harmondsworth, UK: Penguin Books.
Dimmick, John W. 2003. *Media competition and coexistence: The theory of the niche.* Mahwah, NJ: LEA.
Engels, Friedrich. 1883. *Frederick Engels' Speech at the Grave of Karl Marx*. Highgate Cemetery, London. https://www.marxists.org/archive/marx/works/1883/death/burial.htm. (1 August, 2017.)
Engels, Friedrich. 1936. Engels and Darwin – Letter to Lavrov. *Labour Monthly*, (July). 437–442. https://www.marxists.org/archive/marx/works/1875/letters/75_11_12.htm. (1 August, 2017.)
Gitelman, Lisa. 2006. *Always already new: Media, history, and the data of culture*. Cambridge, MA: The MIT Press.
Gitelman, Lisa & Geoffrey B. Pingree (eds.). 2003. *New media, 1740–1915*. Cambridge, MA: The MIT Press.
Flores, Fernando. 1997. *Creando organizaciones para el futuro*. Santiago, Chile: Dolmen.
Glaser, Marion, Gesche Krause, Beate M. W. Ratter & Martin Welp (eds.). 2012. *Human-nature interaction in the anthropocene: Potentials of social-ecological systems analysis*. London: Routledge.
Havelock, Eric. 1963. *Preface to Plato*. Cambridge, MA: Harvard University Press.
Havelock, Eric. 1986. *The muse learns to write: Reflections on orality and literacy from antiquity to the present.* New Haven, CT: Yale University Press.
Huhtamo, Erkki & Jussi Parikka. 2011. Introduction: An archaeology of media archaeology. In Erkki Huhtamo & Jussi Parikka (eds.), *Media archaeology: Approaches, applications, and implications*, 1–26. Berkeley, CA: University of California Press.
Innis, Harold A. 1950. *Empire and communications*. Oxford, UK: Oxford University Press.
Innis, Harold A. 2003 [1951]. *The bias of communication.* Toronto: University of Toronto Press.
Kauffman, Stuart, Robert K. Logan, Robert Este, Randy Goebel, David Hobill & Ilya Shmulevich. 2008. Propagating organization: An enquiry. *Biology and Philosophy* 23(1). 27–45.

Latour, Bruno. 2005. *Reassembling the social: An introduction to Actor-Network-Theory.* Oxford, UK: Oxford University Press.
Lehman-Wilzig, Sam & Nava Cohen-Avigdor. 2004. The natural life cycle of new media evolution: Inter-media struggle for survival in the Internet age. *New Media Society* 6(6). 707–730.
Levinson, Paul. 1979. *Human replay: A theory of the evolution of media*. New York: New York University dissertation.
Levinson, Paul. 1997. *The soft edge: A natural history and future of the information revolution.* New York: Routledge.
Levinson, Paul. 1999. *Digital McLuhan: A guide to the information millennium*. New York: Routledge.
Logan, Robert K. 2004a [1986]. *The alphabet effect*. Cresskill, NJ: Hampton.
Logan, Robert K. 2004b [2000]. *The Sixth Language: Learning a Living in the Internet Age*. Caldwell NJ: Blackburn Press.
Logan, Robert K. 2007. The biological foundation of media ecology. *Explorations in Media Ecology* 6(1). 19–34. http://openresearch.ocadu.ca/884/1/Logan_BiologicalFoundation_2007.pdf. (1 August, 2017.)
Logan, Robert K. 2010. *Understanding new media*: *Extending Marshall McLuhan*. New York: Peter Lang.
Logan, Robert K. 2014. *What is information? Propagating organization in the biosphere, the symbolosphere, the technosphere and the econosphere*. Toronto: Demo Publishing.
Lum, Casey M. K. 2006. Notes toward an intellectual history of media ecology. In Casey M. K. Lum (ed.), *Perspectives on culture, technology and communication: The media ecology tradition*, 1–60. Cresskill, NJ: Hampton Press.
Manovich, Lev. 2009. *How to Follow Global Digital Cultures, or Cultural Analytics for Beginners.* San Diego, CA: Software Studies Initiative / University of California, San Diego (UCSD). http://manovich.net/content/04-projects/062-how-to-follow-global-digital-cultures/59_article_2009.pdf (1 August, 2017.)
Manovich, Lev. 2013. *Software takes command*. New York: Bloomsbury Academic.
Marx, Karl. 2011 [1867]. *Capital, volume 1: A critique of political economy.* New York: Dover Publications.
Marx, Karl & Friedrich Engels. 1975. *Marx-Engels Collected Works*, vol. 41. Moscow: Progress Publishers.
McLuhan, Marshall. 2003 [1964]. *Understanding media: The extensions of man*. New York: Gingko Press.
McLuhan, Marshall & Eric McLuhan. 1992. *Laws of media: The new science*. Toronto: University of Toronto Press.
Moretti, Franco. 2005. *Graphs, maps, trees: Abstract models for a literary history*. London: Verso.
Mumford, Lewis. 1934. *Technics and civilization*. New York: Harcourt, Brace and Co.
Natale, Simone. 2016. There are no old media. *Journal of Communication* 66(4). 585–603.
Nelson, Richard R. & Sidney G. Winter. 1982. *An evolutionary theory of economic change.* Cambridge, MA: Harvard University Press.
Neuman, W. Russell (ed.). 2010. *Media, technology, and society: Theories of media evolution*. Ann Arbor, MI: University of Michigan Press.
Nystrom, Christine L. 1973. *Towards a science of media ecology: The formulation of integrated conceptual paradigms for the study of human communication systems*. New York: New York University dissertation.
Olesen, Mogens. 2016. Media evolution and "epi-technic" digital media: Media as cultural selection mechanisms. *Explorations in Media Ecology* 14(1 & 2). 141–160.
Parikka, Jussi. 2012. *What is media archaeology?* Cambridge, UK: Polity Press.
Postman, Neil. 1985. *Amusing ourselves to death.* New York: Penguin.

Postman, Neil. 1998. Five things we need to know about technological change. In P. De Palma (ed.), *Computers in Society*, 3–7. Dubuque, IA: McGraw-Hill.
Postman, Neil. 2000. *The humanism of media ecology*. Keynote address delivered at the Inaugural Media Ecology Association Convention, June 16–17. New York: Fordham University.
Roncallo-Dow, Sergio & Carlos A. Scolari. 2016. Marshall McLuhan: The possibility of re-reading his notion of medium. *Philosophies* 1(2). 141–152.
Scolari, Carlos A. 2009. Mapping conversations about new media: the theoretical field of digital communication. *New Media Society* 11(6). 943–964.
Scolari, Carlos A. 2012. Media ecology: Exploring the metaphor to expand the theory. *Communication Theory* 22(2). 204–225.
Scolari, Carlos A. 2013. Media evolution: Emergence, dominance, survival, and extinction in the media ecology. *International Journal of Communication* 7. 1418–1441.
Scolari, Carlos A. 2015. *Ecología de los Medios*. Barcelona: Gedisa.
Searle, John R. 1969. *Speech acts: An essay in the philosophy of language*. Cambridge, UK: Cambridge University Press.
Shotter, John. 1993. *Conversational realities: Constructing life through language*. London: SAGE.
Smith, John M. 1993. *The theory of evolution*. Canto Edition. Cambridge, UK: Cambridge University Press.
Stöber, Rudolf. 2004. What media evolution is: A theoretical approach to the history of new media. *European Journal of Communication* 19(4). 483–505.
Strate, Lance & Casey M. K. Lum. 2006. Lewis Mumford and the ecology of technics. In C. M. K. Lum (ed.), *Perspectives on culture, technology and communication: The media ecology tradition*, 71–96. Cresskill, NJ: Hampton Press.
van den Belt, Henk & Arie Rip. 1987. The Nelson-Winter-Dosi model and synthetic dye chemistry. In W. Bijker, T. Hughes, & T. Pinch (eds.), *The social construction of technological systems,* 135–158. Cambridge, MA: The MIT Press.
van Dijck, Jose. 2013. *The culture of connectivity: A critical history of social media*. New York: Oxford University Press.
Winograd, Terry & Fernando Flores. 1987. *Understanding computers and cognition: A new foundation for design*. Reading, MA: Addison-Wesley.
Zielinski, Siegfried. 2008. *Deep time of the media: Toward an archaeology of hearing and seeing by technical means*. Cambridge, MA: The MIT Press.
Ziman, John. (ed.). 2000. *Technological innovation as an evolutionary process*. Cambridge, UK: Cambridge University Press.