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Toward 'Complexics' as a Transdiscipline

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ABSTRACT

The proposed transdisciplinary field of 'complexics' would bring together all contemporary efforts in any specific disciplines or by any researchers specifically devoted to constructing tools, procedures, models and concepts intended for transversal application that are aimed at understanding and explaining the most interwoven and dynamic phenomena of reality. Our aim needs to be, as Morin says, not "to reduce complexity to simplicity, [but] to translate complexity into theory".

New tools for the conception, apprehension and treatment of the data of experience will need to be devised to complement existing ones and to enable us to make headway toward practices that better fit complexic theories. New mathematical and computational contributions have already continued to grow in number, thanks primarily to scholars in statistical physics and computer science, who are now taking an interest in social and economic phenomena.

Certainly, these methodological innovations put into question and again make us take note of the excessive separation between the training received by researchers in the 'sciences' and in the 'arts'. Closer collaboration between these two subsets would, in all likelihood, be much more energising and creative than their current mutual distance. Human complexics must be seen as multi-methodological, insofar as necessary combining quantitative-computation methodologies and more qualitative methodologies aimed at understanding the mental and emotional world of people.

In the final analysis, however, models always have a *narrative* running behind them that reflects the attempts of a human being to understand the world, and models are always interpreted on that basis.

Key Words: complexics, complexity, sociocomplexity, complex adaptive systems, network theory, human sciences, sociology, sociolinguistics, Edgar Morin, Norbert Elias.

Toward 'Complexics' as a Transdiscipline

1. 'Complexics': a terminological and theoretical proposal

The recognition that many phenomena relating to life are 'complex' in nature – i.e., that they are interwoven, self-organising, emergent and processual – has prompted us to re-examine how we have conceived of reality, both the way we have looked at it and the images we have used. This is the point of departure for the various efforts being made in the distinct (inter)disciplines engaged in refreshing such concepts and finding new ways of thinking that better fit the complex organisation of facts and events.

The theoretical and conceptual innovations in this vein can be grouped under headings such as 'complex thinking, 'sciences of complexity', 'complex perspectives', 'complex [adaptive] systems', and so on. In turn, these can be brought together into a more overarching field, one that I propose calling 'complexics', echoing 'mathematics' and 'systemics'. 'Complexics' denotes the *transdiscipline* specifically concerned with giving us suitable cognitive tools to understand the world's complexity. Additionally, the use of the adjective 'complexic' would avoid the common confusion caused by the adjective 'complex', which belongs to everyday usage and already has its own connotations of *complication* and *confusion*. Thus, 'complexic' thinking and 'complexic' perspective would provide clearer terms, be freer of confusion, and refer more precisely to epistemic elements in contrast to the 'complexity' typical of many phenomena of reality[1]. In short, the world would be 'complex', but our way of looking at the world would be 'complexic'[2].

As a transdiscipline, 'complexics' would carry on the perspective of cybernetics: "Cybernetics deals with all forms of behaviour insofar as they are regular, or determinate, or reproducible. The materiality is irrelevant… The truths of cybernetics are not conditional on their being derived from some other branch of science. Cybernetics has its own foundations" (Ashby,

[1] Roggero also points to the problems caused by the many meanings of the term 'complexity', referring to difficulties observed in the reception of the work of Edgar Morin in the field of sociology: "The ambiguity of the same term 'complexity', which is often used as a synonym for 'confusion' or 'faulty thinking' or a 'complicated' objective, makes abundantly clear that Morin's use of the word is not the common one" (2013:113).

[2] According to Ruiz Ballesteros, "the problem is not that we are using the notion of complexity to construct the world – which we already know is complex – but that we are trying to devise a way of thinking about the world, and this is where the greatest difficulty lies" (2013:154). This would be the mission of a transdisciplinary complexics.

1956:1). Thus, it has a distinctly transdisciplinary mission to provide concepts, schema and possibilities of thinking and representation able to express the multidimensional and systemic interwovenness and interdependence of the many, highly significant phenomena of reality that have these characteristics.

Indeed, what the 'complexic' perspective first undertook was to absorb the progress already made in disciplines such as physics – e.g., relativity and quantum theory – and biological ecosystems, as well as the foundations of cybernetics (Wiener, Ashby) and systems theory (Von Bertalanffy). In the field of human and social sciences, the movement has been equally prevalent, although it has perhaps had less impact, despite the contributions of Gregory Bateson, Edgar Morin and Norbert Elias, whose works are central to the perspective applied in the area of human beings (cf. Bastardas, 1996 and 2013).

The proposed transdisciplinary field of 'complexics' would bring together all contemporary efforts in any specific disciplines or by any researchers specifically devoted to constructing tools, procedures, models and concepts intended for transversal application that are aimed at understanding and explaining the most interwoven and dynamic phenomena of reality. This would encompass Edgar Morin's theories of complex thinking; the epistemological and theoretical contributions of physicists such as David Bohm, Ilya Prigogine and Fritjof Capra, or of cognitive biologists such as Humberto Maturana and Francisco Varela, and the proposals of ecologists such as Ramon Margalef and Timothy Allen and of sociologists such as Norbert Elias. It would also include the most recent contributions of Barabási & Albert and of Soler in network theory and of Maxi San Miguel and Albert Díaz-Guilera in statistical physics and the study and computer simulation of complex systems[3].

Without doubt, complexics – and here I cease to use inverted commas to set the word apart – currently lacks an integrated and unified body of theory to enable us to characterise the field in a general, widely agreed-upon manner. Nor can we dispel all doubts about its feasibility, although I am convinced that we shall see important progress in coming years to confirm the wisdom of this approach and, above, of its aspiration to be transdisciplinary. At a minimum, we are already witnessing a series of transversal concepts and models that are not only pushing forward specific disciplines with new images and perspectives that pass between them, but that are also forging a shared scientific lexicon useful in interdisciplinary communication and integration, which are made more difficult by the diversity of terminology.

[3] For a broader look at the perspective as a whole, see the excellent overview provided by José Luis Solana Ruiz (2013). Shorter summaries can be found in Bastardas (2013 and forthcoming) and Massip (2013).

2. The construction of a new theoretical vision

The task of building, in a coordinated and integrated manner, a new transdiscipline such as the one depicted here requires progress on both the theoretical and the methodological levels. Indeed, at present, there are advances being made in both domains, although they appear to lack integration and mutual communication.

On the level of theory, complexics needs to provide a set of principles, concepts and conceptual landscapes that can be applied transversally to distinct areas of knowledge and phenomena of reality, enabling us to gain a much firmer grasp of the complex aspects of their existence than we currently have. For this reason, our aim needs to be, as Morin says, not "to reduce complexity to simplicity, [but] to translate complexity into theory" (1994:315).

To achieve this objective, one of our first tasks is to acknowledge the difficulty of putting into words a reality that is dynamic, processual and changing, using terms from our languages that are based on a rather static and stable view of the world's phenomena. In fact, we need to shift from a science 'of nouns' to one 'of verbs' ('languaging', 'bilingualing, 'identitying', etc.) (cf. Arthur, 2013). By using forms of motion, we not only help our brain/mind to escape from its 'conservative' furrows and open ourselves up to a more creative conceptualisation, but we also draw much nearer to the 'truth' of the characteristics of the observed facts, which are certainly the product of ceaseless interaction among real agents and elements.

One of the other profound changes that we need to address from the epistemological perspective of complexics is the tendency to disconnect the elements of reality once we have given a distinct name to each of them. Apparently, the act of assigning different names tends to lead us to think of these elements as existing independently, not interrelatedly, when, in reality, what is most typical is precisely their interdependence and interwovenness. If we turn our thoughts to 'society', for example, we imagine an entity not only different from the agents – human beings – who comprise it and give it existence, but also an entity that is separate in space. Society, we say, is 'on top of us'. On this matter, Norbert Elias, is clear: "We talk of the person and his environment, a child and his family, the individual and society, the subject and objects without always realising that the person also forms a part of his 'environment', the child is a part of his family, the individual is a part of society, the subject is part of the objects. (…) But our language and our concepts are largely set up as if everything that is outside of the individual person had the character of static objects. Concepts like 'family' or 'school' typically refer to a group of people. But our usual kinds of terminological and conceptual configurations make them sound as if they were objects of the same nature as rocks, trees or houses" (Elias, 1982:14).

In the case of sociocultural facts, Norbert Elias proposes in his figurational sociology that we do not think in terms of 'human beings and their environment' or the 'social framework', but in terms of configurations constituted by groups of individuals (with oneself among them): "Nobody would think to define the process of a game involving a player as the player's 'environment' or 'milieu' or 'framework'" (Elias, 1982:115). Morin concurs; based on his recursive thinking, in which the products and their effects are necessary for their own production, he says: "Individuals are not in society as in a box. There are interactions among individuals that produce society, which never exist without the individuals. (…) … we produce a society that produces us. We are part of the society that is part of us" (Morin, 1994:304-05). Our task here is to change our habitual images and develop visions that are closer to what actually occurs in reality.

In the phenomenon of language, this confusion can also arise. As we have already developed the concept of 'language', we may think that language exists in and of itself as an isolated and independent entity, when to the contrary we must conceive of it as a phenomenon closely tied to the human beings who give life to it and/or change it (or let it cease to exist). And this is where we have the debate on the *locus* of language – or of 'languaging'. Where do forms of languaging reside: in the individual or in society? As we can see, this is a spurious debate. 'Society' is not something outside the individuals who are its members. Rather, they cause it to 'emerge'. It is always a society-of-individuals. For Elias, the patterns of human culture are an emerging property of social processes, the unplanned result of interwoven plans and of the emotional and rational impulses of individual people: "From this interdependence of people arises an order *sui generis*, an order more compelling and stronger than the will and reason of the individual people composing it" (Elias, 2000:366). Indeed, the forms of human languaging are assuredly a singular phenomenon, because they live *in* and *among* people, requiring important conceptual changes to the representations that we have hitherto maintained. One approach is to think of them analogically as if they were a dance: "While different people can dance the same dance figuration, there is no dance as such without dancers" (Dunning & Hugues, 2013:53). Thus, we can study the different language 'dances' created by humans, but we must not lose sight of the fact that they are the socio-communicative actions of diverse groups of people. Forms of languaging are independent of any particular individual, but not of individuals as such.

3. New methodologies for new approaches

It is clear that the appearance and/or consolidation of these new theoretical perspectives must necessarily have ramifications at the more practical level of methodology. New tools for the conception, apprehension and treatment of the data of experience will need to be devised to complement existing ones and to enable us to make headway toward practices that better fit complexic theories.

One of the interesting theoretical-methodological examples is 'network theory', to which researchers such as Barabási and Soler have contributed. Their formulations have resulted in enhanced tools for the representation and mathematical treatment of interconnections at distinct levels of reality. As a result, these tools have been applicable to a variety of disciplines. In the field of sociocultural and communication sciences, however, this contribution may yet be at an excessively one-dimensional state, given that greater stress is being put on the 'internal' interactions of a system than on what happens between the system and its other systems or environments. As proof of this, we now have access to 'big data' to represent and study certain characteristics of a phenomenon – for example, Internet connections between many corners of the globe – and yet we have very little knowledge about what is actually going on. Why do certain connections exist and not others? What communication occurs across these connections and what influence does it exert in the real behaviours that may ensue? What relationships do these points of connection maintain with the socio-political and economic ecosystems with which they co-inter-exist? And so on and so forth. There is much scope here yet for advancement.

Indeed, network theory could be 'ecologised' more in order to include the interrelated multidimensionality of reality. This is what lies behind the addition of 'adaptive' to the phrase 'complex systems' in the terminology of 'complex adaptive systems' (CAS), which was popularised by the Santa Fe Institute, in New Mexico. In fact, I have often wondered what differences of substance existed between the 'ecological' perspective and the new CAS terminology. Apart from any innovations in the mathematical and computational treatment that there may have been, the basic approach is fundamentally very similar[4]. According to Levin (2010), the Santa Fe Institute

[4] This can be seen, for example, in the basic overlapping of approach among advanced socio-cognitive perspectives as shown in my book *Ecologia de les llengües* [*Ecology of Languages]* (1996) and the similarities contained in the document prepared by the interdisciplinary group known as 'The Five Graces', after the name of the hotel in which they met. Their document appeared in print in 2009 under the title 'Language is a complex adaptive system: Position paper'.

has rechristened the perspective and made headway by offering new and significant conceptual and methodological proposals. The change of name has also been positive by enabling us to jettison the overly 'biologising' resonance of the term 'ecology'. 'Complex adaptive systems' has a much wider range of association and application[5], which may be beneficial for its expansion into a far broader array of fields, such as economics, neurology and sociology. Certainly, researchers will produce new innovations to pave the way for yet more progress to be made.

New complexic mathematical and computational contributions have continued to grow in number, thanks primarily to scholars in statistical physics and computer science, who are now taking an interest in social and economic phenomena (cf. Epstein & Axtell, 1997; Wolfram, 2002; Ball, 2005[6]; Epstein, 2006). Drawing on analogies involving the study of systems that arise from the interaction of given agents and their rules in physics and in other disciplines, there are a rising number of contributions seeking to apply the new computational possibilities to our understanding of human social phenomena. This has also reached certain aspects of linguistics, such as the evolution of language, evolutionary contact and change[7].

Especially in the field of sociolinguistics do we find valuable contributions that need to be understood and evaluated seriously[8]. To date, the studies have been based fundamentally on the use of computational techniques known as cellular automata and multi-agent models. Building on the complexic ideas of self-organisation and emergence, these models of complex systems have attempted to simulate and dynamically display on screen the organisational results produced by the interactions among their 'agents'[9], such as, for example, the greater or lesser degree of use of a

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[5] "Ecology views biological systems as wholes, not as independent parts, while seeking to elucidate how the wholes emerge from and affect the parts. Increasingly, such a holistic perspective, rechristened at places like the Santa Fe Institute as 'the theory of complex adaptive systems', has informed understanding and improved management of economic and financial systems, social systems, complex materials, and even physiology and medicine. Essentially, that means little more than taking an ecological approach to such systems" (Levin, 2010).

[6] "Statistical physics may help to liberate planners and policy-makers from their propensity for linear thinking and to encourage a greater sophistication in their perception of cause and effect" (Ball, 2005:571).

[7] "Mathematical or computer models can be useful in the formulation of concepts and in the consideration of properties of the social sphere that are intrinsically linked to its character as a complex dynamic system. From this perspective, the objective is not to draw a realistic portrait of social systems, but rather to explore types of systems in which the relationships between the different levels of organisation involved enable us to reflect on the different levels of organisation that we identify within social systems" (Chavalarias, 2013:186).

[8] The applications of computational and complexic perspectives are also of great interest in the field of general linguistics, cognition and communication. See, for example, the works of Luc Steels, who starts from the belief that "the view that emerges (…) is that language can best be seen as a living system that is continuously evolving and adapting in a cultural process based on the distributed activity of its users. Consequently the computational investigations into genetic evolution, ant path formation, neural networks, and other biological systems are an important source of insight" (Steels, 2000:24).

[9] The use of computational simulations as a heuristic tool and in the production of theories is potentially of great interest. See Ihrig & Troitzsch (2013).

language relative to another language with which it is in contact (cf. Abrams & Strogatz, 2003). To achieve this aim, they have sought to identify the parameters that they believe may be more explanatory, such as the 'prestige' of languages and the 'volatility' (or the propensity of a speaker to switch language), and they simulate the evolution of the encounter between two groups, while also adding or not adding bilingual individuals (cf. Castelló, 2010; Castelló et al., 2007, 2013). By controlling the degree of each of the parameters, we can see the evolutionary changes caused by any variations in these magnitudes. This can help us to better understand the factors determining how the encounter will develop[10].

Not only simulations, but also programmes of this type using real data have been run to validate the model. One example is the use of cellular automata to examine the processes of language shift in a study devised by the group led by Francesc S. Beltran, using data from the autonomous community of Valencia (2009 and 2011). The model is built on the basis of a community using two languages, one dominant and one subordinate. Individuals are characterised as monolingual speakers of the dominant code, as bilingual with a preference for the dominant code, or as bilingual with a preference for the subordinate code. In this case, the model assumes social pressure – the number of people in the neighbourhood who encourage one behaviour or another – to be one of the fundamental variables in the evolution of the sociolinguistic situation, and this allows us to view the evolution of intergenerational language transmission.

4. Integrating theory and methodology

Certainly, these methodological innovations put into question and again make us take note of the excessive separation between the training received by researchers in the 'sciences' and in the 'arts'. Closer collaboration between these two subsets of researchers would, in all likelihood, be much more energising and creative than their current mutual distance.

Nevertheless, we need to have a critical eye and ask to what extent these transdisciplinary computational models, probably valid for other phenomena, are also the most appropriate for an understanding of shifting human phenomena. Their utility – which is based primarily on the simplified representation of human beings as 'agents' with little autonomous, creative cognitive-emotional activity – may be limited if we want to grasp not only the possible evolutions of a situation with 'stably' defined rules, but also, as a

[10] For more on the experience of 'playing' with this kind of tool, see http://www.ifisc.uib-csic.es/research/complex/APPLET_LANGDYN.html.

whole, the causal dynamics that have given rise to and determined the actions of its units[11]. That said, nobody can deny the importance of the studies conducted to date from the perspective of complex systems, or the utility of modelling, which has brought us nearer to the essential elements of processes and to the expression of their interrelationships with the utmost clarity. It seems obvious, therefore, that human complexics must be seen as multi-methodological, insofar as necessary combining quantitative-computation methodologies and more qualitative methodologies aimed at understanding the mental and emotional world of people. The epistemic foundations of complexic theory, set on gaining a deeper understanding of the world, seem to put this as a clear demand. As do human facts, with their peculiarities and their difference in relation to the dynamics that occur at hierarchically 'inferior' levels of organisation in the universe (cf. Malaina. 2012).

Much like physics, we have arrived at a fork or point of separation into two branches – a division that needs to be harmoniously stitched together again. On the one hand, we have the contributions of the more theoretical physicists, such as David Bohm, Ilya Prigogine and Fritjof Capra, and on the other hand, the contributions of more quantitative-oriented physicists from the field of statistical physics modelling, such as Murray Gell-Mann, Maxi San Miguel and Albert Díaz-Guilera. It will certainly be useful for us to gain familiarity with both of these major approaches, see their fruitful application in our disciplines and attempt to exploit them in a coherent and integrated manner. However, I think we must also be cognizant of the peculiarities of human phenomena, which are characterised by the existence not only of purpose and regularity in the control of behaviour, but also by the significant degree of agents' cognitive and interpretative autonomy and by the powerful influence of the emotional dimension.

This differential fact seems to pose a contradiction for the two fundamental orientations of complexics developed to date. On the one hand, the more epistemological and philosophical contributions lead us to postulate the

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[11] One characteristic of this kind of modelling is that it uses few parameters. This clashes with the aspiration of complexic theory to build a comprehensive ecology out of the elements involved: "Several models have been proposed to account for different mechanisms of social interaction in the dynamics of social consensus. The idea is to capture the essence of different social behaviours by simple interaction rules: following the idea of universality classes, in collective emergent phenomena details might not matter" (Castelló, 2000:24). Morin (2005:4) takes a rather more critical view: "Restricted complexity has enabled important advances to be made in formalisation, in the possibilities of models, which in turn stimulates the potential for interdisciplinary efforts. But one is still within the epistemology of classical science. (…) In some sense, complexity is acknowledged, but it is decomplexified. Thus, a gap opens up, and an attempt to plug it ensues: this is the paradigm of classical science, only fractured". To gain an adequate view of the whole and to understand the *how* and *why* of the process pursued by the agents in reaching the states that guide their decisions, as Xavier Castelló has similarly put it, it will probably be necessary to use computational research together with other types of research that are closer to the changing cognitive and emotional activity of the agents.

inevitability of taking into the account the brain/mind and everything that arises bio-cognitively from it in order to understand complex human behaviours. On the other hand, the proposals put forward by physics and computer science move in the opposite direction, postulating the selection of a few 'practical' parameters that can computationally 'explain' the observed facts.

Faced with this sort of dilemma, the need in my view is for the two lines to come to a meeting of the minds, stop disregarding one another as they have done, and take steps toward a mutual integration based on the acceptance of the shortcomings of each approach, achieving progress through a non-contradictory complementarity of perspectives[12]. It must be conceded that the practical and methodological applications of basic complex ideas need to be developed much farther in order to apply them to specific research. At the same time, the limits of complex adaptive systems as computational strategies must be accepted in the pursuit of a better understanding of the dynamic and evolutionary processes typical of human beings. In the final analysis, models always have a *narrative* running behind them that reflects the attempts of a human being to understand the world, and models are always interpreted on that basis. This is precisely what Allen and Hoekstra have recognised in the field of ecology: "Narratives are the bottom line in science. Yes, there are hypotheses, predictions, theories and models, but all of these devices are in the service of achieving compelling narratives. (…) The end product of science is a story improved by models and made convincing by predictions" (2014, forthcoming).

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[12] As Roggero has noted, "Today, there are more experts in formal disciplines taking an interest in the social sphere than there are sociologists borrowing the techniques of the formal disciplines. If a meeting of minds takes place, it will turn out to be hugely beneficial for both groups. The first will need to learn sociology's language and ways of thinking, including the sociological culture; the second will have to contend with the formal rigour, the methodological demands and the utilisation of useful computer tools found in the formal disciplines" (2013:116).

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