Human knowing and perceived complexity: Implications for systems practice

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Complexity has been understood in different ways since its (re)introduction into scientific discourse. Therefore, instead of proposing a definition of complexity, we group the existing explanations about it into two distinct categories: descriptive and perceived complexity. The main features of these categories are described and how they arise as the result of the adoption of contrasting epistemologies is discussed. These categories together with their implications for our doing in the world are explored under the rubric of the 'epistemological problem of complexity'. **The practical significance of the issues we address, especially as they relate to building capacity for systems practice, understood as a way of managing in situations of complexity, is also of concern.**

"Even when the individual trees are highly interesting and picturesque, it has use to see what the forest looks like in the large" (Rescher, 199S; *xvii).*

Introduction

One of the strongest claims of the scientific revolution is that science provides an objective and better description of the natural world than other ways of knowing. However, the 'real-world' of human affairs seems to us to be different than the world simplified by science - we experience it as complex, or more complex than the world and the issues that are usually addressed by 'normal' science and its methods. For a long time complexity has been ignored by classical science, in which scientists described an objective world following deterministic laws. But we live embedded in "situations of complexity". As a result we increasingly become aware of manifestations occurring in natural and social phenomena for which traditional epistemologies based on mechanistic explanations are no longer valid. Instead of considering complexity as a temporary shortcoming arising from our limited or partial understanding of reality, or as something that has to be eliminated in order for scientific progress to proceed (Stengers, 2004), complexity has now been recognized as an emergence in the world we help to co-create and in which we live. Very often we hear the claim that we live in an era of "expanding complexity". However, for Morin (1999a) the problematique of complexity is still marginal in scientific, epistemo-logical and philosophical thinking, although for him "complexity is not only in the foam of real phenomena. It is in its own principle". This is indeed very different from the perspective adopted by Hegel for whom "only in the surface reigns the game of irrational chance", and which has been the predominant and guiding perspective in science since its beginning.

To accept complexity means to turn upside down the view of classical science and a belief in the lawful structure of the world underlying the phenomenal surface. It means also to break an epistemic border. Therefore, the notion that all complex processes could be understood in terms of underlying simple universal laws is indeed an article of faith (Rosen, 1977). The growing acceptance of complexity, also as a worthwhile scientific issue, brought with it the emergence of complexity science. For Dent (1999: 5) "complexity science is an approach to research, study, and perspective that makes the philosophical assumptions of the emerging worldview". This growing "movement" towards complexity has brought with it some challenging questions which must be addressed, like: what is complexity? Do we identify or do we experience complexity? How do we decide that something is complex, or how do we know (or learn) that something is complex? Are there objective criteria to decide that something is complex? How complex is complexity, or how complex is the discourse of complexity? What implications does a particular explanation of complexity have for our doing in the world?

It is not the aim of this paper to explore possible answers to these questions, but to discuss how they are dependent on the epistemological choices made by those answering them. It means that the explanations made about complexity might be built on distinct epistemologies, on different ways of knowing about the world. Furthermore, the (re)introduction of complexity into scientific discourse has raised issues, the significance of which goes far beyond its scientific interest, since they might determine the way we construct and engage with 'real-world' problems. All these issues will be discussed in this paper as constitutive parts of the epistemological problem of complexity. We also

explore the different explanations of complexity which are current by pointing to what they reveal and conceal.

Current understandings of complexity

The word complexity derives from the word complexus and literally means "to weave together". However, since complexity has been (re) introduced into scientific discourse [1], it has been understood in different ways. According to Rosen (1977) our views regarding the concept of complexity have tended to be as richly varied as complexity itself. For Ottino (2004), for example, complex systems can be identified by what they do, and also by how they may or may not be analyzed. But there is no agreement upon a definition of complexity. Therefore, instead of proposing or assuming a particular definition of complexity, we will adopt here two general categories into which the existing explanations about complexity might be included.

Broadly we can say that in some explanations complexity has been understood as an intrinsic property of a certain kind of system, or as occurring in a certain kind of natural and social phenomena[2]. The kind of complexity emerging from this understanding can be called 'descriptive complexity'. All the attempts that have been made to quantify it or to achieve a quantitative measure of complexity might be included in this category. A very common example is the observation that forms the basis for most characterizations of the complexity of an object: the complexity is directly proportional to the length of the shortest possible description of that object, as is reported by Casti (1995). This seems to be also the perspective of Cilliers (1998) for whom "complex systems do have characteristics that are not merely determined by the point of view of the observer". From an epistemological perspective, 'descriptive complexity' is based on the assumption of the existence of an objective reality, external and independent of us, and to which we can have privileged access, resulting in the assumption that complexity can be objectively measured.

In other explanations complexity has been understood as the result of a distinction or resulting from a particular perception of a situation (of complexity) made by an observer, what can be denominated as 'perceived complexity'. Casti (1995: 269-270) recognized the role of the observer in the acknowledgment of complexity. For him "the complexity is an inherently subjective concept; what is complex depends upon how you look. When we speak of something being complex, what we're doing is making use of everyday language to express a feeling or impression that we dignify with the label complex. But the meaning of something depends not only on the language in which it is expressed (i.e. the code), the medium of transmission and the message, but also on the context. In short, meaning is bound up with the whole process of communication and doesn't reside in just one or another aspect of it, As a result, the complexity of a political structure, a national economy or an immune system cannot be regarded as simply a property of that system taken in isolation".

This kind of reasoning in which the observer is part of the description was firstly developed by Heinz von Forster, and as he was asked to give an explanation of what complexity is all about, he said that it resides more in the eye of the beholder than in the observed thing (according to an interview reported by Passis-Pas-ternak, 1993). However, Casti (1995) definitely admits that "whatever complexity a given system might have it is a joint property of the system and its interaction with another system, most often an observer and/or controller (...) So just like truth, beauty, good and evil, complexity resides as much in the eye of the beholder as it does in the structure and behavior of a system itself". Le Moigne (1990) in his book about the theory of a general system also claims that complexity results from the perception of an observer. Therefore, for us, and based on what we have already said, 'perceived complexity' does not result from cognitive incompetence, as suggested by Rescher (1998).

In contrast to 'descriptive complexity', the epistemological assumptions of 'perceived complexity' are related to the epistemologies based on the assumption that reality results from the distinctions made by an observer. According to this epistemology the explanations we make about the world are not in-dependent of us as explainers. However, this kind of epistemology has been associated with subjectivism, which according to the mainstream scientific thinking is opposed to objectivism, and therefore very often has been considered non-scientific, since objectivism is one of the core assumptions of classical scientific thought. It must be remembered that as complexity has been ex-purgated from the dominant scientific discourse, which is inspired by the intelligibility criteria of classical dynamics, until very recently also human subjectivity has been expurgated from the same discourse, where realism still is the predominant epistemology. To some extent, it seems to be compelling to deny subjectivism in the same way as complexity has been denied for a long time, since the shift to a scientific discourse which not only acknowledges situations of complexity but also accepts the uncertainty linked to it, is not straightforward. But we also reject the simplistic dichotomy

(dualism) objectivity-subjectivity, and in this paper subjectivity will be employed only to remind us that it is not possible to separate the observer from the world s/he describes. Furthermore, it must be remembered that the adoption of one or another of these epistemologies does not necessarily follow rational criteria, but seems to be a matter of preference or emotion.

In his attempt to define modes of complexity, Rescher (1998) distinguished three 'modes', namely epistemic, ontological and functional complexity. Among these modes of complexity, the epistemic embraces three categories: descriptive, generative and computational complexity. Although he made an effort to define in different terms these three types of epistemic complexity, in our view they are very similar and closely related to each other. For him, however, descriptive complexity is the most fundamental form, It is remarkable that in the distinctions made by Rescher (1998) there is no place for what is discussed here as 'perceived complexity'. This may be interpreted as strong evidence for the dominant objectivistic epistemology held, whether implicitly or explicitly, by the majority of those who are searching for an explanation for complexity.

These different understandings and explanations about complexity are nurturing the emergence of a science of the complex or a science of complexity. For Casti (1995) the emergence of a scientific theory of complexity "would be a major step toward the development of a framework within which we can begin to understand how to control and manage what our [cognitive] maps tell us are complex processes'. Despite Casti's intention of controlling complexity, revealing the extent to which he still is a hostage of classical epistemologies, we will discuss later one possible framework for managing complexity in the world, what we understand as 'systems practice'. Furthermore, it is also necessary to develop what could be called an 'epistemology of complexity', as a further step to lay down a common ground over which to develop 'complexity thinking' or 'complexity practice',

An epistemology of complexity

For the purpose of this paper the two general categories of complexity we have defined, as well as their epistemological and ontological implications will be understood as complementary parts of the epistemological problem of complexity. One of the first and more important authors to address this issue and to make claims for an epistemology of complexity was the French philosopher Edgar Morin (Morin, 1999a, 1999b, 2002). For him (Morin, 1999a) complexity is marginalized among the classic scholars of Anglo-Saxon epistemology (Popper, Kuhn, Lakatos, Feyerabend, among others), and from the perspective of epistemology there is only one exception: Gaston Bachelard, who considered complexity a fundamental issue, and that there is nothing simple in nature, only the simplified.

The epistemological problem of complexity raises some fundamental cognitive issues of how human beings know about the complexity of the world they live in. For instance, from the perspective of 'descriptive complexity', and considering the strong influence of objectivity in science, the verification of whether the behavior of a '(natural) system' is 'linear' or 'non-linear' frequently has been used as a validation criteria to decide about its complexity. However, we are not keen to provide an 'externalist' explanation of complexity. Instead, we assume here that none of us share a common experiential world. All we have at our disposal is our ability to communicate about our worlds of experience and, sometimes, a history of living in a common culture, including language, over a period of time. The sharing of a common culture allows us to appreciate the apparent paradox between our individual and unique cognitive histories and our experience that collectively we do not experience the world in relative or subjective (meaning here the lack of regularities) ways. And it is this unique cognitive history we each have as human beings that is denied when only an objective explanation of complexity is pursued and accepted as scientifically valid.

Therefore, and following the explanations coming from the biology of cognition, we assume that the way human beings know about the complexity of the world is a biological phenomena. Human beings make distinctions about their world according to their biological cognitive structure, and not according to the structure of the world around them. As argued by Martinez (2001) "biology creates thought and thought creates biology. Just as mind and body cannot be separated, to attempt a separation of mind and world would create an artificial split between observer and observation that assumes we can 'step out' of the world we are attempting to observe". As a result, we claim that complexity is not, as commonly accepted, a specific attribute of physical, biological and social phenomena, but instead a trans-disciplinary epistemological assumption, and a way of knowing about the world.

A different cognitive approach can be found in Rescher (1998). In his book Complexity. A Philosophical Overview he dedicates considerable space to discuss the cognitive aspects of complexity - or how human beings can know about the complexity of their world - particularly in chapter 3. For him, in the development of knowledge, progress is always a matter of complexification, since nature is

ontologically complex. According to him (p. 58) 'to claim the ontological simplicity of the real is somewhere between the hyperbolic and absurd', and the commitment of scientific method to simplicity is nothing else than a matter of the procedural principle of least effort. Now, to assume that the commitment to simplicity results from the procedural principle of least effort [sic] is not only too simplistic but also seems to deny any epistemology behind this approach. Furthermore, this kind of thinking reveals an epistemological commitment to objectivity, which is the basis of 'descriptive complexity'. This is his typical stance, as he says that 'substantial extensions in our cognitive access to new sectors of nature's parametric space is made possible through the enhancement of investigative technology'. In other words, our cognitive limitations regarding complexity might be overcome by technology. This seems to miss the point.

To admit human experience as key to our understanding of complexity does not mean that everything said or done is valid or even that we will find as many distinctions of complexity as living human beings. Although the number of possible distinctions of complexity may appear to be infinite, the diversity of these distinctions will be constrained through human community life, the sharing of culture and history, and through collective interests and preferences. The contrary is nothing more than a fallacy frequently remembered by those who adopt an objectivist epistemology to make explanations about the world, and deny any other approach as plausible. The claim being made here about the understanding of complexity is, therefore, that its recognition is a cognitive process prescribed by the biological structure of human beings, rather than as already existing in the objects of the world and which can be identified and measured. It is therefore of great interest to investigate the interrelationship between biology and epistemology, and how to address the epistemological problem of complexity from the perspective of the biology of cognition, also because we must be aware that the extent to which we as human beings can know about the complexity of the world is constrained by our cognitive limitations.

'Perceived complexity' is therefore necessarily related to complexity thinking. Complexity thinking is based on the assumption that subject and object, although not being the same, also are not radically separate. A complete (total) separation would make knowledge impossible (Ciurana, 2004). As claimed by Casti (1995), complexity resides as much in the eye of the beholder as it does in the structure and behavior of a system itself. And for Morin (1983) the kind of complex thinking he is suggesting requires the reintegration of the observer in his observation. For him, whereas the traditional epistemologies are characterized by disjunction and fragmentation, complexity thinking is a kind of thinking capable of rejoining, or contextualizing knowledge (Morin, 1999b).

To some extent the epistemological problem of complexity can be considered a particular case of the more general epistemological problem of how we human beings know about the world, and what constitutes evidence about that world. Therefore, most of the issues highlighted in this paper are undecidable, i.e. we cannot give definitive explanations about them, and our claim is restricted only to the reintroduction of the role of the observer into the explanations about complexity.

Implications for systems practice

Our concern in this paper is not only with the way human beings know about complexity (what is addressed here as the epistemological problem of complexity), or to discuss only the philosophical-theoretical aspects of this issue, but with its practical significance especially as it relates to building capacity for systems practice, understood as a way for managing in situations of complexity. We are adopting here a different perspective than that of Rescher (1998) for whom the complexity of real problem-situations outruns our capacity for their management. Our motivation in this field is to build a praxiology for 'systems practice' as a generic form of managing complexity in the world. Some attempts at developing methodological devices combining insights coming from systems thinking and complexity can be found in the literature, as in the systemic intervention methodology of Midgley (2003).

One of the most intuitive insights regarding complexity is that 'complex systems' [and complex processes] or situations of complexity are irreducible, i.e. "you cannot start slicing up systems of this type into subsystems without suffering an irretrievable loss of the very information that makes these systems a system" (Casti, 1995). A remarkable aspect is that the emergence of some complex features can only be recognized if we look at the whole system and not its parts. The adoption of this perspective originates from systems thinking, a kind of thinking which deals with wholes, boundaries and emergent properties instead of parts. We claim therefore that systems thinking needs to be situated at the origins of the (re)introduction of complexity into scientific discourse, and should also be considered the theoretical basis of 'complexity thinking' and 'complexity practice'. As Checkland

(1999) has pointed out, in the process of coping with the complexity of the world, the word 'system' is no longer applied to the world, it is instead applied to the process of our dealing with the world. Systems thinking and complexity thinking share therefore the same claim according to which a mechanistic worldview gives way to an organic worldview, despite the fact that some authors, such as those cited by Midgley (2003), contrast complexity and systems thinking.

For Morin (1999a) 'complexity' appeared as a marginal stream between engineering and science, in cybernetics and systems theory. This may explain why complexity was marginal among the classic names of Anglo-Saxon epistemology, since systems thinking itself can be considered only marginal in relation to the main streams of scientific thinking. But systems thinking in its many traditions has evolved to an approach for making sense of complexity, for managing complexity, although we must be aware, as advised by Senge (1990: 281), that "systems thinking shows that there simply is 'no right answer' when dealing with complexity". Therefore, we also avoid the terms 'manage' and 'managed', with their deterministic overtones, in favor of 'managing' which is an active process associated with our daily living.

Ison (2004) describes the fundamental epistemological choice to be made as to see system or complexity either:

a) as something that exists as a property of some thing or situation; and that, therefore, can be discovered, measured and possibly modelled, manipulated, maintained or predicted; or

b) as something we construct, design, or experience in relationship to some thing, event, situation, or issue because of the distinctions - or theories - we embody.

These options can be clearly associated with the two modes of complexity - descriptive and perceived complexity - discussed before. The choice of any one of those options has profound implications for our being and becoming in the world - and thus for our daily living as we do what we do. It means that the adoption of an understanding of complexity will determine the nature of the engagement of a systems practitioner with a 'real-world' situation. For Cilliers (1998: ix) engaging with complexity entails engaging with specific complex systems. For us, however, and from the epistemological perspective we adopt, engaging with complexity entails engaging in situations of complexity and using systems or complexity thinking to learn our way towards purposeful action that is situation improving.

Some implications in making an epistemological choice are suggested by Ison (2004). According to him, by choosing the first option we seduce ourselves into the belief that we can say a lot about the nature of the thing but this choice says almost nothing about the practitioner concerned with the thing. Choosing the latter position, on the other hand, tells us something about the practitioner and about what they know and are able to do, as well as about their relationship to the thing or event they experience - how the 'thing' itself arises in our act of distinction. Ison (ibid) emphasizes that, "making a choice of one epistemological position or another in a given context is not an act of discarding or deciding against the other position - it is an act of being aware of the choice being made" and taking responsibility for it. Being epistemologically aware opens up more choices for action. Following Maturana (19S8) responsibility replaces objectivity as the ethical basis of praxis.

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Notes

[1] For Le Moigne (1999) *complexity* appeared officially in the scientific literature after an historic paper by Warren Weaver published in *American Scientist* in 1948 (pp. 536-544) and entitled "Science and Complexity" - this article is reprinted in this issue of *E:CO. [z]* As an aside it is worth noting that among the plethora of recent authors on complexity the notion of system' is often un- or under-theorised when linked to complexity, as in 'complex system' or 'complex adaptive system'. This of course has practical implications.

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