

RESEARCH ARTICLE

Elinor Ostrom, reader of Herbert A. Simon: *The Sciences of the Artificial* as a methodological guide ‘To deal with complexity’

Massimo Cervesato 

Centre d'Economie de la Sorbonne, Université Paris 1 Panthéon-Sorbonne, Paris, France
Email: massimo.cervesato@univ-paris1.fr

(Received 10 December 2024; revised 30 September 2025; accepted 1 October 2025)

Abstract

This article revisits the methodological foundations of Elinor Ostrom's institutionalism by examining the role of ‘complexity’ in her work and the conceptual influence of Herbert A. Simon. While Simon was not Ostrom's most frequently cited reference, his thought – particularly as articulated in *The Sciences of the Artificial* – exerted a formative and enduring influence on her analytical framework. Drawing on Ostrom's later writings, in which she offers a retrospective account of her intellectual trajectory, we show how Simon's systems-engineering perspective provides a coherent framework for understanding her approach to institutional complexity, despite notable differences in their respective research objects and theoretical priorities. For Ostrom, institutions evolve incrementally as ‘boundedly’ rational individuals attempt to resolve collective problems through successive modifications of rule structures within complex social systems. In contrast to top-down optimisation models, her work emphasises adaptive responses and practical problem-solving. Interpreting Ostrom's methodology through a Simonian lens not only deepens our understanding of her contribution to institutional economics but also illustrates the value of interdisciplinary approaches informed by complexity theory for the field.

Keywords: complexity; economic methodology; institutional analysis; Ostrom (Elinor); Simon (Herbert A.); systems science

Introduction

Elinor Ostrom is best known for her work on common-pool resources (CPR), in which she shows how certain groups of individuals exploiting these resources are best able to find effective and sustainable solutions to the social dilemmas they face (Ostrom, 1990). This thesis builds on an empirical analysis of concrete CPR situations, which invariably involve a complex interplay of institutional, cultural, and biophysical elements. It also relies on the modelling of the cognitive processes through which resource users conceptualise their opportunities and strategies, ultimately leading them to manage – or fail to manage – these resources in a sustainable manner. In other words, Ostrom's empirical analyses rest on a methodological framework aimed at coping with ‘complexity’, a notion that has gradually become central to her research programme on the institutional analysis of social-ecological systems (SES) (Ostrom, 1999, 2005, 2007). It is, therefore, no coincidence that she decided to name her Nobel Prize lecture in 2009 ‘Beyond Markets and States: Polycentric Governance of Complex Economic Systems’, and that she concluded by inviting social scientists ‘to be willing to deal with complexity instead of rejecting it’ (Ostrom, 2010a: 665).

Many commentators have already highlighted Ostrom's use of the notion of complexity and the tools she developed to address issues associated with it (Aligica and Boettke, 2009; Frischmann, 2013; Lara, 2015). Nevertheless, not all of them detail exactly what the notion of complexity refers to, or, more importantly, analyse specifically the structuring use of this notion in Ostrom's work. It is true that Ostrom is partly responsible for this neglect as she sometimes used the notion loosely.¹ This led Lewis (2017: 12) to argue that her use of the notion tended more to be 'a device for differentiating the Ostroms' preferred approach to social analysis from earlier approaches to the study of social phenomena in general and public administration in particular' than a well-articulated, rigorously defined term.² In this article, we intend to shed new light on Ostrom's methodology and her treatment of complexity by closely examining the specific theoretical sources that led her to mobilise this notion. To this end, we show the hitherto neglected decisive influence on her work of the 'sciences of the artificial', a term coined by the political scientist, economist, and precursor of systems thinking, Herbert A. Simon.

The filiation between Ostrom and precursors of systems thinking has only just begun to be explored by commentators. For example, Lewis and Aligica (2024) have shown the crucial influence of Ross Ashby's work in cybernetics on Vincent and Elinor Ostrom's conceptualisation of self-governance. They claim that the influence of cybernetics has, until now, been largely underexplored in Ostromian studies, and they attempt to remedy this by analysing the connection between Ashby and the Ostroms. However, although Lewis and Aligica (2024: 4) rightly stress the importance of other developments in administrative and systems science during the 1950s and 1960s – in particular, Simon's famous book *The Sciences of the Artificial* – they do not go into further detail about it. Moreover, many commentators who trace Ostrom's inspirations in the study of collective goods only briefly mention Simon, or focus solely on the notion of 'bounded rationality' (Clark, 2019; Tarko, 2021; McGinnis, 2021). While some have seen the filiation between Ostrom and Simon on systems thinking (Peneranda, 2012; Wall, 2014), enriching our understanding of Ostrom's methodological approach to complexity, their analyses do not provide an overall view. Thus, one can go further by showing in a more general way that the systems-engineering approach, in particular, as established by Simon, played a greater role than is usually assumed regarding the notion of complexity and the tools Ostrom used to deal with it.

Although Simon and Ostrom had few public exchanges during their lifetimes, Ostrom explicitly stated on several occasions at the end of her career the essential role played by Simon in her own work, emphasising his contribution to systems science (Ostrom, 2004, 2005, 2006, 2017). Indeed, she described *The Sciences of the Artificial* as the precursor of a new methodology that she drew on to understand the most complex system of all: human society (E. Ostrom and V. Ostrom, 2004).

Importantly, Simon was less a systematically cited influence than a long-standing source of conceptual inspiration that deeply structured Ostrom's intellectual trajectory. Given the differences in their respective research objects, Simon was not always Ostrom's primary reference, and his name does not appear consistently across her writings. Nonetheless, a diffuse and persistent resonance of his ideas permeates her work. The more explicit references that emerge in the 2000s, when read alongside her earlier publications, offer valuable insight into the methodological foundations of her institutionalist approach. In this regard, we propose a retrospective reconstruction aimed at clarifying the role that Simon's ideas played in shaping Ostrom's methodological outlook and its application to institutional analysis. While Simon was certainly not the only figure to influence her thinking, as we will show, he is arguably the one who provides the most coherent conceptual framework for understanding her approach to complexity. In other words, we suggest that interpreting Ostrom's work through the lens of

¹In her 1999 article, one of the texts in which her understanding of complexity is most detailed, she advances a standard definition: 'Complex adaptive systems are composed of a large number of active elements whose rich patterns of interactions produce emergent properties that are not easy to predict by analysing the separate parts of a system'. (520–521).

²Vincent Ostrom – Elinor Ostrom's colleague and husband – likely played a significant role in her use of Simon's work, having discussed it as early as the 1970s (V. Ostrom, [1973] 2008). In what follows, however, our focus remains on Simon's influence on Elinor Ostrom herself, who cited his work extensively and contributed to the development of methodological tools within institutional economics (Aligica and Boettke, 2009; Wall, 2014).

Simon's thought deepens our understanding of Ostromian institutionalism. At the same time, this reading also serves to illustrate how an interdisciplinary approach grounded in the notion of complexity can be fruitfully mobilised within institutional economics.

First, we show that the notion of complexity is central to Ostrom's work, particularly in shaping her methodological approach to the study of institutional situations (*The importance of complexity in Ostrom's work*). Then, we describe more specifically what this approach refers to for Ostrom and what it borrows from Simon (*Ostrom's Simonian source of inspiration for the study of complex systems*). Since this methodological approach incorporates several Simonian analytical perspectives on complexity, we take a closer look at three of them and see how Ostrom appropriates them. First, complex systems – like social systems – can be described as 'nearly decomposable systems' (*Analysing complex social systems as nearly decomposable ones*). Second, the dynamics of complex social systems must be understood through their adaptive evolution (*Recognising the adaptive evolution of complex social systems*). Third, scientific results regarding the complexity of these systems require realistic assumptions and empirical research (*Relying on realistic assumptions and empirical investigation as a warrant for scientific inquiry*). This, in particular, will allow us to reinterpret Ostrom's use of Simon's bounded rationality in a more consistent way. Then, by analysing the aspects in which Ostrom departs from Simon, we can enrich our understanding of what she meant by 'the sciences of the artifactual' (E. Ostrom and V. Ostrom, 2004: 139) for the study of human institutions (*The sciences of the artificial or the sciences of the artifactual?*). Finally, we will examine a case study – the management of groundwater basins in California – to illustrate how our analysis sheds new light on Ostromian institutionalism (*Institutional evolution through incremental change: a textbook case*).

The importance of complexity in Ostrom's work

Complexity is one of the main notions structuring Ostrom's work. However, it is distinctive in that it characterises a methodological approach more than a research object as such. Indeed, if we assume institutional situations are 'complex' systems, then it follows that we need methodological tools to deal with them. This is how Ostrom conceives the role of 'complexity sciences' in social sciences:

My take on complexity is that it is a key set of concepts which are essential for understanding how the world works. There are many situations where simple models don't work—when there are 10, 15, 20 variables. ... Here, the ideas of complexity can lend a hand by providing a means of analysis and understanding the reality of these action situations. (Ostrom in Ramalingam, 2012).

Lewis (2017) indicates that Ostrom's notion of complexity includes a series of characteristics that she endeavoured to define and understand throughout her career. According to him, a complex system in Ostrom's work should be comprehended as: 1) a set of elements (human beings, natural resources, cultural communities, etc.) interacting according to a structure of rules; 2) situated within a series of nested structures; 3) adaptive to its environment; 4) and producing emergent properties that are difficult to predict and irreducible to the properties of its constituent parts.

Ostrom's recognition of complexity came gradually. The theme began to be explicitly recognised by her and her husband in the 1980s, when the development of the *Institutional Analysis & Development* (IAD) framework was her principal focus (Ostrom, 1986a, 1986b; see Blomquist, 2022).³ In January 1986, in the Ten-Year Prospectus of the *Workshop in Political Theory and Policy Analysis* they had created in Bloomington, they stressed the problem posed by the complexity confronting social scientists: 'From our cumulative experience of working with theory, collective choice, and empirical consequences, we have become increasingly aware that the phenomena being investigated involve extraordinary complexity requiring multiple levels of foci of inquiry' (E. Ostrom and V. Ostrom [1986]

³The IAD framework that Ostrom elaborated is a direct response to the complexity of the biological, cultural, and social processes she observed in institutional situations (Ostrom, 2010a: 645; see also Poteete, Janssen, and Ostrom, 2010: 56).

in Clark, 2019: 102). Then, from the 1990s onwards, Ostrom focused her writings ever more on how to deal with complex systems. For example, while the theme is only touched upon in her seminal 1990 book *Governing the Commons*, her 1995 essay ‘Designing Complexity to Govern Complexity’ explicitly sets out how her approach and results from 1990 address it. She states:

if complexity is the nature of the systems we have an interest in governing (regulating), it is essential to think seriously about the complexity in the governance systems that are proposed. Without a deep concern for creating complex, nested systems of governance, the very processes of trying to regulate behavior so as to preserve biodiversity will produce the tragic and unintended consequence of destroying the complexity we are trying to enhance (Ostrom, 1995: 34).⁴

From then on, the notion of complexity was to appear explicitly across all of Ostrom’s work in subsequent years. Since her primary concern had always been to build a ‘theoretical framework for understanding institutions and collective action’ across a variety of situations (Blomquist, 2022: 22), the development of tools and methods to address complexity was central to this aim, preceding in fact her research on CPR situations.⁵ It is therefore no surprise that, towards the end of her career, Ostrom continued to assert that, ‘[g]iven the complex, nested systems of the biophysical world’, we still need to further develop ‘a social science of complex, nested systems’. (Ostrom and Basurto, 2011: 337).

For Ostrom, the notion of complexity thus refers more to a global, structuring methodological approach than to a research object as such. It remains to characterise in more detail the origins and attributes of the tools that she associates with it. This is precisely where the contribution of Simon is decisive.

Ostrom’s Simonian source of inspiration for the study of complex systems

Most of the commentators who link the two social scientists do so via the notion of bounded rationality (Chanteau and Labrousse, 2013; Clark, 2019; Tarko, 2021; McGinnis, 2021). Of course, on several occasions, Ostrom explicitly asserts the decisive role Simon played regarding her commitment to bounded rationality (Ostrom, 2005, 2010a). In one of her final writings, she states:

The philosophical foundation of my research program was well established by the early 1980s The most important theoretical foundation has continued to be the theory of polycentricity initially developed by V. Ostrom, Tiebout, and Warren (1961) and V. Ostrom (1999), as well as *Herbert Simon’s* ([1947] 1957, 1978) *theory of bounded rationality and his stress on the importance of field research*. (Ostrom, 2017: 407, our emphasis).

As we can see, Ostrom also takes a step further by explicitly acknowledging that it is thanks to Simon that field research came to occupy such a central place in her work.⁶

Nevertheless, it is in a short essay reflecting on the ten books that most influenced her that Simon’s role becomes most apparent (Ostrom, 2004). Indeed, while it is not surprising that *The Sciences of the Artificial* (Simon, [1969] 1996) features in the ranking, it is more striking to see that no mention of bounded rationality is made when justifying this choice:

Due to its strong focus on design and on using components to build up a well functioning complex adaptive system, for me it is his most cogent book and related to many of my interests. . . . Simon understood better than most political scientists the need to analyze complex systems in

⁴See Lewis and Aligica (2024), who show how Ostrom follows Ross Ashby on this specific point.

⁵This is important because, as we will see in Section ‘Analysing complex social systems as nearly decomposable ones’, Ostrom links the logical basis of the IAD framework – which she developed prior to her research on CPR situations – to Simon’s work.

⁶More on this in Section ‘Relying on realistic assumptions and empirical investigation as a warrant for scientific inquiry’.

terms of their subsystems and their subsystem's subsystem. He understood the importance of examining components all the way down to very tiny components of a very large and complex system—the holons of complex systems. (Ostrom, 2004: 45).

As Ostrom explicitly states, it is Simon's reflections on systems science that seem to matter most for her work. It is also interesting to note that in the same list, Ostrom cites Mayr's book *The Growth of Biological Thought* (1982) to emphasise the systems approach to complexity developed there. Indeed, the approach used by Mayr (1982: 53) is partly influenced by Simon himself. Considering Simon's thinking on systems science and complexity, it thus appears that his influence on Ostrom's work is more substantial than the notion of bounded rationality alone would suggest.

Some commentators have begun to highlight the role of Simonian ideas on systems and complexity in Ostrom's work. Wall (2014) points out, for example, that Ostrom drew on Simon's concept of 'nearly decomposable system' to extend the IAD to SES. Peneranda (2012) writes that the engineering approach developed in Simon's work may have influenced Ostrom in elaborating the 'design principles'. However, one feels that these insights focus primarily on explaining particular operational tools, giving only a fragmented and embryonic vision of what Ostrom borrows from Simon on systems and complex thinking. It perhaps explains why, while Ostrom (2005: 270) argues that her research on complex, adaptive systems is 'strongly influenced by the work of Simon', Clark (2019: 103–104) states that, before Ostrom, 'the groundswell of systems theory and complexity science had not yet occurred', and that her work in this field 'proceeded without support or guidance from others who had come before' her. In contrast to this, we uphold that Simon's reflection on systems science and complexity profoundly structures her global methodology and the tools she uses to conduct her work.

Indeed, *The Sciences of the Artificial*, as conceptualised by Simon, ground a large part of the method employed by Ostrom on social systems, understood as complex systems, as she explicitly acknowledges in a 2004 article co-authored with Vincent:

The quest for meaning in the constitution of order in human societies cannot rely on the methods of the natural sciences. Instead, we face the challenge of developing and working with what might be called 'the sciences of the artifactual' that are broadly applicable to the cultural and social sciences and the humanities. *Herbert Simon has addressed what we call the sciences of the artifactual in The Sciences of the Artificial ([1969] 1981). We prefer the term artifactual to artificial. He addresses the basic issues that need to be emphasized.* (E. Ostrom and V. Ostrom, 2004: 139, our emphasis).

The sciences of the artificial were born from the realisation that humans are now evolving in a world that is more 'artificial' than natural, made up of a growing number of increasingly complex 'artifacts'. These artefacts range from the material objects we create and use to immaterial goods (knowledge, computer data, etc.), to the various organisations we evolve in, with its associated flow of information. What fundamentally characterises these artefacts for Simon is that they are 'being moulded, by goals or purposes, to the environment in which [they live]' (Simon, [1969] 1996: xi). This malleability of artefacts in relation to the goals pursued by humans vis-à-vis the environment implies a certain 'contingency' in artificial phenomena, unlike in natural phenomena: 'The contingency of artificial phenomena has always created doubts as to whether they fall properly within the compass of science The genuine problem is to show how empirical propositions can be made at all about systems that, given different circumstances, might be quite other than they are' (ibid.). This, then, is what needs to be surpassed by the elaboration of a new science, as Avenier (2019: 47, our translation) describes: 'The central project of the sciences of the artificial is, then, to provide an epistemic framework better suited than that of the natural sciences to represent and understand phenomena in which both human intentions and perceived natural regulations are embodied'. The sciences of the artificial are thus composed of several disciplines: systems science, which enables the rigorous study of complex formal systems; cybernetics, which is more concerned with communication between systems

and/or subsystems; design science, which provides systematic methods for system innovation; cognitive science, which studies the processing of information by any system; etc. (Durand, 2017). This new research programme aims both to understand the functioning and evolution of artefacts and to formulate well-founded knowledge and methods for developing new artefacts with desired properties (Avenier, 2019: 47).

It is precisely this objective that Ostrom seeks to achieve in the study of the management of collective goods, particularly from the 1980s onwards. This is why she asserts that the issues and foundations laid down by Simon in *The Sciences of the Artificial* are the same as her own (E. Ostrom and V. Ostrom, 2004). In one of her earliest studies on the institutional framework that would become the IAD, she states that '[n]o guidance or control is possible without an understanding of how complex systems work' (Ostrom, 1986b: 473). Thus, what she finds in *The Sciences of the Artificial* is a series of concepts and tools already at hand for the study of social systems understood as complex systems:

A crucial challenge at the current stage of development is the need to move toward theories of collective action and common-pool resources that acknowledge complexity and multiple levels of analysis Ontological frameworks and diagnostic theories are used in medicine, biology, and information sciences to enable scholars to identify relevant causal processes within complex, nested systems *Within the social sciences, Herbert Simon ([1969] 1981: 196) introduced a similar concept that he called a hierarchic system* (Poteete, Janssen and Ostrom, 2010: 358–359, our emphasis).

It is striking to see that the figure of the systems engineer, linked to these sciences of the artificial, progressively takes on a central role in her work from the 2000s:

The complexity we have found in regard to common-pool resources in the field is not in any way unique to natural resources. For far too long, social scientists have viewed the physics of static, simple systems as the model of science we should try to emulate. . . . The engineers responsible for the design of airplanes and bridges—and now computers—have long coped with complex dynamic systems. (Ostrom, 2005: 242)⁷

So, just as the contingency of artificial phenomena was a preoccupation for Simon, as we have seen, so it was for Ostrom, who ruled out the possibility, or even the desirability, of seeking to 'produce universal laws of political process and outcomes that hold anywhere and at any time (similar to the laws of physics)' (Ostrom, 2006: 6). The work of the social scientist is more akin to that of a systems engineer: 'when the outcome of a particular process is unexpected, important, or has serious consequences . . . , our task is similar to that of engineers who are asked to determine the cause of a failure of some complex equipment such as an airplane, ferry boat, or rocket' (ibid.).

Simon's research programme on the sciences of the artificial is thus presented by Ostrom as a decisive source of inspiration, both conceptually and methodologically. To understand what Ostrom concretely drew from Simon's work, we will now examine in closer detail three analytical perspectives he developed to respond to the challenge of complexity and how she appropriated them for her study of social systems.

Analysing complex social systems as nearly decomposable ones

Simon insists that most complex systems, whether natural or artificial, are to be understood and analysed as 'hierarchic systems' or, more specifically, as 'nearly decomposable systems' (Simon, [1969]

⁷Ostrom was a member of the Science Board of the Santa Fe Institute for five years, a research institute founded in 1984 and renowned for its study of complex adaptive systems (Ramalingam, 2012).

1996). Hierarchic systems refer to ‘all complex systems analysable into successive sets of subsystems’.⁸ Nearly decomposable systems form a particular class of hierarchic systems (ibid.: 185). For Simon, hierarchic systems can be decomposed into ‘the interactions *among* subsystems, on the one hand, and the interactions *within* subsystems that is, among the parts of those subsystems on the other’, with nearly decomposable systems being those hierarchic systems in which ‘the interactions among the subsystems are weak but not negligible’ (ibid.: 197, author’s emphasis).⁹ While nearly decomposable systems would constitute most complex systems, the usefulness of the proposed categorisation actually goes beyond mere description. In the chapter ‘The Architecture of Complexity: Hierarchic Systems’, Simon states:

The fact then that many complex systems have a nearly decomposable, hierarchic structure is a major facilitating factor enabling us to understand, describe, and even “see” such systems and their parts. Or perhaps the proposition should be put the other way round. If there are important systems in the world that are complex without being hierarchic, they may to a considerable extent escape our observation and understanding. Analysis of their behavior would involve such detailed knowledge and calculation of the interactions of their elementary parts that it would be beyond our capacities of memory or computation. (Simon, [1969] 1996: 207)

Thus, this categorisation has heuristic value for researchers seeking to study complex systems, as it aligns well with human cognitive capacities and available resources. Indeed, to analyse and design complex structures, ‘one powerful technique is to discover viable ways of decomposing [them] into semi-independent components corresponding to its many functional parts’, enabling each component to be thought of ‘with some degree of independence’ from the others (Simon, [1969] 1996: 128). While this may seem abstract in relation to human situations, Simon points out that ‘[m]uch of classical organization theory in fact was concerned precisely with this issue’ (ibid.).

Ostrom drew on this very conceptualisation to found the IAD (Ostrom, 2005) and to take better account of the ecological aspect of social systems (Ostrom, 2007; see Wall, 2014). In her 2005 book, in which the IAD plays a central role, Ostrom seeks to provide solutions for social scientists who want to study the social world by acknowledging its complexity. They face ‘a major challenge in identifying the appropriate level of analysis relevant to addressing a particular puzzle and learning an appropriate language for understanding at least that focal level and one or two levels above and below that focal level’ (Ostrom, 2005: 12). To respond to this challenge, as she points out in her Nobel Prize lecture, she drew her ‘inspiration from the work of Arthur Koestler (1973) and Simon ([1969] 1981, 1995) who both challenged the assumption that human behavior and outcomes are entirely based on a small set of irreducible building blocks’ (Ostrom, 2010a: 646). For her, social systems are best viewed as hierarchic and nearly decomposable systems, in which ‘it is somewhat arbitrary as to where we leave off the partitioning and what subsystems we take as elementary’ (Simon, [1969] 1981: 196 in Poteete, Janssen and Ostrom, 2010: 359). This is why she intends to provide a tool capable ‘of “dissecting” complex systems into composite holons that are then dissected further’ (Ostrom, 2005: 11–12).¹⁰ This is precisely what the IAD enables, as Ostrom explicitly describes: ‘It is a framework for analyzing *nearly decomposable systems* ranging from families, to neighborhoods, to large communities, to governmental units at a local, regional, national, or international level’ (Ostrom, 2006: 6–7, our emphasis).

⁸Here is Simon’s ([1969] 1996: 183–184) definition of a complex system: ‘Roughly, by a complex system I mean one made up of a large number of parts that have many interactions. . . . in such systems the whole is more than the sum of the parts in the weak but important pragmatic sense that, given the properties of the parts and the laws of their interaction, it is not a trivial matter to infer the properties of the whole’.

⁹The notion of decomposability began to become a well-established concept for characterising complex systems and organisations during the 1960s. For example, Ashby (1962: 256) also notes the importance of this notion.

¹⁰Basing the notion explicitly on Simon’s work (Koestler, 1967), holons refer to ‘nested subassemblies of part-whole units in complex adaptive systems’, that is, subparts of a complex system that themselves form complex systems as such, and so on (Koestler, 1973: 291 in Ostrom, 2005: 11).

The IAD is conceived as ‘a multitier conceptual map’, in which the analysis of each component can lead to the analysis of its sub-components, which in turn can be broken down in greater detail according to the needs expressed by the researcher (Ostrom, 2005: 14). Within this framework, an institutional situation is indeed defined by an ‘action arena’, itself composed of two holons: the action situation and the participants. The action situation is then characterised by seven variables¹¹, and the participants’ behaviours are modelled through three main variables that must be adapted to each specific situation. However, it is also possible to consider three exogenous variables to the action arena affecting its structure: 1) the characteristics of the biophysical world attached to the situation; 2) the structure of the community (with its norms, habits, cultures, etc.); 3) the rules used by participants in their relationships. Each of these exogenous variables is made up of a large number of variables. Rules being the central object of institutions (Ostrom, 1986a), Ostrom proposes, for example, seven fundamental classes of rules, echoing the seven variables structuring action situations. Nevertheless, it is still possible to go further by detailing the syntactic composition of rules, in particular to dissociate them from norms or collective strategies. Thus, Ostrom also proposes an institutional grammar, which she calls ADICO syntax¹², to recognise these elements and their evolution in each institutional situation (Crawford and Ostrom, 2005: 139–140). Lastly, it is possible to step back and study the interactions between several action arenas ‘linked together either sequentially or simultaneously’ (Ostrom, 2005: 15). As we can see, the IAD corresponds well to nested conceptual maps presented ‘at scales ranging from exceedingly fine-grained to extremely broad-grained’ (Ostrom, 2005: 11). Similarly, when she seeks to take greater account of the ecological environment by developing the SES framework from the IAD, she points out that ‘SESs are partially decomposable systems’ (Ostrom, 2007: 15182). Once more, the Simonian perspective is advocated: ‘[s]cientific progress has been achieved in the past when scholars have recognized that complex systems are partially decomposable in their structure’ (ibid.).

Recognising the adaptive evolution of complex social systems

In addition to this hierarchical conception of complex systems, Simon advocates an approach to the study of complex systems based more on the recognition of the variety of possible evolutions than on a principle of optimisation leading to a single solution, particularly in economics. This thought is similar to his criticism of standard rational choice theory (Simon, 1955, 1956).¹³ Here, however, the argument has more to do with the methodology to be employed in studying economic complex systems. He states:

from the fact that an economic system is evolving, one cannot conclude that it has reached or is likely to reach a position that bears any resemblance to the equilibria found in the theory of perfect competition. Each species in the ecosystem is adapting to an environment of other species evolving simultaneously with it. The evolution and future of such systems can only be understood from a knowledge of their histories. (Simon, [1969] 1996: 47)

His speech to the Richard T. Ely lecture at the *American Economic Association* in 1977 helps us understand the argument advanced here. Simon criticised the systematic, even excessive, use of marginalist calculus inside and outside the ‘traditional domains of production and distribution’ (Simon, 1978: 4). Instead, Simon promoted a functionalist analysis in the social sciences, which was concerned with the realisation and maintenance of individual or social ‘goals’ (Simon, 1978: 3).¹⁴ And

¹¹The seven variables are as follows: ‘(1) participants (who may be either single individuals or corporate actors), (2) positions, (3) potential outcomes, (4) action-outcome linkages, (5) the control that participants exercise, (6) types of information generated, and (7) the costs and benefits assigned to actions and outcomes’. (Ostrom, 2005: 14).

¹²The ADICO syntax enables us to analyse each component of an institutional statement: A stands for ‘ATTRIBUTES’; D for ‘DEONTIC’; I for ‘AIM’; C for ‘CONDITIONS’; and O for ‘OR ELSE’ (Crawford and Ostrom, 2005).

¹³See Jones (2002), Gigerenzer (2021), and Petracca (2021) for a detailed analysis of Simon’s work on rationality.

¹⁴For a presentation of functionalist reasoning in economics and other social sciences, see Mahner and Bunge (2001) and Kincaid (2007).

more specifically, by stepping outside the traditional domains of economics, Simon pointed out that ‘it is not clear that anything new is added’ with marginalist calculation than with ‘cruder and simpler arguments’ of functionalist analysis, ‘since the parameters imputed to the system are largely unmeasured and unmeasurable’ (Simon, 1978: 6–8). Functionalist analysis, on the other hand, enables us to understand how a system can evolve to maintain itself (whether it reaches an equilibrium state or not). Indeed, to consider a solution as such in the functionalist framework proposed by Simon, it is sufficient that it *satisfies* the objectives specific to the system’s survival: ‘all that can be concluded from a functional argument is that certain characteristics (the satisfaction of certain functional requirements in a particular way) are consistent with the survival and further development of the system, not that these same requirements could not be satisfied in some other way’ (Simon, 1978: 4). This is all the truer when the system and its associated environment are complex, in which case ‘there is no assurance that the system’s momentary position will lie anywhere near a point of equilibrium, whether local or global’ (ibid.), with each element continually adapting to the other elements with which it shares a connection. This is why Simon states in *The Sciences of the Artificial* that ‘the evolution of firms and economies . . . is probably best understood through an examination of its history’ (Simon, [1969] 1996: 48).

The study of the commons proposed by Ostrom (1990), resulting in the eight design principles, is perfectly in line with the Simonian logic of considering the adaptive evolution of systems rather than their optimal solutions. While Ostrom (1990, 2005, 2007) calls for never relying on ‘universal solutions’ or ‘panaceas’, whatever the institutional situation under consideration, the elaboration of the design principles shows a way of getting around this problem. For her, a design principle refers to an ‘essential element or condition that helps to account for the success’ of institutions managing a CPR, promoting a sustainable management of the CPR and the conformance of users to the institutional rules, generation after generation (Ostrom, 1990: 90).¹⁵ These principles are special because they do not indicate ready-made solutions, but instead correspond to what the rules of an institutional situation must respect to enable agents to find solutions adapted to their situation. As Peneranda (2012: 28, our translation) points out, these design principles find their foundation in an ‘engineering approach that consists in designing procedural rules’ where ‘[i]t is not the decision that is optimized’ but ‘the process of coordinating actors in decision-making that is strengthened’. As a result, several sets of rules, depending on the specific and historical situation of the problem under consideration, can fulfil the same goals, such as the survival of the CPR and agents’ conformance to collective rules. In other words, we find here the notion of functional equivalence that Simon ([1969] 1996, 1978) defended concerning complex systems, as we saw above. For this reason, Ostrom stated the following about the design principles in 2005:

At a recent colloquium where the design principles were discussed, Mike McGinnis made an interesting observation drawing broadly on the work of Herbert Simon. He noted that Simon has repeatedly stressed the complexity of designing humanly engineered systems whether they be computers, road networks, or institutional arrangements. In *The Sciences of the Artificial* ([1969] 1981), Simon specially argues that no humanly designed, complex system can be fully planned to achieve optimal performance. Rather, he stressed that all complex systems must be built up from simpler components. . . . My own conclusion related to the impossibility of doing a *complete* analysis of a complex, adaptive system is, of course, strongly influenced by the work of Simon, as well as our research on coupled social-ecological systems. (Ostrom, 2005: 270–271, author’s emphasis).

More generally, she explicitly states that no notion of optimality is automatically attached to the gradual adaptation of institutional rules since each institutional situation is too complex ever to be sure of achieving any optimality. Ostrom emphasises that it is the very notion of ‘optimality’ that poses a

¹⁵These are the eight design principles: 1) clearly defined boundaries; 2) congruence between appropriation and provision rules and local conditions; 3) collective-choice arrangements; 4) monitoring; 5) graduated sanctions; 6) conflict-resolution mechanisms; 7) minimal recognition of rights to organise; 8) nested enterprises (Ostrom, 1990: 90). The eighth principle is a clear recognition of the nearly decomposability of institutional situations.

problem for institutional situations: ‘In fact, given the high levels of uncertainty involved and the difficulty of measuring the benefits and costs, it would be extremely difficult to obtain a meaningful measure of optimality’ (Ostrom, 1990: 59–60). And she continues in the associated footnote: ‘I prefer to argue that optimality is not well defined in a changing environment, including the capacity to change the institutional rules themselves’ (Ostrom, 1990: 224; see also Ostrom, 2005: chap. 8; Ostrom and Basurto, 2011: 319–321). This clearly echoes Simon’s comments (1978: 4): ‘when the system is complex and its environment continually changing (that is, in the conditions under which biological and social evolution actually take place), there is no assurance that the momentary position will lie anywhere near a point of equilibrium, whether local or global’. Other influences also play an important role in Ostrom’s adaptive conception of institutional rules. These influences include evolutionary theories in economics (Nelson and Winter, 1982; Schmid, 2004), notably with the notion of ‘path-dependence’ (North, 1990), in psychology (Campbell, 1975; Holland, 1995), and in biology (Mayr, 1982; Boyd and Richerson, 1985). Remarkably, many of them explicitly incorporate Simon’s work into their approach (Mayr, 1982; Boyd and Richerson, 1985; North, 1990), and some consider it fundamental (Koestler, 1967; Nelson and Winter, 1982; Schmid, 2004; Holland, 1998). This reveals Simon’s central reference in this field of research, although he is obviously not its only representative. Thus, it is not surprising to see Ostrom combine Simon’s concepts – the satisfaction criterion and adaptive solutions – with North’s path dependency within the same line of reasoning:

Field settings are so wrapped up in complexity and uncertainty that *satisfactory* rules-in-use are a significant achievement, regardless of whether such individuals can actually achieve the optimal solution. . . . One can expect that the efforts of individuals to constitute and improve their own rule systems are likely to improve the outcomes they achieve. They may even discover local optima. Whether global optima are ever discovered by participants (or, for that matter by external officials) in highly complex field settings is far less probable. One can expect path dependence to be as important a constraint in the design of institutions as it is in the design of technology (see Arthur 1989; North 1990). (Ostrom et al., 1994: 325, authors’ emphasis; see also Ostrom, 2004: 44–46)

Therefore, Simon’s emphasis on the adaptive evolution of complex social systems had a significant direct and indirect influence on Ostrom’s work.

Relying on realistic assumptions and empirical investigation as a warrant for scientific inquiry

One final analytic perspective on complexity that Ostrom adopted from Simon is his continual commitment to relying on realistic assumptions and conducting empirical work through field surveys, experiments, and simulations. In addition to his work on *The Sciences of the Artificial*, Simon ([1947] 1957) is best known for his book *Administrative Behavior*, in which he delivers a major critique of the science of administration, and, in particular, the ‘administrative principles’ traditionally used to define the type of organisation that works best.¹⁶ Simon disapproves the aprioristic and hardly operational nature of these administrative principles, since they are not derived from empirical analyses based on the ‘efficiency’ criterion that organisations actually aim at: ‘studies of administrative agencies have been carried out without benefit of control or objective measurements of results, they have had to depend for their recommendations and conclusions upon *a priori* reasoning proceeding from “principles of administration”’ (Simon, [1947] 1957: 43–44). He aims to give a stronger methodological foundation for administrative science by promoting a more empirical research programme: ‘What is needed is empirical research and experimentation to determine the relative desirability of alternative administrative arrangements’, knowing that the ‘methodological framework for this research is already at hand in the principle of efficiency’ (Simon, [1947] 1957: 42). This emphasis on empirical investigation would remain a defining feature of Simon’s research throughout his career: in his view,

¹⁶Simon focuses on the work of Gulick and Urwick (1937).

only empirical testing could ensure the validity of a hypothesis (Simon, 1997). This position appears even more compelling in the context of complex systems, which are characterised by the difficulty of inferring their structural properties solely from knowledge of their individual components (Simon, [1969] 1996: 184). This is why ‘the genuine problem [of the sciences of the artificial] is to show how empirical propositions can be made at all’ (Simon, [1969] 1996: xi). Hence, Simon (1999: 118) goes so far as to call himself an ‘empirical scientist’, insisting that abduction is a legitimate method for conducting social science research, and is always careful to return to the empirical evaluation of hypotheses, especially when they refer to complex situations (Simon, [1969] 1996: 23, 52, 121).¹⁷

The importance of empirical research in the study of any system is precisely what would influence Ostrom to conduct field investigations in metropolitan areas and later in CPR situations. If the importance of conducting empirical research in Ostrom’s work is well established (Aligica and Boettke, 2009; Frischman, 2013; Herzberg, 2015), few have noted the role again played by Simon. As early as 1971, in an article co-authored with V. Ostrom, they claimed to promote a new approach to the study of public administration, based in part on the public choice research programme, but also on Simon’s observations and guidelines for administrative science (V. Ostrom and E. Ostrom, 1971).¹⁸ It is from this point onwards that Ostrom clearly expressed her mistrust of any solution presented as panacea, and asserted the need always to rely on empirical studies, whether in developing an operational vocabulary, establishing measurements or conducting experiments. This explains in particular the numerous field surveys conducted during the 1970s in the case of metropolitan areas, as she explicitly states (Ostrom, 2017: 407). It also clarifies her remark in her 2004 article: ‘Simon also urged scholars to add simulation techniques to their tool kits. He did this very self-consciously. He felt that many of the overly simple mathematical models used in policy analyses were dead wrong and led to incorrect decisions if not tragedies’ (Ostrom, 2004: 45). Her criticism of economic models on collective action problems, which she regards as mere ‘metaphors’ disconnected from actual CPR situations, echoes Simon’s criticism of ‘traditional administrative principles’, which he regards as mere ‘proverbs’ disconnected from actual administrative organisations (Simon, [1947] 1957). This alignment also sheds light on Ostrom’s late-career enthusiasm for agent-based models (ABMs), especially in situations ‘too complex to be modeled as a simple game’ (Ostrom, 2005: 7; see also Ostrom, 2007: 15186; Ostrom and Basurto, 2011: 337). And, even then, Ostrom emphasises the importance of confronting these models with empirical data (Janssen and Ostrom, 2006; Poteete, Janssen, and Ostrom, 2010, chaps. 8–9).

Furthermore, Simon’s emphasis on introducing greater complexity into economic modelling and rational choice theory helps clarify Ostrom’s own perspective on these approaches. Indeed, from 1990 onwards, she began explicitly to deplore the lack of theory capable of accounting for the empirical observation that individuals succeed in organising themselves to manage a CPR: ‘We have not yet developed a *behavioral theory of collective action* based on models of the individual consistent with empirical evidence about how individuals make decisions in social-dilemma situations’ (Ostrom, 1998: 1, author’s emphasis; see also Ostrom, 1990: 25–26). Her central criticism is that standard rational choice theory is too simplistic to understand the complex reality of collective action, being limited mainly to ‘open competitive situations’ (Janssen and Ostrom, 2006: 39; see also Ostrom, 2005: 100–101). Individuals possess cognitive capacities and limitations that have evolved in accordance with their social and ecological environments (Ostrom, 1998; 2005: 104). This is why she states that the analyst ‘needs to substitute the assumption of bounded rationality—that persons are “intendedly” rational but only limitedly so—for the assumptions of perfect information and utility maximization used in axiomatic choice theory’ (Ostrom, 2010b: 18). Some commentators duly underscore the role of complexity in this critique (Lara, 2015; Lewis and Petersen, 2023) and others duly note that she

¹⁷It is also what motivates his critique of standard rational choice theory: ‘Our procedure will be to introduce some modifications that appear (on the basis of casual empiricism) to correspond to observed behaviour processes in humans’ (Simon, 1955: 104).

¹⁸See Aligica and Boettke (2009) and Aligica (2019) for a comparative analysis of the public choice research programme and Ostroms’ work in Bloomington.

appropriates Simon's notion of bounded rationality (Chanteau and Labrousse, 2013; Tarko, 2021). However, none of them goes so far as to explain Simon's influence on Ostrom's conception of rationality *through the emphasis on complexity and the related general methodological approach*. Yet, once again, a striking parallel emerges with Simon, who argued nearly fifty years earlier that 'the concept of "economic man" ... is in need of fairly drastic revision', and should be replaced by a conception of rational behaviour aligned with actual human capacities *and* situated within specific environments (Simon, 1955: 99).¹⁹ It also explains why, when criticising previous research on collective action problems in her Nobel Prize lecture, Ostrom states that 'the *basic assumptions* that were made at that time ... have been challenged by scholars around the world, including the work of Herbert A. Simon (1955) and V. Ostrom ([1973] 2008)' (Ostrom, 2010a: 642, our emphasis).

Therefore, Ostrom's commitment to conducting empirical investigations and relying on realistic assumptions – particularly through the development of models of bounded rationality – borrows Simon's insistence on recognising the importance of addressing the complexity of the systems under study through empirical and realistic analysis.

The sciences of the *artificial* or the sciences of the *artifactual*?

Although Ostrom explicitly acknowledges Simon and claims a direct intellectual lineage with his work, she opts for the expression 'the sciences of the artifactual' rather than Simon's original term, 'the sciences of the artificial' (E. Ostrom and V. Ostrom, 2004: 139). This terminological choice is far from neutral. It reveals Ostrom's distance from certain aspects of Simon's work. Two points of tension stand out in particular.

First, Ostrom (1990, 2007) is wary of any methodological posture marked by a desire to design the organisations in which social actors evolve. Simon, however, is more ambiguous on this subject. As we saw in the previous section, both Simon and Ostrom adopt a bottom-up approach to science. It is their reluctance to believe in 'panaceas' that leads them to opt for such an approach.²⁰ However, after conducting an empirical and contextualised analysis of an institutional problem, the question remains of who will participate in designing and implementing the solution. For Ostrom, it is ultimately up to the social agents themselves to assume this responsibility within the institutional context they inhabit (Ostrom, 1990, 2005).

For Simon, however, the answer is more complicated. On the one hand, he often refers to 'designers of administrative organizations' ([1969] 1996: 128) or social 'planners' who act from above on the behaviour of the members of the social system under consideration (ibid.: chap. 6). On the other hand, he points out that these members can never be regarded as 'passive instruments', but rather as 'themselves designers' of the institutions in which they find themselves, 'seeking to use the system to further their own goals' (Simon, [1969] 1996: 153). According to Simon, this is because any complex system is primarily composed of 'stable intermediate forms' that operate 'nearly independently of the detailed processes going on within the other subsystems' (ibid.: 192–193), as discussed in Section "*Analysing complex social systems as nearly decomposable ones*". Thus, as Fiori (2010: 155) analyses, social systems evolve for Simon through the 'continuous interaction' of their subsystems, 'without fixed goals' guiding them since 'every step in the interaction constitutes a new base for the emergence of new plans' for these subsystems. And, it is on the basis of this interpretation that Ostrom takes up Simon's defence regarding the ambiguity of the term 'hierarchy' he uses: 'Simon overtly distinguished his concept of hierarchy from one involving human bosses at each level' (Poteete, Janssen and Ostrom, 2010: 377). More generally, this Simonian conception of social system evolution can, to some extent, be linked to the concept of 'polycentric governance', which Ostrom (2005, 2010a) uses to characterise a public economy.²¹

¹⁹For a discussion of the cognitive *and* environmental dimensions of Simon's notion of bounded rationality, see Petracca (2021).

²⁰Ostrom (2004: 45) praises Simon in particular for this aspect, pointing out that he 'spent a great deal of his career trying to convince social scientists that they could not fabricate and propose complete top-down solutions. He challenged the presumption that large corporations or government agencies were managed by top-down, centralized structures'.

²¹Polycentric governance refers to a public economy made up of a multitude of public and private decision-making units that are formally independent but interact through processes of cooperation, competition, and conflict management (V. Ostrom et al., 1961; Ostrom, 2010a). On this topic, see Aligica and Boettke (2009), Aligica (2014), and Tarko (2022).

Nonetheless, Ostrom firmly rejects the idea of a ‘social planner’ acting above social actors, as it inevitably risks relying on ‘self-evident truths’ or ‘one-size-fits-all’ solutions (Ostrom, 2000; 2005: 270; 2007). This is what led Ostrom to declare at the end of her career: ‘The term “design principle” has confused many readers. Perhaps I should have used the term “best practices” to describe the rules and structure of robust institutions’ (Ostrom, 2010a: 653, *our emphasis*). Hence, the term ‘artifactual’ more accurately reflects Ostrom’s method than the term ‘artificial’ because the former emphasises the cultural and social aspects of institutions, whereas the latter inherently conveys an engineer’s design perspective.²²

Second, Simon was suspicious of some of the tools Ostrom used to deal with bounded rationality in institutional settings, such as game theory and public choice theory (Simon, 1985, 1999). His refusal to participate in the 1997 *American Political Science Association* annual meeting, when Ostrom was president and invited him, perfectly illustrates this point. Simon fully associates Ostrom with the public choice movement and its ‘ridiculous ideas of perfect rationality’ (Simon, 1996). While this certainly reflects Simon’s lack of familiarity with Ostrom’s work, it also indicates two different understandings and applications of bounded rationality in institutional settings. Simon seeks to understand the bounded rationality of individuals making decisions within specific ecological and social environments. Bounded rationality is therefore central and is defined in terms of adaptation to ‘constraints imposed *both* by the external situation and [human] capacities’ (Simon, 1985: 294, *author’s emphasis*; see also Simon, 1955, 1956). Yet, as he himself acknowledges, the internal – cognitive – dimension has at times overtaken the environmental dimension in his work (see Petracca, 2021). This is why such constraints typically relate to the individual’s computational limits, the incommensurability of her various objectives, and uncertainty regarding both the environment and the range of possible alternatives. Faced with this complexity, agents can attend to only a limited and biased amount of information. They, therefore, construct simplified mental models of the situation while generating new alternatives that may transform it (Simon, 1985). And they respond primarily to the criterion of satisfaction rather than maximisation, as discussed in Section “*Recognising the adaptive evolution of complex social systems*”.

From another perspective, Ostrom (1990, 1998, 2005, 2010a) primarily seeks to understand how individuals solve collective action problems through collective decision-making. Bounded rationality is secondary in her work and is always applied within a social context. To understand the interactions between individuals that lead to collective choice, it is then useful in her perspective to turn to public choice theory and game theory, notably by linking them to laboratory experiments (Ostrom et al., 1994). Thus, Ostrom places greater emphasis than Simon does on reciprocal relations, norms, communication, and individuals’ commitments within a community to develop ‘second-generation models of empirically grounded, boundedly rational, and moral decision making’ (Ostrom, 1998: 15).²³

Therefore, Ostrom and Simon agree on the need to use models of bounded rationality that are consistent with the complex approach to social systems described throughout this article. However, they adopt different perspectives in doing so, reflecting the distinct phenomena each initially seeks to explain.

Having examined Ostrom’s appropriation of Simonian analytical perspectives to study social systems, we now turn to a case study to illustrate how this lens deepens our understanding of her institutionalism.

Institutional evolution through incremental change: a textbook case

One good example that illustrates our general argument is Ostrom’s study of the management of groundwater basins in California, as discussed in *Governing the Commons*. Although it was the case

²²In fact, Simon ([1969] 1996: 4) claims that he does not fully appreciate the term ‘artificial’; however, it is not so much the ‘design’ aspect that bothers him. On the contrary, this aspect partly led V. Ostrom ([1976] 2012: 14) to prefer the term ‘artifactual’ to ‘artificial’ when he first used it.

²³The concept in Simon’s work most closely related to this is ‘organizational identification’ (Simon, [1947] 1957, 1999).

study of her 1965 thesis, she revisited it in 1990 when developing her design principles, offering a new interpretation. The problem was that many different users, including private landowners and numerous private or public water companies, exploited these basins. Until the mid-20th century, water rights in California were not clearly defined. And every unit of water used by one user was effectively withdrawn from the others. Yet, overconsumption of water could lead to sedimentation of the basin or, in the case of basins closest to the Ocean, to the intrusion of salty seawater. In other words, these were CPR that risked being destroyed by overconsumption if no action was taken – the ‘tragedy of the commons’. By analysing three basins (Raymond, West, and Central), Ostrom (1990, chap. 4) shows how participants succeeded in implementing private and public measures to alter the situation, thereby stopping overconsumption and destruction of the basins: creation of local water associations; definition of water rights and appropriation rules ratified by the California court, along with an associated market; creation of a ‘watermaster service’ at the California Department of Water Resources; creation of special water districts; etc.

The main lesson Ostrom draws from this is the ‘incremental’ aspect of the institutional transformation that took place (Ostrom, 1990: 137). Far from having the final solution in mind from the outset, participants began by creating water associations. This enabled them to establish ‘a forum for face-to-face discussions’ and ‘a mechanism for obtaining information about the physical structure of the basins’ (Ostrom, 1990: 138). Through this process, participants realised ‘that it was possible to accomplish some joint objectives by voluntary, cooperative action’ and gather information on ‘the condition of their basins and the likelihood that others would commit themselves’ (ibid.). Thus, although ‘[d]iscussion by itself was not sufficient to change the pumping strategies of the participants’, it was what ‘enabled the participants to reach an enforceable agreement to limit their water withdrawals’, later ratified by the California court (ibid.). This aspect fully reflects the Simonian analysis of complex social systems as nearly decomposable systems, composed of agents that are boundedly rational, and in which the main point of analysis is their adaptive evolution. Indeed, the ‘resulting institutional infrastructure’ created by the participants represents ‘a major investment’ that none would have been prepared to make initially, especially considering the risks of defection (Ostrom, 1990: 141). However, since some rule changes ‘could be undertaken with low transformation costs’, we observe the formation of intermediate states that enable ‘participants to gain some advantages of collective action’ before confronting ‘more costly alternatives’ (Ostrom, 1990: 141). In other words, ‘[e]ach institutional change became the foundation for the next change’: starting by solving ‘some initial second- and third-order problems can help participants move toward solving first-order problems [the tragedy of the commons], as well as the more difficult second- and third-order problems’ (ibid.), which closely aligns with Simon’s conception of social system evolution.

This particular view guided Ostrom throughout the rest of her career as she sought to understand the institutional ‘dynamics of rules’ (Ostrom, 2008: 49; see also Ostrom, 1999: 524–525; 2000: 149). The conclusion of her 1994 game-theoretic book on CPR situations fully encapsulates this idea (Ostrom et al., 1994: 322–323). And the new methods she proposes afterwards for analysing the evolutions of rules and norms take shape from this incremental aspect, as the evolutionary tables that recapitulate the phylogeny of irrigation systems’ rules and norms in Nepal (Ostrom, 2008; Ostrom and Basurto, 2011).²⁴ Thus, interpreting Ostrom’s work through Simon’s complex approach adds depth to Ostromian institutionalism: the analysis of CPR situations requires an incremental understanding of their evolution, based on their nearly decomposable structure.

²⁴Interestingly, communication in Ostrom’s analysis of the evolution of rules and norms is similar to Simon’s conception of communication’s role in the evolution of nearly decomposable structures (Simon, [1969] 1996: 186, 200–201): while intra-community communication is frequent, enabling rapid, autonomous evolution within each community; inter-community communication is less frequent, but it can lead to significant rule modifications, notably through ‘imitation’ (Ostrom and Basurto, 2011: 325–326).

Conclusion

Individuals facing complex social dilemmas can reshape the structure of their situations by building trust and reciprocity, modifying or creating rules, or disseminating information about the biophysical characteristics of the resources they use. However, they can seldom anticipate the new decision-making structures emerging from each change – let alone predict the aggregate outcomes resulting from all individual choices. This uncertainty is especially acute when individuals face weak initial incentives to invest in costly collective solutions. Yet, despite these challenges, they often manage to resolve such dilemmas.

Drawing on Simon's analytical perspectives on complex systems, Ostrom developed a distinctive institutionalist approach to addressing this complexity: 'the sciences of the artifactual'. Institutional situations are social systems best described as nearly decomposable hierarchic structures. Furthermore, the individuals who compose these systems are only 'boundedly' rational: they do not optimise or foresee all the consequences of their actions, but instead attempt to address problems incrementally as they arise. Institutional evolution is thus adaptive and should be understood through the co-evolution of its subsystems: each rule change affects the subsystem of rules, gradually shaping a particular structure of incentives for individuals – one that may actually be familiar or novel, anticipated or unforeseen.

This incremental and adaptive view of institutional change, grounded in an empirical systems approach, forms the core of Ostromian institutionalism. It also illustrates how an interdisciplinary approach informed by complexity theory can make a constructive contribution to institutional economics.

Acknowledgements. I am grateful to the seven anonymous referees for their insightful comments, which have greatly improved the quality of this paper. I would also like to thank my two PhD advisors, Jean-Sébastien Lenfant and Dorian Jullien, as well as all the participants of the 'Albert O. Hirschman' PhD Seminar at Paris 1, for their valuable feedback and suggestions on earlier drafts of this article.

References

- Aligica P.D. (2014) *Institutional Diversity and Political Economy: The Ostroms and Beyond*. Oxford University Press.
- Aligica P.D. (2019) Artefactual and Artisanhip: James M. Buchanan and Vincent Ostrom at the Core and Beyond the Boundaries of Public Choice. In Wagner R.E. (ed.), *James M. Buchanan: A Theorist of Political Economy and Social Philosophy*. Palgrave MacMillan, pp. 1105–1129.
- Aligica P.D. and Boettke P.J. (2009) *Challenging Institutional Analysis and Development: The Bloomington School*. London: Routledge.
- Ashby W.R. (1962) Principles of the self-organizing system. In von Foerster H. and Zopf G.W. (eds), *Principles of Self-Organization: Transactions of the University of Illinois Symposium*. London: Pergamon Press, pp. 255–278.
- Avenier M.-J. (2019) Les Sciences de l'artificiel : une conceptualisation révolutionnaire de sciences fondamentales à parachever. *Projectics/Proyética/Projectique* 24(3), 43–56.
- Blomquist W. (2022) Linking the Origins and Extensions of Commons Theory. In Foster S.R. and Swiney C.F. (eds), *The Cambridge Handbook of Commons Research Innovations*. Cambridge University Press, pp. 17–25.
- Boyd R. and Richerson P.J. (1985) *Culture and the evolutionary process*. University of Chicago Press.
- Campbell D.T. (1975) On the conflicts between biological and social evolution and between psychology and moral tradition. *American Psychologist* 30(12), 1103–1126.
- Chanteau J.-P. and Labrousse A. (2013) L'institutionnalisme méthodologique d'Elinor Ostrom : quelques enjeux et controverses. *Revue de la régulation. Capitalisme, institutions, pouvoirs* 14(2). [Online]. Available at: <https://doi.org/10.4000/regulation.10555>
- Clark S. (2019) *Elinor Ostrom: A Biography of Interdisciplinary Life. Thesis for the degree of Doctor of Philosophy*. Indiana University.
- Crawford S. and Ostrom E. (2005) A Grammar of Institutions. In Ostrom E. (ed.), *Understanding Institutional Diversity*. Princeton, N.J.: Princeton University Press, pp. 137–174.
- Durand D. (2017) *La systémique*. 13th Edition. Presses Universitaires de France.
- Fiori S. (2010) Is H.A. Simon a theoretician of decentralized planning? A comparison with F.A. Hayek on planning, market, and organizations. *Constitutional Political Economy* 21(2), 145–170.
- Frischmann B.M. (2013) Two enduring lessons from elinor ostrom. *Journal of Institutional Economics* 9(4), 387–406.

- Gigerenzer G. (2021) What is bounded rationality? In Viale R. (ed.), *Routledge Handbook of Bounded Rationality*. Routledge, pp. 55–69.
- Gulick L.H. and Urwick L.F. (1937) *Papers on the Science of Administration*. Institute of Public Administration.
- Herzberg R. (2015) Governing their commons: elinor and vincent ostrom and the bloomington school. *Public Choice* **163**(1), 95–109.
- Holland J.H. (1995) *Hidden Order: How Adaptation Builds Complexity*. Addison-Wesley.
- Holland J.H. (1998) *Emergence: From Chaos to Order*. Addison-Wesley.
- Janssen M. and Ostrom E. (2006) Empirically Based, Agent-based models. *Ecology and Society* **11**(2), 37. [Online]. Available at: <https://doi.org/10.5751/ES-01861-110237>.
- Jones B.D. (2002) Bounded rationality and public policy: herbert a. simon and the decisional foundation of collective choice. *Policy Sciences* **35**(3), 269–284.
- Kincaid H. (2007) Functional explanation and evolutionary social science. In Turner S.P. and Risjord M.W. (eds), *Philosophy of Anthropology and Sociology*. Amsterdam: North-Holland, pp. 213–247.
- Koestler A. (1967) *The Ghost in the Machine*. Hutchinson.
- Koestler A. (1973) The Tree and the Candle. In Gray W. and Rizzo N.D. (eds), *Unity Through Diversity*, pt. I. New York: Gordon and Breach Science Publishers, pp. 287–314.
- Lara A. (2015) Rationality and complexity in the work of Elinor Ostrom. *International Journal of the Commons* **9**(2), 573–594.
- Lewis P.A. (2017) The Ostroms and Hayek as theorists of complex adaptive systems: commonality and complementarity. *Advances in Austrian Economics* **22**, 35–66.
- Lewis P.A. and Aligica P.D. (2024) The Ostroms on Self-Governance: The Importance of Cybernetics. *Journal of Institutional Economics* **20**(e23), 1–17.
- Lewis P.A. and Petersen M. (2023) Elinor Ostrom on choice, collective action and rationality: a Senian analysis. *Journal of Institutional Economics* **19**(6), 852–867.
- Mahner M. and Bunge M. (2001) Function and functionalism: a synthetic perspective. *Philosophy of Science* **68**(1), 75–94.
- Mayr E. (1982) *The Growth of Biological Thought: Diversity, Evolution, and Inheritance*. Cambridge, Mass.: Harvard University Press.
- McGinnis M.D. (2021) New Institutional Economics: Building from Shared Foundations. In Lemke J. and Tarko V. (eds), *Elinor Ostrom and the Bloomington School: Building a New Approach to Policy and the Social Sciences*. Newcastle upon Tyne: Agenda Publishing, pp. 25–46.
- Nelson R.R. and Winter S.G. (1982) *An Evolutionary Theory of Economic Change*. Cambridge: Harvard University Press.
- North D.C. (1990) *Institutions, Institutional Change and Economic Performance*. Cambridge: Cambridge University Press.
- Ostrom E. (1986a) An agenda for the study of institutions. *Public Choice* **48**(1), 3–25.
- Ostrom E. (1986b) A Method of Institutional Analysis. In Kaufmann F.-X., Majone G., and Ostrom V. (eds), *Guidance, Control, and Evaluation in the Public Sector: The Bielefeld Interdisciplinary Project*. Walter de Gruyter.
- Ostrom E. (1990) *Governing the Commons: The Evolution of Institutions for Collective Action*. Cambridge University Press.
- Ostrom E. (1995) Designing Complex to Govern Complexity. In Hanna S. and Munasinghe M. (eds), *Property Rights and the Environment: Social and Ecological Issues*. Washington D.C.: World Bank, pp. 33–45.
- Ostrom E. (1998) A behavioral approach to the rational choice theory of collective action. *The American Political Science Review* **92**(1), 1–22.
- Ostrom E. (1999) Coping with tragedies of the commons. *Annual Review of Political Science* **2**(2), 493–535.
- Ostrom E. (2000) Collective action and the evolution of social norms. *The Journal of Economic Perspectives* **14**(3), 137–158.
- Ostrom E. (2004) The ten most important books. *Tidsskriftet Politik* **7**(4), 36–47.
- Ostrom E. (2005) *Understanding Institutional Diversity*. Princeton, N.J.: Princeton University Press.
- Ostrom E. (2006) Converting threats into opportunities. *PS: Political Science & Politics* **39**(1), 3–12.
- Ostrom E. (2007) A diagnostic approach for going beyond panaceas. *Proceedings of the National Academy of Sciences* **104**(39), 15181–15187.
- Ostrom E. (2008) Developing a method for analyzing institutional change. In Batie S.S. and Mercurio N. (eds), *Alternative Institutional Structures: Evolution and Impact*. Routledge, pp. 48–76.
- Ostrom E. (2010a) Beyond markets and states: polycentric governance of complex economic systems. *The American Economic Review* **100**(3), 641–672.
- Ostrom E. (2010b) A long polycentric journey. *Annual Review of Political Science* **13**, 1–23.
- Ostrom E. (2017) Learning from the Field. In Cole D.H. and McGinnis M.D. (eds), *Elinor Ostrom and the Bloomington School of Political Economy: Volume 3, A Framework for Policy Analysis*. Lexington Books, pp. 389–412.
- Ostrom E. and Basurto X. (2011) Crafting analytical tools to study institutional change. *Journal of Institutional Economics* **7**(3), 317–343.
- Ostrom E., Gardner R. and Walker J. (1994) *Rules, Games and Common-Pool Resources*. Ann Arbor: University of Michigan Press.
- Ostrom E. and Ostrom V. (2004) The quest for meaning in public choice. *American Journal of Economics and Sociology* **63**(1), 105–147.

- Ostrom V. ([1973] 2008) *The Intellectual Crisis in American Public Administration*. 3rd Edition. Tuscaloosa, AL: University Alabama Press.
- Ostrom V. ([1976] 2012) David Hume as a Political Analyst. In Allen B. (ed.), *The Quest to Understand Human Affairs: Essays on Collective, Constitutional, and Epistemic Choice*. Lexington Books, pp. 3–30.
- Ostrom V. and Ostrom E. (1971) Public choice: a different approach to the study of public administration. *Public Administration Review* 31(2), 203–216.
- Ostrom V., Tiebout C.M. and Warren R. (1961) The organization of government in metropolitan areas: a theoretical inquiry. *The American Political Science Review* 55(4), 831–842.
- Peneranda A. (2012) Du public aux commons regards croisés sur Ostrom et Simon. *Revue de l'Organisation Responsable* 7(2), 24–30.
- Petracca E. (2021) On the origins and consequences of simon's modular approach to bounded rationality in economics. *The European Journal of the History of Economic Thought* 28(5), 708–732.
- Poteete A., Janssen M. and Ostrom E. (2010) *Working together : collective action, the commons, and multiple methods in practice*. Princeton and Oxford: Princeton University Press.
- Ramalingam B. (2012) Conversations on complexity: a tribute to elinor ostrom. *Aid on the Edge of Chaos*, 16 August 2012. Available at: <https://aidontheedge.wordpress.com/2012/08/16/conversations-on-complexity-a-tribute-to-elinor-ostrom/>
- Schmid A.A. (2004) *Conflict and Cooperation: Institutional and Behavioral Economics*. Malden: Wiley-Blackwell.
- Simon H.A. ([1947] 1957) *Administrative Behavior*. 2nd Edition. Collier Macmillan Ltd.
- Simon H.A. (1955) A behavioral model of rational choice. *The Quarterly Journal of Economics* 69(1), 99–118.
- Simon H.A. (1956) Rational choice and the structure of the environment. *Psychological Review* 63(2), 129–138.
- Simon H.A. ([1969] 1981) *The Sciences of the Artificial*. 2nd Edition. Cambridge: MIT Press.
- Simon H.A. ([1969] 1996) *The Sciences of the Artificial*. 3rd Edition. Cambridge: MIT Press.
- Simon H.A. (1978) Rationality as process and as product of thought. *The American Economic Review* 68(2), 1–16.
- Simon H.A. (1985) Human nature in politics: the dialogue of psychology with political science. *The American Political Science Review* 79(2), 293–304.
- Simon H.A. (1995) Near Decomposability and Complexity: How a Mind Resides in a Brain. In Morowitz H.J. and Singer J.L. (eds), *The Mind, the Brain, and Complex Adaptive Systems*. Reading, MA: Addison-Wesley, pp. 25–44.
- Simon H.A. (1996) Response to Ostrom on APSA Meetings. *Transcript—American Political Association Conference—Correspondence*, Collection: Herbert Simon, 10-19-1996. Available at: <http://doi.library.cmu.edu/10.1184/pmc/simon/box00086/fld06888/bdl0001/doc0002>
- Simon H.A. (1997) *An Empirically Based Microeconomics*. Cambridge University Press.
- Simon H.A. (1999) The Potlatch Between Economics and Politics Science. In Alt J.E., Levi M., and Ostrom E. (eds), *Competition and Cooperation: Conversations with Nobelists about Economics and Political Science*. New York: Russell Sage Foundation, pp. 112–119.
- Tarko V. (2021) Elinor Ostrom as Behavioral Economist. In Lemke J. and Tarko V. (eds), *Elinor Ostrom and the Bloomington School: Building a New Approach to Policy and the Social Sciences*. Newcastle upon Tyne: Agenda Publishing, pp. 25–46.
- Tarko V. (2022) Polycentricity. In Melenovsky C. (ed.), *The Routledge Handbook of Philosophy, Politics, and Economics*. Routledge, chap. 15.
- Wall D. (2014) *The Sustainable Economics of Elinor Ostrom: Commons, Contestation and Craft*. London and New York: Routledge.