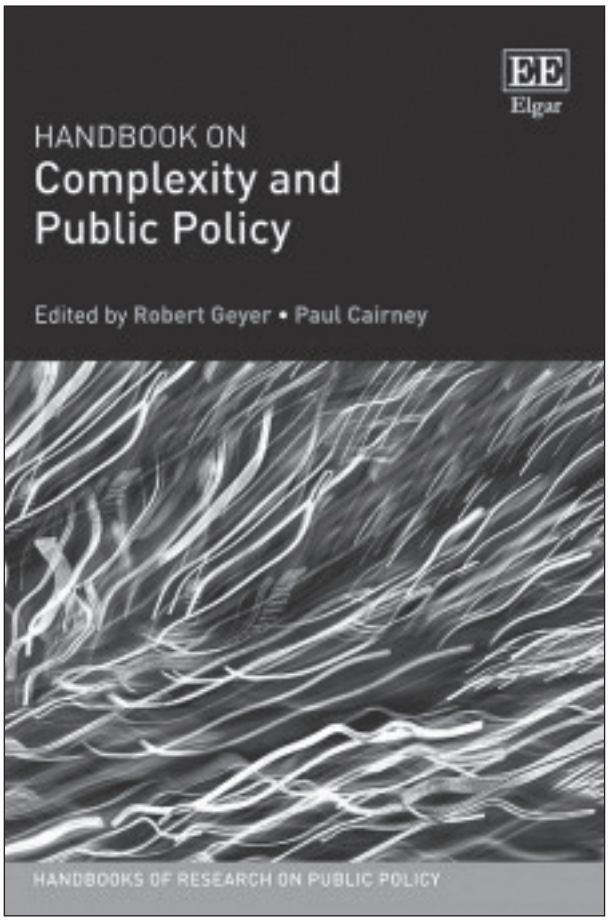
Book review

Robert Geyer and Paul Cairney (Editors)

Handbook on Complexity and Public Policy

Reviewed by Paul Gandar*



The aims of *Handbook on Complexity and Public Policy* (HCPP) are set out in an introductory chapter by the editors, Robert Geyer, Professor of Public Policy at Lancaster University, UK, and Paul Cairney, Professor of Politics and Public Policy at the University of Stirling, UK. They are to 'improve the theory and practice of policymaking by drawing on the theory, concepts, tools and metaphors of complexity' and to advance 'complexity thinking' as a means for understanding and explaining the policymaking world and as a basis for policy development.

These aims are pursued through 482 pages in 27 chapters, with a total of 40 authors. There are seven chapters on 'theory and tools', six on 'methods and modelling for policy research and action', twelve chapters on applying complexity to local, national and international policy, and a concluding chapter by the editors.

There are two ways to approach a review of a book of this size and scope, in detail and in overview. Both approaches deserve attention.

In detail, there are points of interest in most chapters to an extent that makes it impossible to do justice to all in a brief review – indeed the editors themselves find it necessary to use eight pages in their introductory chapter simply to outline the contents and conclusions of the chapters that follow. So, I shall touch briefly and selectively only on a few highlights.

An introductory chapter by the editors sets the scene for the book. They provide a definition for complex systems based on a list of the properties that these systems are said to share – being greater than the sum of their parts, operating with various positive and negative feedbacks, exhibiting sensitivity to initial conditions, behaving in ways that depend more on local interactions than on central organisation ('emergence'), and giving rise to various patterns of behaviour (e.g. 'attractors', 'punctuated equilibrium'). They note that this set of properties positions complexity theory as a scientific paradigm focussed on wholes rather than parts and that this makes it an alternative to the 'fatally flawed' paradigm of reductionism.

These ideas are picked up in the group of seven chapters on 'theory and tools' that follow. These unite in the view that complexity theory is necessary because real-world systems cannot be studied or understood adequately using frameworks such as realism, positivism and objectivism[1] based on, or related to, reductionism. This view is not, however, one-sided. Together, the seven chapters provide a useful critique of ways in which ideas about complexity relate to, sometimes complement, and sometimes fall short of other explanatory frameworks and philosophies of science, and they also highlight various quite significant gaps in current views of complexity theory, a point to which I shall return.

There are then six chapters on 'methods and modelling for policy research and action'. These focus on methods such as data mining, social network analysis, case studies and document analysis for describing what is there and on approaches such as scenarios and agent-based and dynamical-system simulations to gain insights into ways in which system behaviours change over time. All of the chapters discuss 'modelling' in one way or another. Here, there is some of the usual conflation of this term with computer-based simulation modelling but there are also several useful discussions of the wider view of models as tools[2] used for thinking and therefore as spanning from mental models, to verbal models (including metaphors), to diagrams,

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[1] Variously, in Little (Ch.3) on applications to politics; Webb (Ch.4) on applications to law; Givel (Ch.5) and Morçöl (Ch.6) on applications to public policy and public administration.

[2] Most notably in discussions by Occelli & Sembolini (Ch.12) and by Edmonds & Gershenson (Ch.13) on the roles and nature of models.

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and on to simulations and mathematical models. A chapter by Kasey Treadwell Shine (Ch.11) stood out for me in this grouping because of a model for child poverty that makes use of a metaphor in which social complexity is described as a force warping a social fabric and channelling behaviours into basins of attraction, some positive, some negative. This is a nice example of the way in which complexity theory opens up new and quite liberating ways for thinking about social phenomena and, from there, creates new avenues for carrying out research and looking for solutions[3].

The remaining twelve chapters of HCPP are focussed on 'applying complexity', and span from the small and local[4] to global issues such as climate change and the 2007/08 international financial crisis. The need to find the right loci for policy formation and decisionmaking is a common theme in many of these chapters. The argument is that much public policy is still based on forms of centralised, top-down policy formation and implementation and that this approach is often ineffective because it fails to take into account the realities of diversified, distributed knowledge and of bottom-up and adaptive responses to settings. Methods for balancing top-down and bottom-up approaches, for working with uncertainty and incomplete knowledge, and for adjusting policies and targets as learning occurs are discussed in most chapters, but there is little consistency about the packages of approaches discussed. Overall, there is a sense that the main impacts from attempts to use complexity theory in applications come through the 'conceptual inspiration'[5] provided, the freeing up of thinking and greater willingness to work with a plurality of approaches to problems.

The book ends with a further chapter by the editors highlighting the tension between the belief by 'converts' that a complexity view of the world is necessary, and the belief elsewhere – notably in much of science and in political and policy discourse – that reality is sufficiently described using reductionist frameworks. Two responses to this tension are suggested: challenging reductionism within academia by establishing better evidence for the explanatory efficacy of complexity theory; bridging gaps between complexity thinking and reductionist thinking in policymaking by finding pragmatic ways to work with, and educate policy makers, politicians and the public on gains that can come through use of concepts and tools from complexity theory.

What to make of all of this? The book certainly provides a summary and update on a particular way of thinking about complexity (see below) and it contains many ideas of interest and much that is thought-provoking. As such, HCPP should find a place as a useful reference book in university libraries and on the bookshelves of academics in places such as Victoria University's School of Government. But for less specialised readers, including most policy advisors and policy makers, its value is less certain. These readers will rapidly discover that HCPP is not the handbook its title suggests – it does not supply a concise framework to explain complexity, nor, despite a range of interesting applications and useful discussions, does it provide clear guidance on how to use complexity thinking in policymaking. Furthermore, and particularly in the New Zealand context, it is hard to imagine policy makers having the time, the mandate, the motivation or the energy to work through, and sift out the useful ideas from the large amount of quite dense material covered in HCPP.

So how well does HCPP measure up against its overall aim of improving the theory and practice of policymaking through use of ideas about complexity? My reaction here is mixed. The book helps to expand horizons and contains many useful insights but, at the same time, I have been left with the sense that it misses its mark in at least two critical areas. The first is that it is tied too narrowly to a particular view of complexity and therefore that it fails to get to grips adequately with the ramifications of 'complexity theory'. The second is that some of the material in HCPP on improving the practice of policymaking seems to be inspired more by advocacy for the superiority of complexity-based thinking than by the actualities faced by policymakers.

My first point of criticism deserves an immediate qualification: it is unfair to charge a book whose forty authors almost certainly hold forty different understandings of 'complexity theory' – a diversity noted ruefully in the editors' concluding chapter – with failure to get to grips with the ramifications of the concept; across all authors, HCPP touches on many ramifications. However, there is still an issue of framing because of the way in which the overall approach in the book has been anchored on a narrow view of the nature of complexity.

This view comes from studies of complexity in the natural sciences[6] and is summarised in the editors' opening chapter: systems are complex when their behaviours as wholes are greater than the sums of the behaviours of their parts[7] and this complexity is characterised through the properties listed in my fifth paragraph. To a greater or lesser extent, this framing is also used by most of the other authors of HCPP so that the book's overall approach to complexity is tied into conceptual origins in the natural sciences[8].

This linkage has had both positive and negative effects. The positives have come from the infusion and use of new concepts, metaphors, simulations and mathematical models in the social sciences. Thus, much is made in HCPP of the way in which complexity thinking has freed these sciences from the limitations of reductionist worldviews based on assumptions about simple causal mechanisms, clear rules, certainty of information and the feasibility of rational decisionmaking. Indeed, many chapters

[3] For example, Shine (Ch.11) discusses various factors that help to create behavioural attractors and ways to deepen positive attractors and drain away the negative ones.

[4] A New Zealand touch is provided through Ch.23 by Wellington general practitioner, Dr Ben Gray, on the ways in which New Zealand public-health policies and plans worked in response to various epidemics and on the tensions between these plans and policies and the realities faced by frontline healthcare workers.

[5] Tenbensel (Ch.22) discussing application to health policy

[6] The 'natural sciences' referred to centre on physics but with admixtures from chemistry, biology and ecology. The understanding of complexity derived from studies in these disciplines came to prominence in the 1990s (a point noted by the editors) most famously through popularisations by writers such as Kauffman, Holland, Arthur and others with links to the Santa Fé Institute.

[7] This idea appears in several places in HCPP but is nowhere adequately explained. 'Sum' should be viewed as a metaphor because the mathematics involved is far removed from simple notions of addition. An introductory explanation is provided by Robert Rosen (1991), *Life Itself*, Columbia University Press.

[8] As several authors in HCPP note, the idea that social systems are, in some way, 'complex' long predates the transfer of concepts, metaphors and models from natural to social sciences that started mainly in the 1990s (footnote 6). The transfer appears to have been a starting point mainly because it popularised and, to a large degree, legitimised the idea of complexity in the social sciences.

illustrate the richer ways of thinking that unfold when these assumptions are muted or abandoned. Metaphors like 'attractors' to explain dynamics and 'small worlds' to characterise networks provide prominent examples of these ways of thinking. As noted above, these conjure up new mental models for the whats, hows and whys of social phenomena and they also open up new avenues for the design of research, for gathering and analysis of data, and for simulation modelling.

Unfortunately, these gains are offset by general looseness surrounding concepts related to complexity. Thus, HCPP is replete with terms like 'nonlinearity', 'self-organisation', 'path-dependency' and 'emergence', but these are rarely defined with precision or tied down to the specific features of particular systems under discussion. Instead, there are mainly multitudes of words, and these leave a prevailing sense that much of what passes for complexity thinking is vague, abstract, incoherent, high-level and in a state of flux. Looseness of this sort creates a poor foundation for the advancement of any science, and this is, indeed, one of the impressions left with me by HCPP.

Besides the multitudes of words, there are also gaps in the framework adopted from the natural sciences. These are noted in a good number of the chapters in the book. Thus the framework has little or no place for ideas like power, motivation, purpose, choice, values, beliefs, interests, culture, knowledge, anticipation, memory, learning, observers, levels of organisation, viewpoints or even, it would appear, for the characterisation of 'policies'. In other words, much of what matters in systems involving humans is left out.

These lacunae arise because of use of a natural-sciences view of complexity as a starting point. In essence, the sets of the entities and relationships required for the analysis of complexity in the natural sciences, their ontological stances ('what exists and needs to be considered'), are simply much smaller and much more restricted in type than those that are required in the social sciences. As a result, complexity as conceived in the former is too simple and too narrow for the latter[9].

Much the same criticism about over-simplification and narrowness can be made when it comes to the epistemological stances ('how to think about, or model, the behaviour of the things that exist') adopted in HCPP. These too are based predominantly on approaches used in the analysis of complexity in the natural sciences – network theory, agent-based modelling and, in particular, dynamical systems theory. The importance of the latter is shown by the fact that at least three of the five defining characteristics of complexity in the editors' introduction[10] arise out of models based on systems of differential equations. The drawback with these models as starting points is that they place the analysis of complexity in the social sciences close to the state-variable-based approaches of standard physics, a framing that is far too restricted to deal with the essentially relational concerns of the social sciences.

Approaches to complexity that focus on relationships rather than states are widespread in disciplines such as computer science, theoretical biology, quantum physics, and even business modelling, and these build upon the rich and deep mathematics of category theory[11]. Unfortunately, there is almost no hint in HCPP that these approaches exist. To this outsider, it seems as if a form of path-dependency is in operation: there has been an infusion into the social sciences of ideas about a particular type of complexity found in comparatively simple physical and biological systems and this has been deemed to be sufficient and has now acquired a self-contained and self-perpetuating life of its own. From this perspective, the insufficiency of the starting point is evident in shortfalls, illustrated in HCPP and noted above, in the form of loose and vague terminology and of ontological and epistemological gaps. It also seems clear from the shortfalls that many more infusions from outside are going to be required before there is something like an adequate version of complexity theory for use in applications within the social sciences.

My second area of reservation about HCPP is that, when it comes to applications to the processes of policymaking and policy implementation, there is an over-emphasis on advocacy for adoption of complexity-based thinking because of its supposed superiority over other approaches and an under-emphasis on the fact that policy processes are already complex and that the needs of policy makers and implementers therefore centre more on being able to 'navigate' across a spectrum of approaches than on adopting any single approach.

This reservation requires some unravelling. First, there is a central point that both the systems that policy makers deal with and the processes of policymaking and policy implementation are complex in the colloquial sense of the word – i.e. intricate and consisting of, or involving, many different and interwoven parts[12]. Because this interpretation differs from that generally used in HCPP it is worth distinguishing the two at this point by writing '$complex_{CQ}$' when the colloquial sense is in use and '$complex_{NS}$' when the sense carried over from studies of natural systems is in use[13].

The fact that the systems policy advisers and implementers deal with and the processes involved in policymaking and policy implementation are $complex_{CQ}$ is fairly obvious – those involved

[9] This point is made in places within HCPP, notably by Room (Ch.2), Little (Ch.3) and Morçöl (Ch.6). Wider-ranging commentaries on the same issue in other disciplines can be found, amongst others, in Rosen (2000), *Essays on Life Itself,* Columbia University Press; Baianu & Poli (2011), *From simple to highly complex systems: a paradigm shift towards non-Abelian emergent system dynamics and meta-levels,* http://www.academia.edu/3600494/From_Simple_to_Highly_Complex_Systems_Baianu_Poli_

[10] The five characteristics are summarised in the fifth paragraph of this review. The three alluded to here are feedback effects, sensitivity to initial conditions, and behaviours such as convergence on phase-space attractors and punctuated equilibria.

[11] Category theory itself underpins much of mathematics and is wide-ranging, often highly abstract and generally hard for non-mathematicians to get to grips with. Unfortunately, the latter is unavoidable: complexity in the real world demands matching complexity in the tools used for thinking about it. *Category Theory for Scientists* by David Spivak (2013, http://ocw.mit.edu/courses/mathematics/18-s996-category-theory-for-scientists-spring-2013/textbook/) provides a relatively accessible introduction. Applications of category theory and the wider approaches to complexity alluded to are illustrated in: Goguen (1991), A categorical manifesto, *Mathematical Structures in Computer Science 1*: 49–67; Ehresmann & Vanbremeersch (2007), *Memory Evolutive Systems*, Elsevier; Louie (2009), *More Than Life Itself,* Ontos Verlag; Coeke (2008), *Introducing categories to the practicing physicist,* http://arxiv.org/pdf/0808.1032.pdf; Macfarlane (2011), *Category Theory and Business Modelling,* http://www.slideserve.com/loren/category-theory-and-business-modelling.

[12] 'Complex' is sometimes also used in policy circles to mean a problem is intractable with few avenues for progress in sight.

[13] As in the fifth paragraph in this review.

cannot avoid being aware of the multitudes of stakeholders, viewpoints, interests, uncertainties and incomplete understandings that surround issues and even the simplest of policies and policy implementations. But their job is to find a way through these thickets and, at least in the New Zealand context, they often do so on an ad-hoc basis with little reference to particular theories about system behaviour or policymaking and, even more rarely, with any reference to complexity$_{NS}$ theory. This leads to circles of miscommunication in dialogues between policy advisors and implementers and complexity theorists. Both groups agree that the world is 'complex' but there is a confusing mixture of overlap and gap between advisors' and implementers' somewhat inchoate conceptions of this term as complex$_{CQ}$ and complexity theorists' conceptions of it as complex$_{NS}$. The overlap comes when theorists offer complexity-based lists of principles for use by advisors and implementers[14] – many of the items in the lists seem already to be part of practices under complexity$_{CQ}$ and hence, barely new. The gap appears when theorists advocate use of concepts derived from models for complexity in natural systems – although sometimes liberating, as noted above in the case of Shine's use of attractors, many of them seem to be abstract and poorly connected to the practicalities of policymaking and hence, of little direct use.

This brings me to the issue of advocacy. In parts of HCPP there is a somewhat evangelical tone about the desirability of use of complexity theory driven by the belief that it provides superior explanatory power to alternatives and, most notably, to reductionism. I do not doubt the overall truth of this proposition, particularly if more comprehensive understandings of complexity are developed through better interactions with frontiers in other disciplines, as suggested above. But in the meantime, I can imagine the reaction of, say, a Minister of Finance to the suggestion that a 'holistic approach' involving a 'complexity lens' be used develop the annual budget or some similar area of policy. The point here is that reductionism, simple models and simple, direct, top-down policies are useful in some circumstances[15] despite the fact that underlying systems and processes are almost invariably complex in any of the senses of the word touched on in this review. Under these circumstances, direct advocacy for use of greater use of complexity ideas is not persuasive.

How then to connect complexity ideas more effectively to policymaking and implementation? The editors' answer, noted above, is in essence to chip away at the problem by demonstrating value through specific applications of the sort illustrated in many of the chapters of HCPP. This seems to me to be only part of the answer. The larger need is to develop better methods for 'navigating' through the thickets of policymaking and policy implementation alluded to above. Here, I have in mind elements such as (i) the use of more careful and complete descriptions of systems of interest, including their levels of organisation, so that there are explicit and enduring foundations for policies, (ii) the tracking of assumptions so that there is understanding of the ways in which possible models for behaviours and policies, ranging from simple to complex, fit together and (iii) the use of ideas such as subsidiarity and requisite variety so that there is some basis for balancing decisionmaking between top-down and bottom-up. Elements of this sort are central to any theory of complexity but are often missing in policy development and application[16]. Efforts to make them central components in these processes seems likely to be an effective way to increase the impacts of complexity theory on public policy.

[14] For example, by Price et al. (Ch.7) in HCPP and, locally, by Eppel, Matheson & Walton (2011), *Policy Quarterly 7(1)*: 48–55.

[15] The fact that reductionist simplifications are used, and are useful in policy making and implementation alongside other approaches is recognised in several chapters in HCPP. See, for example, Bovaid & Kenny (Ch.16) in local government, de Roo (Ch. 21) in urban planning, and Tenbensel (Ch.22) and Gray (Ch.23) in health systems. These and other chapters also outline reasons for the preference for reductionist-based policies ranging from the human preference for cognitive shortcuts to pressures surrounding communication and public accountability that politicians operate under.

[16] Readers of this journal have probably been puzzled by the ever-changing and amorphous nature of science policies in New Zealand over past decades. The continuing state of flux owes much to the lack of a complete and enduring framework for describing the science system, to disregard by ministers and managers of the need to understand assumptions and learn about their validity from past experience, and to the absence of consistent principles for determining who should have responsibility for research and allocation decisions at various levels of system organisation.