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Complexity Theory in Public Policy

Abstract
The term 'complexity' has relevance to a wide range of theories in public policy which describe the replacement of the simple 'clubby days' of early post-war politics by 'complex relationships' at multiple levels of government and among a huge, politically active population. Yet, the focus on complexity is often indirect and vague. This contrasts with complexity theory in the natural sciences that gives the complex system explanatory value. It suggests that we shift our analysis from individual parts of a political system to the system as a whole; as a network of elements that interact and combine to produce systemic behaviour that cannot be broken down into the actions of its constituent parts. There is also scope to adapt the natural science term 'phase transition', which describes the tipping point at which change results from the marginal effect of energy. Yet, there are problems when we apply complexity theory to political systems, not least because the theory appears deterministic. The danger is that if the complex system is predominantly the causal factor then we lose sight of the role of agency. This paper explores the opportunities and constraints offered by the application of complexity to studies of public policy, focusing on the applications so far and the problems to be overcome in the future.

Introduction

There are two exciting claims that can be made for complexity theory. First, it marks a scientific revolution; representing a revolutionary break from the 'reductionist' approach to one which analyses complex systems as a whole (Mitchell, 2009: x). Second, its approach has relevance and appeal across the sciences as a whole. While many social scientists have long been interested in applying natural science *methods*, complexity theory also appears to offer a *theory* of systemic behaviour. The term 'complexity' is used increasingly in political science but without a common definition to tie together a wide range of studies. A broad use of the term suggests relevance to many theories of public policy. For example, multi-level governance describes a sense of complexity regarding individual and institutional relationships which blurs the boundaries between government action and non-governmental influence. Similarly, theories such as punctuated equilibrium, the advocacy coalition framework and Hall's (1993) policy paradigms chart the replacement of the simple 'clubby days' of early post-war politics by 'complex relationships' among a huge, politically active population.

Yet, the focus on complexity is often indirect and rather vague. This contrasts with the expanding use of complexity theory in the natural sciences that appears to give the complex system itself explanatory value. Complexity theory suggests that we shift our

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analysis from individual parts of a political system to the system as a whole; as a network of elements that interact and combine to produce systemic behaviour that cannot be broken down merely into the actions of its constituent parts. Rather, the aim is identify what types of systemic outputs occur when its members follow the same basic rules, and how sensitive the system is, or what small changes in rules will produce profound changes in systemic behaviour.

Excitement in the potential to apply complexity theory to political science appeared to be summed up in the subtitle to APSA 2009: 'Politics in Motion: Change and Complexity in the Contemporary Era', perhaps because it may help explain why policies change non-incrementally. Yet, the term 'complexity' was used rather loosely in that conference and very few panels were devoted to complexity theory (note that the term 'punctuated equilibrium' is used almost as loosely). Further, the mood at complexity theory panels was fairly sombre, with most paper-givers either encouraging caution about the claims we can make for complexity theory or waiting and hoping for the next big breakthrough.

The aim of this paper is to try to explain the gap between this overall excitement in the sciences with the relative despondency in political science. It seeks to define complexity theory and describe how this concept has been used directly to explain processes in public policy. It suggests that although the public policy literature using the terms 'complex systems theory' or 'complexity theory' is not large, there is a much wider literature which describes aspects of the same processes. It then explores numerous possible reasons for a lack of complete take-up of these terms:

1. Complexity theory is difficult to pin down (although this has not stemmed the popularity of other terms such as 'governance' and 'institutionalism').
2. When we do pin down the meaning of complexity theory, it seems to present a deterministic argument.
3. It is difficult to identify or define a system and separate it from its environment.
4. It is difficult to determine the most appropriate level of analysis.
5. It is difficult to know which types of policy issue or area complexity theory applies to.
6. Although anti-reductionism and whole-systems approaches sound attractive, reductionist theories have a strong hold in political science.
7. Complexity theory may merely complicate rather than improve the existing body of knowledge.

Finally, the paper suggests that many of these problems arise because the meaning of complexity theory and its implications for public policy have not yet been unpacked fully. It outlines how the literature has been applied so far and what issues still remain unclear.

What is Complexity Theory?

Complexity theory may be seen as 'a way of thinking, and a way of seeing the world' (Mittleton-Kelly, 2003: 26). For Sanderson (2006: 117) it developed as a consequence of seeing the world differently, as a 'world of instability and fluctuations' when in the past it

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was seen as 'stable'. According to Mitchell (2009: x), it represents a revolutionary break from the 'reductionist' approach to science. The approach seeks to explain why complex or system-wide behaviour emerges from the interaction between 'large collections of simpler components' (2009: x; Kernick, 2006; Blackman, 2001). Different accounts identify different factors, or place more emphasis on some at the expense of others. There is also some doubt about the unity of the theory, with Mittleton-Kelly (2003: 23) in particular arguing that it is really a collection of theories from a variety of disciplines in the natural and social sciences (and there are variants, such as theories of complex adaptive systems). This makes the identification of its key tenets difficult. However, the paper identifies six common assumptions regarding how complex systems behave and how we should study them:

1. A complex system cannot be explained merely by breaking it down into its component parts because a key element of system dynamics is the manner in which those elements interact with each other. Instead, we must shift our analysis to the system as a whole; as networks of elements that interact, share information, adapt and combine to produce systemic behaviour.
2. The behaviour of complex systems is difficult to predict. Complex systems exhibit non-linear dynamics produced by feedback loops in which some forms of energy or action are dampened (negative feedback) while others are amplified (positive feedback). As a result, small actions can have large effects and large actions can have small effects. This suggests that periods of equilibrium are also unstable because a small input of energy can have a large effect. This can be linked to the term 'phase transitions', which describes the tipping point at which dramatic change results from the marginal effect of energy (such as when a liquid becomes gas).
3. Complex systems are particularly sensitive to initial conditions which produce a long-term momentum, suggesting that any small measure in initial measurement, or failure to account for the effect of seemingly insignificant factors will produce major errors in predictions of future behaviour (the 'butterfly effect').
4. They exhibit emergence, or behaviour that evolves from the interaction between elements at a local level rather than central direction. This makes the system difficult to control.
5. They may contain 'strange attractors' or demonstrate extended regularities of behaviour (Bovaird, 2008: 320). They may therefore exhibit periods of 'punctuated equilibria' - in which long periods of stability are interrupted by short bursts of change - such as when new species emerge suddenly in the process of evolution.
6. The various problems that complexity theory seeks to address – such as predicting climate change, earthquakes, the spread of disease among populations, the processing of DNA within the body, how the brain works, the growth of computer technology and artificial intelligence, and the behaviour of social and political systems – can only be solved by interdisciplinary scientific groups (Mitchell, 2009: x).

In this light, a complex system is a large number of elements that interact with each other

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to produce system-wide behaviour. This process cannot be understood simply by breaking it down into its individual elements. For example, swarming behaviour in bees and coordinated behaviour in ants cannot be explained merely by the actions of individual insects. Rather, we must study their actions as a whole, the rules they follow, how those rules are communicated and the extent to which a small change in rules causes a large systemic change. The brain is also a complex system in which emergent processes, such as thoughts and feelings, are difficult to break down into the performance of individual neurons. While it may seem like a bit of a stretch, there may be some resonance with public policy processes. Complex systems display behaviour that is difficult to predict or control. It is difficult to predict because it is 'non-linear': the effects of some actions are dampened but others amplified - such as when a policymaker ignores one source of information but responds to another. It is difficult to control centrally because behaviour seems to emerge from the interaction between agents at a local level - such as when service delivery organisations make policy as they implement it.

Complexity Theory in Public Policy

As Mitleton-Kelly (2003: 25-6) suggests, we should be cautious about the value of complexity theory to the social sciences because human behaviour or 'the capacity to reflect and to make deliberative choices and decisions among alternative paths of action' makes the social world a different object of study than the natural or physical world. Although there seems to be plenty of evidence in the public policy literature to suggest that policymaking systems exhibit the characteristics of complex systems, our key concern regards the extent to which complexity is used merely as a metaphor or analogy rather than a real system (2003: 26; Kernick, 2006: 389). Or, we may be concerned that our interest in complexity is driven not by the policy problem at hand but by the existence of a new theory which has, at best, uncertain applications to public policy (Bovaird, 2008: 321).

The complexity and public policy literature consists of two main strands: a relatively small strand that engages directly with complexity theory when analysing public policy and a much wider range of studies, central to the public policy literature, that highlight complex system characteristics without necessarily using the language of complexity. In this section I consider the extent to which the direct literature confirms the importance of complexity's key tenets, and in the next section I consider our ability to identify those tenets in the broader literature.

In their introduction to a special edition on complexity theory in *Public Management Review*, Teisman and Klijn (2008: 288) highlight an initial difficulty in finding an adequate definition of complexity theory: no-one is quite sure what a complex system is, beyond an intuitive reference to a collection of parts which may be analytically distinct but intertwined in practice and therefore difficult to separate when we observe their interaction. Jervis (1998: 5-6) suggests that 'We are dealing with a system when (a) a set of units or elements is interconnected so that changes in some elements or their relations produce changes in other parts of the system, and (b) the entire system exhibits properties and behaviours that are different from those of the parts'. However, he also recognises

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the limits to such definitions and prefers to define by example (in accordance with the principle 'I know it when I see it'). This is not a problem in itself since most terms in the political science literature defy common definition, while many vague terms such as 'institutionalism' are used to represent a common focus. Rather, the problem may be to identify a common and distinctive scientific endeavour around the term 'complexity'.

For Teisman and Klijn (2008: 288) the endeavour in public policy is based on four insights. The first is that law-like behaviour is difficult to identify because the policy process is 'guided by a variety of forces', suggesting that X will only have an effect on Y under particular conditions that are difficult to specify. The second is that systems have 'self-organizing capacities', making them difficult to control; the effect of an external force may be large or small and this is impossible to predict from the external force alone. The third relates to the metaphor of the 'fitness landscape' or 'surroundings in which living beings exist and behave'. This landscape provides the context for the choices of agents and is affected not only by the choices of agents but also 'external pressures' (2008: 289). In effect, agents or organisations must not rely on a single policy strategy because the landscape or environment is unstable and often rapidly changing (Mitleton-Kelly, 2003: 35-6). The fourth is that actors within complex systems are 'self-organizing, creating their own perception of what they want and how to behave in the landscape they are in' (2008: 289).

Overall, Teisman and Klijn point to a way of understanding 'governance' as a process that defies simple solutions. For example, while top-down implementation models might link success to simplicity, to one clear goal and a select number of officials to carry it out, complexity theory suggests that this process could not be separated and made immune from its wider, complex, context (2008: 294). Rather, implementing officials will have to adapt policy in response to this dynamic process (see also Bovaird, 2008: 339).

We can tease out more from Mitleton-Kelly's (2003: 37) focus on the complex system's ecosystem, which provides negative and positive feedback signals. This is a key source of change when we consider the timing of events: positive feedback at an early stage provides an impetus to change or increases the probability that significant change will be amplified over time. Mitleton-Kelly (2003: 38) gives the example of the positive feedback provided to manufacturers of VHS, not Betamax, tapes and recorders to demonstrate the importance of signals from the environment. A wider demonstration of the importance of timing (or sensitivity to initial conditions) is provided when we consider an experiment with 2 balls – one black and one red – in a container. The experiment is to determine what happens if we add a black or red ball according to which ball we pull from the container. It shows the degree of chance involved and the effect of that chance occurrence on the trajectory of the container's contents. If a black ball is chosen, we not only add a black ball, but also increase the probability of a black ball being chosen next time (from 1 in 2 to 2 in 3). The more we choose, then the greater the cumulative effect of this first event.

Mitleton-Kelly (2003: 41) also places more emphasis on self-organisation and emergent behaviour as it relates to the whole system. In this sense, we are not talking about

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individuals adapting to their environments because ‘a system may need to be studied as a complete and *interacting whole* rather than as an assembly of distinct and separate elements’. In other words, breaking the process down into a system’s constituent parts (including the actions of individuals within it) will undermine explanation.

Complexity Themes in Public Policy

To some extent, the literature which attempts to apply complexity theory to public policy employs a particular jargon to demonstrate that political systems exhibit the characteristics of complex systems. Yet, even this brief description of complexity theory has resonance with a large collection of theories and discussions of public policy.[i]

First, the focus on sensitivity to initial conditions is a key tenet of historical institutionalism. Institutionalism is the study of the mediating role of institutions in politics, with an institution defined as ‘the formal rules, compliance procedures, and standard operating procedures that structure conflict’ (Hall in Thelen and Steinmo, 1992: 2; which perhaps makes an institution as hard to pin down as a complex system). Historical institutionalism in particular focuses on ‘historical contingency’ and ‘path dependence’ (1992: 2). Path dependence suggests that when a commitment to a policy has been established and resources devoted to it, over time it produces ‘increasing returns’ and it effectively becomes increasingly costly to choose a different path (Pierson, 2000). The focus of analysis becomes the details of a ‘critical juncture’ and the timing of decisions is crucial, because it may be the order of events that sets policy on a particular path. The model identifies both inertia and unpredictability, as relatively small events or actions can have a huge and enduring effect on policy change which is very difficult to reverse (Pierson, 2000). The link between complexity theory and modern path dependence discussions is strong.[ii] Indeed, Pierson (2000: 253) adopts the same ‘black and red ball’ language (and Betamax/ VHS example) to describe the initial unpredictability of choice (when one black and one red ball can be chosen), subsequent inflexibility (when it becomes increasingly likely that one colour will be chosen), and that, ‘Accidental events early in a sequence do not cancel out’. Institutional explanations in general may also be relevant when the aim is to identify the rules governing systemic behaviour and the extent to which policy changes when those rules change.

Second, the term ‘complexity’ has relevance to a wide range of theories in public policy which describe the replacement of the simple ‘clubby days’ of early post-war politics by ‘complex relationships’ at multiple levels of government and among a huge, politically active population (Heclo, 1978: 94; 97; Baumgartner and Jones, 1993: 177-8; Jordan, 1981: 98). This shift is reflected in the group-government literature. The policy community and iron triangle approaches became associated with explaining stability in political systems, followed by a focus on explaining policy change within the policy networks literature. In the US, this may be a response to the identification since the 1970s of a more complex political system - containing a much larger number of groups, experts and other policy participants – which makes it much more difficult for policy issues to be insulated from the wider political process and for policy monopolies to restrict debate (Baumgartner and Jones, 1993). In the UK, it may follow the experience of the Thatcher government and the imposition of policy change in the face of

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widespread opposition, rather than through the types of negotiation and compromise that incrementalist and policy communities approaches suggest. In the EU, it may follow the identification of a policy process which is 'more fluid and unpredictable – and less controllable – than seems to be implied by enthusiasts of the network approach' (Richardson, 2000: 1008). In each case, the focus is on explaining a less predictable and more complex process.

Punctuated equilibrium theory (as promoted by Jones and Baumgartner, 2005; Baumgartner and Jones, 1993; Workman et al, 2009) is particularly relevant because it employs much of the language of complexity theory to explain the shift in group-government relationships. The 'general punctuation hypothesis' demonstrates, in a study of information processing, that policy processes exhibit non-linear dynamics and punctuated equilibria. Jones and Baumgartner (2005: 7) define information processing as the 'collecting, assembling, interpreting and prioritizing [of] signals from the environment'. Policymakers are effectively surrounded by an infinite number of 'signals', or information that could be relevant to their decisions (from, for example, interest groups, the media or public opinion). Since they are 'boundedly rational' (Simon, 1976) and do not have the ability to process all signals, they must simplify their decision-making environment by ignoring most (negative feedback) and promoting few to the top of their agenda (positive feedback).

Negative feedback may produce long periods of equilibrium since existing policy relationships and responsibilities are more likely to remain stable and policy is less likely to change when the issue receive minimal attention from policymakers (a feature of policy communities - Richardson and Jordan, 1979; Jordan and Maloney, 1997). Positive feedback may produce policy 'punctuations' because when policymakers pay a disproportionate amount of attention to an issue it is more likely that policy will change dramatically. This is particularly the case following a 'bandwagon effect' in which policymakers and interest groups at multiple levels of government all pay attention to an issue at the same time, often seeking to contribute to finding new ways to address old problems and challenge the right of one organisation to command policy responsibility. The 'selective attention' of decision-makers or institutions explains why issues can be relatively high on certain agendas, but not acted upon; why these powerful signals are often ignored and policies remain stable for long periods. Policymakers are *unwilling* to focus on certain issues, either because ideology precludes action in some areas, there is an established view within government about how to address the issue, or because the process of acting 'rationally' (making explicit trade-offs between a wide range of decisions) is often unpopular. They are also *unable* to give issues significant attention, because the focus on one issue means ignoring 99 others. Change therefore often requires a critical mass of attention to overcome the conservatism of decision-makers and shift their attention from competing problems (2005: 19-20; 48-51). If the levels of external pressure reach this tipping point, they cause major and infrequent punctuations rather than smaller and more regular policy changes: the burst in attention and communication becomes self-reinforcing; new approaches are considered, different 'weights' are applied to the same categories of information; policy is driven ideologically by new actors; and/ or the 'new' issue sparks off new conflicts between political actors (2005: 52; 69).

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Information processing is characterised by 'stasis interrupted by bursts of innovation' and policy responses are unpredictable and episodic rather than continuous (2005: 20).

Third, complexity theory's focus on emergent behaviour in the absence of central control brings to mind the literature on implementation and governance which explores the problems that central governments face when they do not recognise the extent to which policy changes as it is implemented (Cairney, 2009; Butler and Allen, 2008; Klijn, 2008). The level of interdependence governments share with implementing organisations has prompted the identification of 'self-organizing networks' (Rhodes, 1997: 50) and images of 'bottom-up' implementation through self-selecting clusters of organizations in which a variety of public and private organizations cooperate (Barret and Fudge, 1981; Hjern and Porter, 1981). While there is some scope for central governments to control implementation, most notably through cross-cutting targets linked to the control of public expenditure (Richards and Smith, 2004), Lipsy's (1980) analysis of 'street-level bureaucracy' suggests that since public sector professions are subject to an immense range of (often unclear) requirements laid down by regulations at the top, they are powerless to implement them all successfully. Instead, they establish routines and use rules of thumb to satisfy a proportion of central government objectives while preserving a sense of professional autonomy necessary to maintain morale. While such problems have prompted governments to embrace new public management (or the application of private business management methods to the public sector) and seek to impose order through hierarchy and targetry, such implementing structures may not be amenable to such direct control.

Finally, the normative side of complexity theory may resonate with incrementalism. Sanderson (2009: 706) suggests that the implication of complexity is that we do not know exactly how any policy measure will make a difference. Therefore, social scientists should be modest about their level of our knowledge (and less wedded to the notion of universal laws and one-best-way to conduct research – Sanderson, 2006: 119) and policymakers should be careful when making an intervention. This suggests a greater use of "'trial and error' policy making" and learning from pilot projects (2009: 707).[iii] It seems to represent a rejection of top-down control, giving implementing organisations the chance to learn from their experience and adapt to their environment (2009: 708). It also seems uncannily like the spirit of Lindblom (1959: 86): 'Making policy is at best a very rough process. Neither social scientists, nor politicians, nor public administrators yet know enough about the social world to avoid repeated error in predicting the consequences of policy moves. A wise policy-maker consequently expects that his policies will achieve only part of what he hopes and at the same time will produce unanticipated consequences he would have preferred to avoid. If he proceeds through a succession of incremental changes, he avoids serious lasting mistakes'.

Why has Complexity Theory Struggled for Attention?

The first difficulty with complexity theory is that it is difficult to pin down. While we may find similar discussions in a wide range of texts in the literature, this may be merely because it is vague. Its appeal in the sciences may be because it means different things to different people, suggesting that initial enthusiasm and cross-disciplinary cooperation

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may be replaced by growing scepticism.

The second is that, when we do pin the meaning of complexity theory down, it seems to present a deterministic argument. The danger is that if the complex *system* is predominantly the causal factor then we lose sight of the role that policymakers play; there may be a tendency to treat the system as a rule-bound structure which leaves minimal room for the role of agency. It is tempting to contrast this picture with interpretive social science which rejects the assumption of structural constraint. Rather, it explores how agents perceive their decision-making environments; how they reproduce, accept or challenge the structural, institutional and wider systemic constraints that they appear to face when making decisions. Indeed, they may even reject terms such as 'institution' and 'rule' because they imply a sense of permanence or common understanding that has not been demonstrated (Bevir and Rhodes, 2003; 2006). This is the essence of the study of politics, explaining why different policymakers make different decisions under the same circumstances. Yet, there is perhaps good reason to resist this temptation because, if the aim of complexity theory is to identify a shift in rule-bound behaviour, then it could have something *in common* with interpretivist accounts which seek to understand how agents interpret, adapt to and influence their decision-making environment. This seems to be Teisman and Klijn's (2008: 289) point when they focus on agents adapting to the fitness landscape. Further, as Schneider and Bauer (2007: 6) discuss, complexity theory appears to differ from the old functionalist logic of systems theories that has gone out of fashion in political science. A kinder treatment of complexity suggests that, so far, it has been used in public policy more to provide practical advice to public managers than to inform the wider theological debates on structure and agency we find in political science. I return to this theme in the next section.

The third is that it is difficult to identify or define a system and separate it from its environment. For Mitleton-Kelly (2003: 30) this is not a problem because it is useful to work on the assumption that there is no fixed boundary between the two. Rather, the picture is one of overlapping systems or an 'intricate web of inter-relationships', suggesting that systems as a whole engage in 'co-evolution'. Rather than a system adapting to its environment, we picture organisations influencing and being influenced by the 'social ecosystem' which consists of other organisations (2003: 31).

This conclusion raises a fourth problem related to scale or perspective in complex systems. Not only do we not know what a complex system is, but we don't know at what level we should view it. Wider scientific accounts relate the benefit of complexity theory to the ability to step back and see the system as a whole, in much the same way that we move from looking at molecules to observing the whole being. Yet, this doesn't guide us too much, because we could still see systems at different levels, such as a healthcare system or a political system or even an international political system (plus authors such as Mitleton-Kelly often seem to situate analysis at the organisational level). While this gives us some flexibility, it could raise a whole host of further theoretical questions (are central policymakers situated within, or treated as external to, the systems they cannot control? If a country's political system is made up of a number of other systems, does

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this suggest that there are super-emergent processes when systems interact with each other?).

The fifth is that it is difficult to know which types of policy issue or area complexity theory applies to. For example, Klijn (2008: 314) suggests that complexity theory is best suited to 'wicked problems', suggesting that it refers primarily to issues of joined-up-government and/ or intractable policy problems (what would this exclude?). Bovaird (2008: 325) suggests that complex systems "are less likely to be found in 'command-and-control' environments". This is confusing for two related reasons. First, the best example in the UK of a command-and-control approach is the English NHS. Yet, Kernick (2006) argues that complexity theory is well suited to explain why the NHS is impervious to central control. Second, perhaps Bovaird is referring not to areas with command-and-control styles, but those conducive to them. If so, there seems to be no way to decide which areas are most relevant. The irony of governance, highlighted by Rhodes (1997), in which successive governments have contributed to their own lack of central control, knows no bounds. Perhaps the point is that the identification of emergence and self-organizing behaviour is most likely in areas where the role of the 'centre' is not strong, but this also raises further issues (below).

The sixth is that, although anti-reductionism and whole-systems approaches sound attractive (almost like a valence issue), reductionist theories have a strong hold in political science. Indeed, rational choice theory may represent complexity theory's poplar opposite because it seeks parsimonious results based on a reduction of the social world into as few factors as possible. This is as much a practical as a philosophical issue. While we may view the world as a complex system, we do not have the ability to study it as one. The ACF, for example, situates analysis at the level of the subsystem and identifies two main processes: a process of learning within subsystems as advocacy coalitions compete to define the policy problem and account for new information, and an external process which may produce shocks to the system that change how the subsystem operates (Sabatier and Jenkins-Smith, 1993; Weible et al, 2009). The interesting aspect of this framework is that, while from a complex systems perspective we may prefer to study the system as a whole, the ACF may be no worse a way to study the process when we are faced with limited resources and cognitive abilities.

A final problem may be that complexity theory complicates the study of public policy without offering something new. This point seems strongest when applied to the study of implementation. For example, one case study in the PMR special issue demonstrates 'how local governments develop contrasting behaviour on the same national policy impulse due to self-organizing abilities to combine adaptiveness and self referentiality' (Teisman and Klijn, 2008: 296), but Teisman and Klijn do not show how this differs from similar 'bottom-up' processes of self-selection in implementation structures (Hjern, 1981; Hjern and Porter, 1982) or street-level bureaucracy (Lipsky, 1980) identified 30 years ago (also compare Buuren and Gerrits' 2008: 382 line that 'decisions are neither the starting nor the finishing points of a decision-making process' with Barret and Fudge's focus on 'policy in action'). Similarly, the statement that complexity theory shows us that 'managers are not the rational beings presented in many managerial handbooks'

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(Teisman and Klijn, 2008: 297) does not seem startlingly original. We are in the very familiar territory of uncertain policy effects and unintended consequences. A sympathetic assessment might suggest that these points are being restated because the lessons from bottom-up studies have been lost or ignored. This seems to be the tone of Butler and Allan's (2008) argument that there is no one-best-way in the delivery of local services and in Kernick's (2006: 388) criticism of the assumption of a single organizational solution in the NHS (and promotion of a more meaningful dialogue between those who design and those who deliver and use the service). But is there anything more to complexity theory than this?

Unpacking Complexity Theory

It may be that these problems arise because the meaning of complexity theory and its implications for public policy have not yet been unpacked fully. Its arguments may already have been expressed in existing texts, but perhaps not as a coherent whole linking sensitivity to initial conditions and non-linear dynamics with a self-organizing system with emergent behaviour. However, the overall coherence of the project is also not laid out by the public policy literature dedicated to complexity theory. For example, it seems that complexity theory has either solved the problem of the structure/ agency duality or it conflates two contradictory processes in a confusing and unsustainable way. There is also still too much confusion about the meaning of self-organising behaviour.

With regards to structure and agency, on the one hand we have 'self-organizing landscapes' (Teisman and Klijn, 2008: 289) or complex *systems* that adapt and change behaviour; behaviour is 'emergent' from the processes within systems and is not readily broken down to the agents within it. Further, much of the explanation for outcomes comes not from individuals but from the level of connectivity between them (Mitleton-Kelly, 2003: 28). On the other, we have the 'self-referential behaviour' of *agents*, reacting to 'external forces and changes' but also, 'creating their own perception of what they want and how to behave in the landscape they are in' (Teisman and Klijn, 2008: 289). The latter seems more in keeping with social scientific explanation and indeed would not look out of place in interpretive texts such as Bevir and Rhodes (2006). However, it also appears to contradict the former because it highlights what appear to be independent actions by agents which are separable from each other. Indeed, breaking the process down into a series of actions of individuals interacting with other individuals within a particular decision-making environment is not a million miles from rational choice.

For systemic behaviour to be in operation, it may be that we identify regularities or patterns of behaviour; that although agents could act differently they appear to act in the same way and follow the same basic rules. We may also then say that this produces what appears to be system-wide behaviour. In turn, we may observe emergent systemic behaviour when those same individuals suddenly follow a different rule. Again, a useful parallel is rational choice theory which often discusses group or organisational action on the assumption that it is a shorthand; that such action can be broken down to the level of the individual (Dowding, 1991: 10). Yet, this does not seem to be what complexity theory describes in other fields (e.g. the brain is treated as a complex system in which

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emergent processes, such as thoughts and feelings, are difficult to break down into the performance of individual neurons). A lot comes down to how we understand terms such as 'autopoietic' systems – are they systems that somehow regenerate and reproduce *themselves* or are they systems maintained by agents within them? Although this appears to be a semantic argument, such semantics seem to make the difference between a deterministic or rational choice or interpretive explanation of events. The distinctions are also crucial because, without the identification of emergent systemic behaviour and self-organisation, it would be difficult to know what makes complexity theory different from the existing literature.

In this respect, a lot hinges on what sort of organisations we call systems. The idea of systemic behaviour may be less problematic in organisations with a recognisable (or even formal) mode of decision-making. For example, political parties, interest groups, governments or government departments have regulations in place to govern decision-making. This compares to institutions such as policy networks and self-organising implementation networks in which the membership and degree of interaction is not fixed or regulated and there is some doubt about where decision-making takes place. This is surely the most significant area where complexity theory can make a difference. We already have theories of organisational action. What we don't have is a theory of system-wide action in the absence of central control. This may in turn contribute to the study denoted of wholes, 'built up of smaller entities which are themselves wholes' (Checkland in Mitleton-Kelly, 2003: 44). In other words, surely the excitement of this kind of research is that it points to the interconnectedness of decisions made in different parts of political systems and the unintended consequences of one decision in a subsystem on another (Jervis, 1998: 3; 11). Yet, this is also the area in which it is most difficult to describe systemic action in a convincing language.

The key issue of language can be found in Klijn's (2008: 302, drawing on Maguire and McKelvey) definition of complex systems. Klijn describes a complex system (2008: 302) essentially as a series of subsystems, all of which have their own rules of behaviour and external forces to deal with. System behaviour represents what happens when these subsystems interact with each other. This is the stage at which feedback mechanisms operate, because subsystems act but also react to other subsystems and the positive and negative signals they send when they interact. This is the cause of unpredictability because there are so many subsystems interacting at one time and, while there may be degrees of control within subsystems, no one is controlling the system as a whole. Hence, the system is different from the sum total of the actions of subsystems because explanation comes not only from the way subsystems act but also the interaction between them (and the subsequent action that this interaction influences). This is also why we may witness emergent behaviour and the absence of central control. While there may be evidence of control within subsystems, there is less evidence that the 'centre' can control how all of these subsystems interact with each other and hence the overall behaviour of a complex system. Rather, emergent behaviour is associated with 'self-organization', when subsystems 'spontaneously communicate with each other and abruptly cooperate in coordinated and concerted common behaviour' (Stacey in Bovaird, 2008: 321; perhaps as when bees swarm).

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So far, so good.[iv] However, the waters are muddied by a subsequent discussion in which Klijn (2008: 308) appears to link the idea of self-organisation to the agenda setting and group-government literature, in which policy networks or subsystems are in part insulated from the wider world when its members (many of which are non-governmental actors who can't be directly controlled by the government) share a common understanding about the policy problem (how it is framed and how it should be solved). Now, we appear to have moved from the absence of central control in *systems* to the absence of control in *subsystems* (unless this is just an unfortunate use of the term 'subsystem'). This in itself is not a problem, since it reflects a very large policy networks and governance literature highlighting that very process (some of which effectively describes the interaction of various policy communities within a subsystem). However, the idea of diminished or diminishing central government control within subsystems or implementation networks is by no means accepted in the public policy literature (Cairney, 2009; Marsh, 2008; and the 'centre' is often the main object of study - Bulpitt, 1983; Cairney, 2006; Watts, 2007) and it should be demonstrated rather than assumed.

The argument about self-organisation is complicated further by effectively describing the policy implementation and formulation processes as 'two different networks' and 'two different systems which have to co-evolve to be fruitful' (Klijn, 2008: 309; see also Butler and Allan, 2008: 432 which treats local authority housing as a system). Again, while this is not necessarily a fatally flawed distinction, it is problematic and it clashes with the other work Klijn cites, such as the advocacy coalition framework which focuses on subsystems which include policymakers at all levels of government. This type of problem produces an overall impression of pick-n-mix theorising in which complexity theory is chosen and its proponents seek similar discussion in the literature without examining the challenges (e.g. the role of the centre, the policy formulation/ implementation distinction) that each discussion presents.

The pick-n-mix approach by Klijn (2008) and others appears to undermine Jervis' (1998: 5-6) 'I know it when I see it' approach; the more we delve into the specifics of public policy the more it seems that different authors are seeing different things. While these issues could be resolved, I suspect that when the empirical work on complexity increases, more of such problems will occur when different authors have different ideas about what constitutes a system and a subsystem. While we can laud the flexibility afforded by the framework, we may also worry about the proliferation of new, often vague, terms and the difficulties in accumulating knowledge. As things stand, what we have is a theory or framework whose themes can be identified throughout the literature but without providing us with an understanding about how coherent, complementary or contradictory that literature is (Cairney, 2009b).[v] These issues are additional to the problems that any theory faces when engaged in policy analysis. For example, how do we identify periods of incremental or radical change and how do we identify the punctuation or critical juncture that produced such change?

Conclusion: The End or the Beginning for Complexity Theory?

Overall, we have an interesting practical problem with complexity theory in public

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policy. On the one hand, it is a distinct way to look at the world, as a whole system which is different from the sum of its parts (Jervis, 1998: 12). On the other, empirical studies and examples of processes within complex systems necessarily focus on those parts rather than the system as a whole (and there is not enough of them to see what the body of evidence will look like – Klijn, 2008: 306). It is also tempting to be dismissive of the results, because complexity theory may provides us with a new language to view the world but not to study it. Teisman and Klijn (2008) often appear to describe the scope for discretion in the public sector when policies are implemented, while Mitleton-Kelly (2003: 42; 44) describes rather commonplace examples of individual and team-based innovation and the learning that takes place between and within organisations. Recommendations that arise from complexity theory – which can be abstract (encourage systemic emergence; encourage co-evolution with the social ecosystem; shift from strategic planning to strategic management) or specific (support the production of new ideas and ways of working in complex systems; encourage 'subsystems' within organisations to communicate with each other; give delivery organisations the freedom to manage) – may seem either meaningless or banal to academics or public managers. Complexity theory tells us that policy outcomes are difficult to predict and control because there are too many people involved and too many simultaneous processes to consider and seek to influence (Klijn, 2008: 291), but didn't we know this already? Many accounts also seem to downplay the planned or centralised context in which emergent behaviour takes place, and perhaps the issue of power in general, without giving a convincing reason to do so.[vi]

The discussion so far may lead us to suggest that complexity theory has little to add to the public policy literature. The themes are discussed already in a variety of guises and the conclusions reached in these discussions may be less problematic. So what is the value of complexity theory in this context? The main advantage of this approach is that it helps us to take the links between the social and natural sciences seriously. To put it briefly and perhaps rather simplistically, the main debates on subjects such as behaviouralism and rational choice theory related to how (in)appropriate it is to import scientific methods from the natural sciences. With complexity theory there is much more scope for a conversation between types of science rather than the importation of one from the other. Indeed, the trend in the physical sciences appears to be to look to the social sciences for the next big breakthrough in theory. Quite how this will arise is the million dollar question. However, at the very least, this is a subject or framework that has the potential to foster a meaningful degree of interdisciplinary collaboration. The hook is that since the identification of complex system behaviour is more problematic in politics than in nature, there is a two-way dialogue taking place. Complexity theory applied from the natural to the social sciences may aid our understanding of the policy process but also yield insights into our overall understanding of complex systems. I explore the implications of this collaboration in the companion paper 'Bridging the Methodological Gap Between the Physical and Social Sciences: Complexity Theory and Mixed Methods' http://www.psa.ac.uk/2010/PanelDetails.aspx?PanelID=36

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[i] See also Klijn (2008) for a link to the literature on governance, multiple streams analysis and game theory.
[ii] Further, in the absence of an ability to predict future behaviour, a key concern for complexity theory is to 'reconstruct the particular constellation of structured choice and accident that led to the present reality' (Reed and Harvey in Sanderson, 2006: 118) – a key focus of historical institutionalism.
[iii] Perhaps prompting us to consider if, in a system characterised by a lack of equilibrium, the lessons in time period 1 will be relevant to policy in time period 2. As Sanderson (2006: 118) notes: 'knowledge of a system's behaviour in the past will provide little guide to likely future behaviour'.
[iv] If we ignore the nagging suspicion that 'concerted' behaviour may in fact be organisations acting to address the unintended consequences of other organisational action. Lindblom's (1959) 'partisan mutual adjustment' also comes to mind.
[v] Or perhaps what we should study next. For example, Pierson's (2000: 253) conclusion is that 'history matters' because 'Earlier events matter much more than later ones'. Is this study of history and critical junctures the complexity theory agenda?
[vi] For example, if A is beating B, finds that the stick breaks too easily because B's head is too hard, and so resorts to a metal bar – is this 'co-evolution'?

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