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STRATEGIC POLICYMAKING WITHIN COMPLEX TIMESCAPES

Author: Graham Room

Department of Social and Policy Sciences, University of Bath, United Kingdom

Email: hssgjr@bath.ac.uk

The complex interactions of social life serve to structure in time the opportunities, threats, and constraints that confront different social actors. This article examines policymaking within such complex "timescapes." It does so by reference to the policy sciences literature and the complexity literature. The former is rich in its qualitative treatment of policymaking and time but has been slow to exploit the analytical tools of the complexity literature. The latter has been slow to appreciate the complexity of timescapes and to recognise the importance of power and the struggle for positional advantage. This article develops a synthesis of the two, combining their analytical power. It shows how this can illuminate the policy world, both conceptually and practically. It draws on Hirschman's treatment of the "interlocking vicious circles" that hold development back and the "upward spirals" that can—when the time is right—be mobilised. It sets this within an appreciation of political economy and institutionalism. It concludes by considering the practical tools available for policy makers to navigate complex timescapes—and how the social scientist can subject those policy decisions to stringent scrutiny.

Keywords: complexity; landscapes; timescapes; policymaking

INTRODUCTION

It is common to assume, when speaking of time, that it is enough to distinguish the past, present and future, the short-term and the long-term. We also speak as though the rhythms of time—and the calendar of social and political life—are the same for all actors. In general, they are not.

It is not just that the nomenclatures of time—the day of the week, the hour of the day—are socially constructed, as with the many other classificatory activities of human societies (Adam, 1990). It is more that the complex interactions of social life serve to structure in time the opportunities and constraints that confront social actors and the threats to which they are exposed[1]. Exogenous shocks also intrude, exposing the resilience and vulnerability of different actors.

Spatial and temporal patterns are thus closely interrelated - what Prigogine describes as the "timing of space" (Prigogine and Stengers, 1984: 17). It follows that the language of fitness landscapes, employed by writers on complex systems, could be complemented by the language of complex "timescapes" (Adam, 1998)[2].

This article examines policymaking within such complex "timescapes." It does so by reference to the policy sciences literature and the complexity literature. The former is rich in its qualitative treatment of policymaking and time but has been slow to exploit the analytical tools of the complexity literature. The latter has been slow to appreciate the complexity of timescapes and to recognise the importance of power and the struggle for positional advantage—central tenets of the policy sciences. The first half of this article develops a synthesis of the two, combining their analytical power. The second half shows how this can illuminate the policy world, both conceptually and practically[3].

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[1] This re-works Marx's affirmation (inspired by Hegel) that men make their own history, not under circumstances of their own choice, but under circumstances directly encountered, given and transmitted from the past.

[2] There is an argument for using the uglier but otherwise preferable neologism of complex "time-landscapes." My argument is after all that landscapes and timescapes are socially co-produced. Given however that the focus here is on making the case for the temporal dimension of such co-production, it seemed appropriate to use the simpler language of "complex timescapes."

[3] This argument was first developed in the author's 2011 book, *Complexity, Institutions and Public Policy* (starting with Section 1.4). Chapter 1 concluded: "the first concern of the book is conceptual and ontological, integrating complexity science and institutionalism. I argue that each is in need of the other, as far as social science is concerned. Complexity science is bereft of an adequate treatment of institutions; institutionalism needs the formal dynamic modelling of complexity science .... I argue that there are remarkable—but so far I think largely unremarked—convergences between the two, which make

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Before proceeding to that scholarly exercise however, it may be helpful to consider in more everyday terms in what sense "timescapes" are indeed woven into the interactions of social life.

Notice first that all moments are not the same. Some are critical, in giving access to opportunities or avoiding danger, if only we can act. "There is a tide in the affairs of men, that taken at the flood leads on to fortune ... and we must take the current when it serves, or lose our ventures"[4]. But most of the time we just get on with the demands of our everyday lives, while watching and waiting for those brief moments, when decisive action is called for[5].

It may also be that, in Lenin's words, "There are decades where nothing happens; and there are weeks where decades happen." But these decades and weeks are not the same for everyone; they depend upon the specific arena in which a person finds themself. Even within a particular arena, you may be dealing with no more than the routines of everyday life, while I face a critical moment. Nevertheless, how I then decide to act may, in due course, impinge in major ways on your quiet and untroubled existence, confronting you, in turn, with decisive choices. But "in due course" is the crucial qualification—it takes time for such effects to work their way through the system and become manifest. That timescale may be very long-term, as for example with our actions on climate change, and the responsibility we exercise towards those yet unborn.

We play out our lives within a variety of local arenas—family, workplace, local community—each with its own strategic dilemmas and calendar. We all face moments when it is our turn to choose which card to play, but some have more turns than others and hold more trump cards. An incumbent Prime Minister may have some freedom of manoeuvre over when to call an election; a committee chair some freedom in deciding what items to include on the agenda and which to postpone[6]. The rest of us have to adjust to what these better-placed actors do. Nevertheless, even these adjustments – when played out across a myriad of minor actors – can in turn change the landscape that major actors confront.

We try to multi-task, hoping that these various rhythms do not produce a tangled log-jam, all requiring our focused attention and strategic imagination at the same time. Double-booking in our diary may cause social embarrassment (the very rationale for having a diary is to decompose our busy lives into manageable, bite-sized, and non-overlapping chunks); much worse is to find that the rhythms of one arena and the attention these demand crowd out all other concerns, however pressing. One obvious example has been the calendar of Brexit negotiations in the UK, sucking the air out of the political system and incapacitating it from addressing other pressing needs; likewise with the Coronavirus pandemic of 2020.

I have described such complex timescapes by reference to the dilemmas and dynamics of social action for those involved. History is here not just a calendar of what happened when and in what order (in Toynbee's words, just "one damn thing after another"); it is the sequence of acts and scenes, within the interlocking dramas that social actors co-produce.

One person's critical moment can coincide with another person's routine existence. Nevertheless, moments and spaces of rapid reconfiguration tend to bring many out of their everyday placidity, whether driven by hope or by fear of change. Here the struggle for positional advantage intensifies; new alliances emerge. Within the larger drama, a myriad of sub-plots unfold, which could then become the seed of altogether different dynamics.

In short: It may sometimes be sufficient—practically and analytically—to treat timescapes as though they were simple, and do no more than distinguish past, present, and future, the short-term and the long-term, with an appropriate time discount rate. But often not.

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plausible the project of integrating them." My 2016 book, *Agile Actors on Complex Terrains,* took this integration project further, with particular reference to power and the struggle for positional advantage. The present article builds on those antecedents, to address the question of policy timescapes.

[4] Shakespeare, *Julius Caesar*, Act 4

[5] Watching and waiting as a dynamic system develops, and intervening at key moments, is something all of us have watched in the children's playground—as a parent pushes a child on a swing, timing each push to ensure that it reinforces the swing, or dampening it down, when it is time for the ride to end.

[6] Recall Lukes' second dimension of power (Lukes, 2005).

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POLICY TIMESCAPES: THEORETICAL SCOPE AND FOCUS

The foregoing applies to all of us, to a greater or lesser degree. It applies with particular force to actors who shape and implement public policies.

"Policy" is a somewhat fuzzy notion—and one used in a diversity of ways. It is in part about the choice of goals, the means for achieving them, the obstacles to implementation. It is also about organisational contexts, capabilities, and constraints, and about the power and interests of different stakeholders.

Much conventional policy analysis relies on the assessment of individual policies, viewed by reference to their "impact" on a target population. These assessments assume that the rest of the landscape remains more or less fixed. Policy forecasts often extrapolate from such assessments, projecting them into the future. These simple models and forecasts may offer some limited insights for the placid backwaters of our societies; but not where we need them most, in the arenas of dramatic and convulsive change, where the boundaries of policies are actively contested.

The language that policy makers themselves use betrays their awareness of the complex timescapes they face. During the COVID pandemic, national leaders and their public health advisers have had to make sense of the rise and fall in the rates of infection, the critical junctures when lock-downs should be imposed or relaxed, and the consequences of these restrictions for the functioning of the health service, the economy and public morale. What indicators to use of such levels of infection; what evidence that different sorts of lock-down will sufficiently reduce social mingling; what signs that morale is breaking down or that public indiscipline is spreading? Will the pandemic be over soon, or are we in for a long haul? The language of climate change likewise betrays anguished acknowledgement of a no less tangled mix[7].

This article takes stock of the treatment of timescapes within the policy science literature. It goes on to consider timescapes within the complexity literature—and the points of convergence between the two. On these conceptual foundations, it examines policymaking within complex timescapes and the tools and capabilities on which policy practitioners can draw.

The article shows how this can illuminate the policy world, both conceptually and practically. It draws on Hirschman's treatment of the "interlocking vicious circles" that hold development back and the "upward spirals" that can—when the time is right—be mobilised. It sets this within an appreciation of political economy and institutionalism.

The article concludes by considering the analytical and practical tools that policy makers might use, to navigate complex land-timescapes. How are they to recognise critical junctures and tipping points, wicked problems and smart solutions? How should they decide when to wait, when, and where to act? And not least, how is the social scientist to subject those decisions to stringent scrutiny?

CONCEPTUAL FRAMEWORKS: THE POLICY SCIENCES

The policy literature offers several idealised accounts of policymaking. Each sheds some light on the policy world—policymaking as a process of evidence assessment and rational analysis (Bardach, 2005), as a process of experimentation and "muddling through" (Lindblom, 1959), as the manipulation of symbols (Edelman, 1964), as the exercise of brute power (Klein, 2007). None of these however brings centre-stage the complexity of policy timescapes.

Nevertheless, within the policy science literature there are some critics of that mainstream who show how this can be done. I take three classic treatments—and one more recent contribution.

In his study *Politics in Time*, Pierson (2004) argues for sensitivity to a variety of time-scales in the explanation of social phenomena. He questions the general focus in social science upon the immediate, where both causes and effects are manifest in the short-term. He challenges the tendency to attempt explanation by reference to "variables" that "are ripped from their temporal context" (p 1); and he questions whether "the social significance of historical processes can be easily incorporated

[7] https://www.pnas.org/content/115/33/8252?mod=article_inline

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into the 'values' of particular 'variables' at a moment in time" (p 78). He notes that the current focus on short-term and immediate causes and effects was not always so; he cites the modernisation literature (p 98) and its collapse in face of the critique it faced, in terms of functionalism and teleology.

Pierson underlines the importance of sequencing. The timing and direction of institutional reforms will shape future administrative capabilities and constrain subsequent options for social change. It may be difficult to reverse them because of the procedural time and trouble involved and the benefits they generate for significant constituencies. Many of the studies he reviews stress the fixity of institutional legacies: clay rather than putty, swords that only with difficulty can be turned into ploughshares.

Pierson also however deals with situations in which, notwithstanding such path dependency, there may be occasional bursts of change, set in motion—but maybe at some remove—by earlier and external critical events. Slow changes in background social and economic conditions may have effects that are far from gradual; at particular thresholds or "tipping points," there are sudden avalanches of change (McGee and Jones, 2019).

At times Pierson adopts the language of attractors and trajectories that writers on complex systems employ. He may not offer a toolkit of formal models. Nevertheless, his study reveals the convergence between historical institutionalism and complexity science and it reinforces the case for a shared analytic approach to social dynamics.

Abbott's *Time Matters* (2001) deals with trajectories and attractors, turning points and fateful choices. He considers the time scale—long-term or more immediate—within which particular processes unfold, whether as effects or as the causes of other processes. He refers to triggers and switches—events and processes which create thresholds or tipping points, critical junctures, and bifurcations. He discusses the whole sequence of developments, by virtue of which an agent re-deploys—but never escapes—the endowments of the past.

Abbott (1977) elsewhere considers how social dynamics can be analysed by reference to both time and space. For the Chicago school of sociology, some social dynamics played out within neighbourhoods whose connections with the larger socio-economic system were stable and rather limited. In consequence, it was possible to study the sequence of stages through which each such neighbourhood typically developed, with only limited reference to these larger contexts. Other neighbourhoods—and other social spaces such as organisations and professions for example—involve regular abrasion against environing factors; they variously pursue their "careers" in relation to that larger context, or have careers thrust upon them. Finally, such abrasion may be so great that the research focus is necessarily on the interactional processes themselves—the "macro" co-evolution of neighbourhoods—and the cascades of change that such interactions—not always predictably—unleash across the city.

Kingdon (1984) (*Agendas, Alternatives and Public Policies*) has also become an established classic of policy timescapes. Social problems, policy ideas, and political agendas each develop in their own way, but when they happen to align, the proponents of a particular policy idea may find that a window of opportunity opens, as political actors embrace it, for addressing a particular social problem. Kingdon uses a series of case studies of major national policy changes in the US, to explore how these alignments develop—and the combination of patience and agility displayed by the proponents of particular policy ideas.

Nevertheless, there are limitations to Kingdon's treatment. Power and political economy affect the politics of policy change, but he leaves them rather in the background. The focus moreover is on the cockpit of political power, Washington DC—that is where his empirical case studies were conducted, but somewhat to the neglect of the dynamics of social change in the wider society. Kingdon is right to study the social construction of political reality—but that reality is not just the construct of politicians.

Kingdon offers qualitative lessons drawn from his case studies about the development of conjunctures and the timescapes of the policy world. Especially in the second edition, he also acknowledges the new literature on complex systems as a source of analytical insights. To that extent, he foreshadows the argument for complexity approaches to be integrated with institutional analysis and political economy (2011, 2016).

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Finally, among more recent writers, Jacobs (2011) (*Governing for the Long Term*) examines policies which have their costs and benefits spread over the short and long run, the distributional consequences for different social groups, and the political consequences for politicians concerned with their own electoral survival. He assumes rational citizens, who will heavily discount the promise of long-run future benefits, and rational political leaders, who will avoid imposing unpopular short-run costs. He asks whether those leaders will ever "govern for the long-term."

In grappling with the question of how and whether it is ever rational for political leaders and citizens to embrace policies for the long-term, Jacobs confronts some aspects of what I am calling the complexity of policy landscapes and timescapes. First, any policy decision to invest in new production possibilities will shift the society to a new set of capabilities. This will in turn change the consumption possibilities available in future periods. Jacobs points out that with pensions policies for example, many scholars have studied the distributional question in terms of transfers from today's workers to today's pensioners, rather than as an inter-temporal re-allocation of consumption between today and tomorrow, by reference to the new capabilities landscape that has by then emerged. It is he argues misleading to assume that the long-term is connected to the short term only by the discount rate that is applied

While starting from an assumption of rational actors, much of Jacobs' discussion reveals how remote from the real world that assumption is. Rationality is heavily bounded, surrounded by much uncertainty. Policy choices made now will set in train a myriad responses among social and economic actors on the ground, whose interactive consequences will become evident only in the course of time. There will be challenges and resistance from organized interests, watching for opportunities to act at critical moments, to sabotage the policy or to ensure that its costs are diverted onto other groups. Jacobs acknowledges (pages 53-57) the "complex causal chains" involved in these dynamics. Like Kingdon, he does not offer a clear analytic for handling these; nevertheless, he makes reference to discussions of "punctuated equilibria"—a key feature of the literature on complex systems—and to the importance, again, of integrating this with institutional analysis and political economy.

Jacobs concludes with the need to study political ideas, the mental maps that policy makers use and the patterns of information processing that characterize human cognition. No less important is the quality of political leadership, appealing to moral commitments and practical interests and telling a persuasive story of a future to be achieved and futures to be avoided—futures that, as Jacobs argues, are no mere extrapolations from the present, but involve shifts to a different landscape. To this extent, political leaders may seek to lay claim to—or even we might say to occupy—one of those futures, laying out its contours and binding the community to its realisation.

These four policy scientists all recognise the bounded rationality of the policy actors they study. They focus primarily on the bounds that arise from the limited information available and the limits of human cognitive powers. The main limitations however to rational decision-making and foresight are those that arise from the complex social dynamics that these actors confront, the counter-intuitive processes of emergence they entail and the complex timescapes within which they present moments for decisive action.

All four writers are innovators in handling these fundamental ontological and epistemological challenges. They acknowledge the complex dynamics exhibited by the social and policy systems in which these actors find themselves. The models that they use of such complex dynamics are however rather general and they make little explicit use of the rich stream of models issuing from complexity science. It is therefore to those models that we now turn, in an effort to forge a closer synthesis of the two literatures (Room, 2011: Ch 1).

CONCEPTUAL FRAMEWORKS: FITNESS LANDSCAPES

Critical junctures are moments when the landscape shifts, to reveal new opportunities or dangers, where decisive action is both possible and necessary. Icebergs come together to create a temporary bridge, over which we can move if we hurry; or an ice floe may break up and oblige us to

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scramble immediately to safety. In contrast, if everything is connected in a continuous ice sheet, we can venture forth whenever we want—time is much simpler.

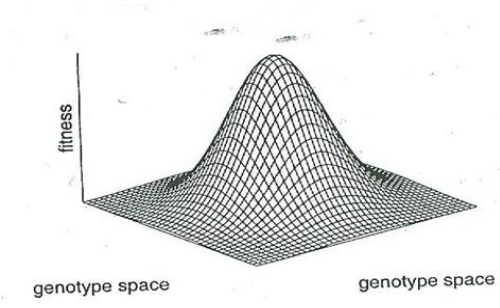
Critical moments are thus intimately bound up with the particular landscapes within which actors find themselves: social time and social space are co-produced. To discuss complex timescapes it will therefore be convenient first to consider complex *landscapes*, where there is a more well-established literature (for a critical overview, see Gerrits and Marks, 2015).

The biological: Kauffman

Kauffman (1993) applies the literature on complex systems to biological systems and evolutionary dynamics. His first concern is with the evolutionary fitness of the populations of different species. A fitness landscape displays how the genetic variations underlying population characteristics (the horizontal plane in Figures 1 and 2 below) affect their fitness (the vertical dimension) in the daily struggle for existence. The horizontal plane of our diagram is limited to just two dimensions—whereas of course in the real world the genotype of even the simplest organisms will vary across many dimensions.

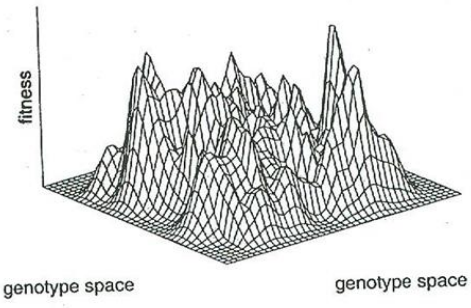
In Darwinian models of evolutionary development, populations will (over many generations) throw up variations in each of these dimensions. Where greater overall fitness results from one of these variations, the population of the species in question can advance to a higher point on the fitness landscape (Figure 1). If this is generally the case, the fitness landscape will display a single peak, towards which all journeys lead.

If however a fitness improvement in relation to one endowment means a decrease in relation to another – if in other words there are trade-offs between these different genetic investments – the fitness landscape, instead of offering a smooth ascent, will instead be rugged. Any evolutionary journey across such a landscape is replete with points where the 'choice' of one line of ascent may ultimately lead to a low fitness peak, from which no subsequent improvements of position are readily available (Figure 2). There is strong path dependency in these transitions; and the sequencing of moves matters.



Single peak fitness landscape

Figure 1



Rugged fitness landscape

Figure 2

The contrast between the single peak and the rugged fitness landscape is what Kauffman refers to as his NK model. This is however not all. Kauffman goes on to consider how the fitness landscapes that different species face may be linked through the food webs in which they are involved. This is his NK(C) model. One species may, for example, thrive the more that another thrives, as with flowering plants and insects; their co-evolution will typically involve increasing specialization around this particular interdependence. In the case of predators and prey however, the increasing predatory capability of the one species means that the prey survives only insofar as its population develops greater

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capabilities of escape or disguise - strategies which then in turn incite further shifts in the capabilities of the predator population.

The fitness landscape of each species can thus be re-shaped by the shifts that other species make across their own fitness landscapes. What previously appeared to be a single peak fitness landscape may become increasingly rugged, so that a species gets stuck on a low peak – or indeed, it may find the peak breaking up and collapsing beneath its feet, so to speak. Alternatively, it may discover particular areas of its fitness landscape are being raised to new heights, a narrow and brief window of opportunity for advance.

The result of these co-evolutions may be a stable state, where the participating species discover a shared ecosystem that allows both of them to thrive, or a "red queen" dynamic, an arms race where each must keep moving fast, if it is to stay in the same place[8]. Between these two extremes, there lie many different forms of emergent structure. Periods of equilibrium are punctuated by moments of more or less sudden change; shifts by one species may open up or close off opportunities for fitness improvement by the other, even if it takes time for these effects to work their way through and become manifest.

How shall we understand the temporal dimension of such fitness landscapes? Within the NK model, the single peak "Mount Fuji" in Figure 1 involves no trade-offs between different genetic endowments—hence the smoothness of the ascent, from any direction, at any time, towards the peak. In contrast, the rugged landscape of Figure 2 involves strong interactions and trade-offs between those endowments—and the danger of ending up on a low fitness peak. Past investments both enable and limit what future ascents are possible. Nevertheless, these constraints of the past are a given—no brief moments when they lift and allow a new ascent.

Contrast that with the temporal dimension of the NK(C) model. Here the movement of one species across its fitness landscape produces movements in the fitness landscape of another—changing the patterns of ruggedness that now confront that second species. This moreover is a dynamic and temporal process, producing periods of stasis and blockage but then maybe new opportunities for ascent, as the landscape shifts beneath the feet, so to speak, of the species in question, if only for a moment. It is here that Kauffman's fitness landscape becomes a complex timescape also.

The social: Potts and Crouch

These fitness landscapes can provide a powerful toolkit for thinking about complex landscapes within not only biological but also social systems. But how are we to move from the language of genetic endowments, fitness, and food webs to the social and policy world? The answer is in terms of capabilities, positional advantage and institutional connections (Room, 2016: Ch 5).

These can be illustrated through the work of Potts (2000). He offers, from the standpoint of complex systems, a critique of orthodox economics and Walrasian equilibrium. The latter assumes an economic space where all buyers and sellers have free and ready access to each other. This is a fully connected landscape, a "well-mixed pot." This in turn allows all markets to clear. Futures markets with appropriate discount rates extend this beyond the present. Neither space nor time has any structure; they are smooth and featureless.

Against this, Potts argues that in the real world, economic space is a "non-integral" network—not everything is connected to everything else. While some nodes have multiple connections (the hubs or seaways of the world), others are accessed only via one or two connections (the remote and well-insulated hinterlands). Potts' non-integral space is Kauffman's rugged landscape, where easy transitions are often barred by deep valleys. It is from this standpoint, and inspired by the literature on complex systems, that Potts brings together diverse critiques of Walrasian orthodoxy (including for example Simon on decomposable systems (Earl and Potts, 2004).)

[8] Kauffman reserves the designation of Red Queen to extreme versions of such arms races, where those involved are "forever doomed by their own best efforts to... deform ... their own landscapes" (Kauffman, 1995: 223). However, some evolutionary biologists would use the term somewhat more generally, to mean evolutionary change that is continuous due to antagonistic feedbacks between two co-evolving partners.

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Potts proceeds to shift the ontology of economic life away from Walrasian exchange, back to production and capital accumulation, as in the classical tradition of economics. Instead of buying and selling in markets, the primary focus is now on economic actors and firms endowed with capabilities: there are resonances here with Penrose (1959). These they acquire, develop, and recombine, so as to build positional advantage in terms of technological and market dominance. In the fitness landscapes in the Figures above, the horizontal plane now captures these diverse bundles of capabilities, the vertical (fitness) dimension displays the positional advantage the economic actor enjoys, in relation to rivals[9].

For Potts, those capabilities are nested and activated within systems of micro-, meso-, and macro-rules (Dopfer and Potts, 2008: Ch 3), including property relations. Social and policy scientists will more commonly speak of institutional rules. It is these that decompose economic and social space, but also then mediate the dynamic interdependencies of different spaces. They thereby constrain and channel the exercise of capabilities. Moreover, by tethering social actors within rule-based environments, they enable others to exercise imperative coordination and to dominate a wider social canvas. The stronger these tethers, the less scope there is for the social actors caught within them to interact outside those rules - and the easier for the powerful to shape and predict the future.

Crouch (2005) offers an account of agile institutional entrepreneurs that closely parallels Potts and his technology entrepreneurs. Like Potts, he places centre-stage creative actors who, armed with mental models of how the world works, scan the array of available materials with a view to combining them in new ways. In the case of Crouch, the available materials are institutions; they are combined using systems of governance, selected by reference to the composite actors they bring together and the capacities and knowledge assets they enable them to deploy.

Both Potts and Crouch insist that actors thus find themselves on terrains that are "complex." Modelling the environment in which actors finds themselves must therefore be in sufficiently "fine detail" to respect this complexity and must not treat actors as though they were located in a topographically uniform "abstract space" (Crouch, 2005: 101). Both think of the entrepreneur as searching for new institutional or technological combinations using simplified templates. There are differences between Potts and Crouch, but the parallels are more important.

Purpose, Power and Positional Advantage

Kauffman uses fitness landscapes to explore the evolution of different species and populations. Potts and Crouch adapt this approach to the world of technological and institutional transformation and struggles for positional advantage.

Micro-actors experiment with a myriad innovations, but the macro-world evolves through emergent processes, hardly less blind than the evolution of Darwinian biology. History is made largely behind their backs; only to a limited extent can they glimpse and act upon its emerging contours.

Larger actors—corporate and governmental—can in greater degree shape the world to their own ends. To apply the notion of fitness landscapes to the social and political world requires that we recognise not only of the blind dynamics of the micro-interactions between small actors, but also the purposeful interventions by big actors, as they build their positional advantage.

It is in terms of such positional advantage that Room (2016: Ch 5) reviews the conceptual value of fitness landscapes. He starts with the "one-dimensional view" inspired by Hirsch (1977): positional advantage as a monotonic pecking order. On a fitness landscape, this is positional advantage as the vertical height of the landscape at any point. There is also however a "two-dimensional view" concerned with access and exclusion, connections across boundaries. On a fitness landscape, this means easy movement to new positions, rather than being isolated on a low fitness peak of Kauffman's NK rugged landscape (see also Burt, 2004 on "structural holes").

[9] There is a large literature in complexity economics that explores the implications of this: see for example Hidalgo (2007), with reference to national technological capabilities and global positional competition.

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Finally however, there is a "three-dimensional view" of positional advantage, as the scope to shape the co-evolutionary dynamics of linked fitness landscapes. Here we are back with Kauffman's NK(C) model – but with social actors seeking to re-work the system parameters, so as to steer those dynamics to their own advantage. This is a process with periods of stasis and blockage, but then maybe opportunities for ascent: in short, a complex timescape.

These purposeful struggles for positional dominance are the stuff of political economy and policy analysis. Even as they watch and wait, these strategic actors look to enforce their occupancy of the institutional landscape, and thereby to "occupy the future." Fitness land- and timescapes, when thus extended to the social and policy world, are drenched in inequalities of power.

PATH DEPENDENCY - CHAINS OF THE PAST OR CAPABILITIES FOR THE FUTURE?

Path dependency is a central preoccupation of many policy scientists, but also of writers on complexity. It will pay us to examine this is greater depth, as we attempt to forge a mutually enriching synthesis of these two intellectual traditions.

For historical institutionalists in particular, such path dependency operates primarily via the institutions within which policy is developed. This sort of lock-in is well-illustrated by Pierson's writings on the US congress (Hacker and Pierson, 2010). Path dependency is no less a preoccupation of complexity writers, examining the extent to which a complex system carries within it a "memory" of its origins. This includes the rugged landscape of Kauffman, where depending on the evolutionary route followed, a species may find itself caught on a low fitness peak, with no easy escape. For both literatures, path dependency involves the constraining chains of the past, hemming us in and constraining options for the present and the future.

Jacobs however notices that any policy decision to invest in new production possibilities will shift the society towards a new future capabilities landscape. Reforms to pension policies should therefore be viewed as a long-term re-allocation of consumption between today and tomorrow, within whatever landscape of new capabilities has by then emerged. (This is very much within the economics tradition of Alfred Marshall and Keynes, where the "short-term" is defined in relation to fixed capabilities, while the long-term allows for changes in capital and capabilities.) Also within the institutionalist literature, a similar perspective is offered by Crouch (2005), who as we have seen recognises institutions as a source of change in public policy, in the hands of agile institutional entrepreneurs.

The same is true of agile actors trapped on an NK rugged fitness landscape. For simplicity, we commonly visualize such a landscape as having just two dimensions of capabilities, set in the horizontal plane. New forms of capability will bring additional dimensions, however; a low peak can then become a saddle point, through which the system can pivot, to take advantage of this new range of capabilities and thus improve its fitness[10]. This might arise in the biological world from sexual recombination. In the social and technological world, such additional dimensions are limited only by human inventiveness and investment in new capabilities.

The existing situation is therefore not so much a prison as a launch-pad, a pivot to new ascents. Embedded within it, we enjoy the security and familiarity from which we can make sense of the world; but we can also identify the ways in which the present order is constraining the potentialities of the present - and the new capabilities that will be needed, in order to escape these constraints.

Typically, such a break-out will build on existing assets but combine them with new or external assets in new ways. By these novel combinations of the existing and the new, we transform our capabilities and organise them into new configurations. Path dependency is here not a lock-in, an

[10] This conversion of peaks into saddles was recognised by Fisher, whom Gavrilets (2004: 36-7) however criticises for suggesting that the new ascents thus made available would enable a population to move towards a single global fitness peak. Whether such a global peak exists is of course a quite separate matter. Nevertheless, having criticised Fisher on the question of a global peak, Gavrilets does not himself pursue the implications of successive monotonic ascents as new dimensions of genotypic space open up.

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impasse, constraining us to more of the same; instead, it provides a vantage point from which we discover pathways to innovation, and we escape from the chains of the past. Here therefore the rugged NK fitness landscape offers a new dawn, with the possibility of new ascents. Indeed, under these new conditions, new co-evolutionary interactions may also develop with other landscapes, of the sort that are modelled by Kauffman's NK(C) model and its complex timescapes.

POLICYMAKING ON COMPLEX TIMESCAPES

Consider now the practical implications for policymaking, viewed as a strategic walk. This recognises choice and agency in relation to a range of possible futures. It recognises multiple actors pursuing interdependent but potentially conflicting aims, each of whose plans of action must be taken into account. It acknowledges uncertainty in relation to the larger social, economic, and physical environment, within which the strategy will unfold. It recognises fateful choices—the paths not taken, the windows of opportunity ignored, the relationships of mutual benefit never explored.

To speak thus of strategy involves recognising the complexity of timescapes. This is quite different from a timeless world, where decision-making can be boiled down to the rational calculation and comparison of alternative inputs and outcomes, and the associated costs and benefits. Instead, it acknowledges that the interactions among multiple actors unfold over time, and they cannot be entirely predicted. The strategic policymaker must therefore wait and watch—and intervene only when the moment is right. The leader who has a new strategic vision each day will soon exhaust the emotional energy of their followers, unless the environment they face is so redolent with danger or with promise that frequent adjustments to strategy are self-evidently necessary. The leader, who waits too long, risks being brushed aside—"too little too late."

What then is a strategic policymaker? What is it to engage with policy on a complex timescape?

Hirschman's heterodox ideas on development policy, as set out in *The Strategy of Economic Development* (1958), have in recent years attracted renewed interest, in part through the work of Edelman (2013). Hirschman asks: what are the preconditions for economic development? The mainstream literature answers in terms of particular resources—natural resources, capital, entrepreneurs, etc. But, Hirschman points out, it proves difficult to agree empirically on which of these is key; and indeed, once development gets going, somehow they all fairly readily appear.

Hirschman therefore offers an alternative view. What seems to matter much more than any particular resource are the "interlocking vicious circles" that hold development back, and, in contrast, the "upward spirals" that can bring forth all the resources that are needed. The focus should therefore be not on the resources themselves but on the "essential dynamic and strategic aspects of the development process" (p 6). Hirschman adds however that many of these resources may be latent rather than immediately available. Development depends on mobilising and combining these purposefully, but also in a spirit of experimentation—trying out different makeshift adaptations and finding which ones will work.

It is this capacity—to mobilise and combine, to adapt and redeploy—that Hirschman therefore places at the centre of development strategy. It is inappropriate to embrace a strategy of "balanced growth," hoping to make simultaneous progress across all sectors. Instead, "if the economy is to be kept moving ahead, the task of development policy is to maintain tensions, disproportions and disequilibria," mobilising in force against particular critical points (p 66). We must moreover locate this within an appreciation of the exercise of social, economic, and political power within the society concerned. This in turn requires recognition of the alternative possible futures that development strategies may offer, the political choices and trade-offs involved and the key turning points.

Hirschman, to repeat, refers to the "interlocking vicious circles" that hold development back. This is reminiscent of the language of "wicked problems" (Rittel and Webber, 1973). Policy makers may want to disentangle the convoluted mess that history has produced. That is sometimes possible in a physical system—for example, a tangled skein of threads—but it is impossible to unscramble an omelette, however well one understands the processes by which it was produced. It is also rare in most social situations; in the real world no groundhog days are possible, re-setting the clock to zero. This is

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why parties to a historical conflict, if they are to make a new beginning, often need to reach for a shared account of the hurts entailed by their shared history—and the responsibility and wickedness it involved. Here the deployment of models of complex interactive change may well have a role, especially in making evident the interaction of many factors, in producing those injustices.

Hirschman also however refers to the "upward spirals" that can bring forth all the resources that are needed. These he places at the centre of attention for the development policy strategist. So also, alongside the wicked problems that the policy maker faces, there may be corresponding "smart solutions," whereby careful attention to the interrelationships of these problems, "upward spirals" of dynamic interdependence can be set in motion, through which these problems can be jointly addressed. This might in a physical system mean disentangling a skein of threads and then using them to weave a new garment. Nevertheless, wholesale disentangling is not always necessary or appropriate, even where it is possible. The tangles themselves may have produced combinations that can now be re-worked, with each other and with other resources, to create something novel and useful. This is why Hirschman expects development strategists to be sufficiently agile and imaginative, to break out from these tangled constraints and path dependencies, mobilising new micro-interactions among them, new disequilibria that confound pessimism and complacency. This requires recognition of the alternative possible futures that development strategies offer, the political choices and trade-offs that are involved and the key pivot points.

The more we conceive of the policy maker in Hirschman's terms, the more appropriate the earlier conceptual discussion of fitness landscapes in Sections 4 and 5 now appears. That discussion culminated in Kauffman's NK(C) model—applied not to co-evolving species, but to social actors seeking to re-work the system parameters within a complex timescape. The policy maker is constrained by the interlocking blockages that hinder progress but hopes from there to see what new combinations of capabilities—and what new institutional connections—will transform low fitness peaks into saddle points for fresh advance. Recall also the discussion of path dependency and the chains of the past, entangling us and blocking any forward movement. No less, recall our argument that path dependency is Janus-faced: so that nestling among those chains, innovators may be able to identify how—and when—a breakout into new lines of ascent may become possible.

The moments—the critical junctures—at which such turns can be made may be brief. This applies to many of the major interlocking policy problems that our complex societies face, including climate change and the COVID pandemic. Nevertheless, wait and watch for the mists to clear—the moment for decisive action may be there for the taking.

TOOLS FOR POLICYMAKING

Faced with such challenges, how are policy makers to navigate these complex land-timescapes? How are they to recognise critical junctures and tipping points, wicked problems, and smart solutions? How should they decide when to wait, when and where to act?

What analytical and practical tools can we, as social scientists, provide? How can we enhance the strategic imagination of the policy maker and the elucidation of alternative societal trajectories?

At the *analytical* level, the scholarship that has developed over recent years offers many models of complex systems that are applicable to the policy world: not only Kauffman's fitness landscapes, but others such as agent-based modelling and cellular automata, in the tradition of Schelling (1978) and Holland (1995) and evolving networks (Jain and Krishna, 2003). Policy researchers have applied these models to simulated and empirical datasets. They also engage actively with the policy world, expanding the range of "mental models" that policy actors can deploy, as they consider how their complex world may unfold[11].

The present article challenges all these writers on complexity—using their wide range of approaches, beyond that of fitness landscapes—to take much more seriously "the timing of space." It

[11] For example, CECAN at the University of Surrey: https://www.cecan.ac.uk/

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also however insists on embedding this within an appreciation of political economy and power, something that they often miss (Room, 2015). To exercise power is to expand one's own freedom of manoeuvre and to limit the times when others have the opportunity to choose which card to play. Power is the luxury of being free to decide when to act to maximum advantage, rather than being rushed by the throng.

At the *practical* level, the need is for "weak signals" of impending shifts in the policy landscape—critical junctures and pivot points, where the policy maker can act decisively. This is a search for tools of practical monitoring and navigation—maybe a whole dashboard, or at least some simple rules of thumb.

Scheffer argues that there are generic symptoms of complex adaptive systems that are approaching a "tipping point" (Scheffer, Bascompte et al., 2009). These include for example a slow-down in the recovery rate after small perturbations and increased variance in the pattern of fluctuations. Fisher (2011) looks for "weak signals" of impending change: surface signs of deeper dynamics that are underway. He begins with the natural world—toads migrating in response to earth tremors for example—but also climate change and biodiversity. Examples from the social world might include the reputation of a school falling and parents hastily switching their allegiance elsewhere (Room and Britton, 2006). In some developing countries, signs of impending distress include the eating of the seed corn for next year, or the age of marriage for daughters falling (Chambers, 1989, Bevan and Sseweya, 1995, Indra and Buchugnani, 1997, Carney, 1998, Moser, 1998). These signals are however all very context-specific.

These rules of thumb often refer to thresholds (Room, 2016: Ch 6.4). In relation to the COVID pandemic, thresholds include the R-value; in relation to climate change, rates of ocean warming[12]. These indicators are often embedded within a prognosis of the timescale within which action, if taken, can be expected to bring the disaster in question under control, or the sequence of consequences to be expected, if that timescale is missed (Werners, Pfenninger et al., 2013, Steffen, Rockström et al., 2018). Their selection is always however contestable, predicated as they are on our incomplete understanding of the complex dynamics in question.

Not that this is a language that is only for the potential disasters that face our societies. The policy landscape also encompasses the technology ecosystem. Here the literature in complexity economics, referred to earlier, is the basis for policy-related research into national and regional technological capabilities and global positional competition, and the indicators by reference to which policymakers can identify new and profitable niches, wherein they can re-position their regional and national economies (Pugliese and Tübke, 2019).

CONCLUSION

The article began by asking what analytical and practical tools the policy makers might use to navigate complex timescapes. How are they to recognise critical junctures and tipping points, wicked problems and smart solutions? How should they decide when to wait, when, and where to act? And not least, how is the social scientist to subject those decisions to stringent scrutiny?

These questions are not new. On the contrary, they have long been central to sociological debate—perhaps most obviously in Weber's lectures on science and politics as vocations at the end of WW1 (Gerth and Mills, 1948). Weber addressed himself to Germany's political leaders, facing a mass of tangled and wicked problems, amidst the ashes of Germany's defeat.

His task as a social scientist was not to compare alternative ways of tackling some specific policy problem or to produce an evidence-based assessment of an intervention. It was, instead, to identify the interlocking and complex problems that Germany face, to illuminate the available policy choices, to notice the "weak signals" of the societal shifts that were underway, and to foresee the

[12] https://www.theguardian.com/environment/2020/jan/13/ocean-temperatures-hit-record-high-as-rate-of-heating-accelerates

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shifting coalitions of interests that these would likely produce. This remains the fundamental task of the social scientist, in relation to the policy world.

The task of the policy maker—at least in more or less democratic societies—is to interpret the world but also to change it and to provide a justificatory account as to the journey and the destination, a justificatory account that the social scientist will then however expose to stringent scrutiny. The conceptual framework elaborated in this paper is to be judged, not least, by the extent to which it helps to sharpen that scrutiny.

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