

Working within a complexity frame of reference – the potential of ‘integrated methods’ for understanding transformation in complex social systems

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‘The complexity frame of reference’ is an appropriate term to use in describing the way in which across science¹ as a whole there has been a turn towards attempting to understand complex systems with complex systems defined thus:

‘... a simple system is one to which a notion of state can be assigned once and for all, or more generally, one in which Aristotelian causal categories can be independently segregated from one another. Any system for which such a description cannot be provided I will call complex. Thus, in a complex system, the causal categories become intertwined in such a way that no dualistic language of state plus dynamic laws can completely describe it. Complex systems must then process mathematical images different from, and irreducible to, the generalized dynamic systems which have been considered universal.’ (Rosen 1987 324)

The essential characteristics of complex systems are first that they have emergent properties, that is to say that the character of the system cannot be determined by an analytical specification of the properties of the components of the system, and second, that significant change in such systems is qualitative rather than incremental. Significant change takes the form of ‘phase shifts’, that is to say radical changes in kind rather than marginal changes of degree. We can identify changes as they have occurred in the past through the examination of the paths through time of complex systems – their trajectories. Significant changes involve radical transformations of the position of a system in its possible state space – in brutal summary we see radical relocation within the range of possible conditions which that system can occupy. It is very important to note that whilst there are multiple possible positions for a system, for complex systems the number of positions is limited and may whilst being plural also be small.

In social systems we have also to take account of the reflexive agency of the human actors in the system. In other word people can understand their world and act on the basis of that

¹ With science understood here as by the Gulbenkian Commission on Restructuring the Social Sciences (1996) as the construction useful empirical knowledge about reality, rather than in terms of a set of specific research practices constituting ‘the scientific method.’

understanding in order to change it. There are a number of texts which have developed these ideas in a general sense in relation to the theoretical foundations of social science. These include Byrne 1998, Kiel and Elliott 1996, Khalil and Boulding 1996, and Smith and Jenks 2006. Much recent work has been influenced by the philosophical approach to complexity suggested by Cilliers 1998. Here it is important to recognize that we can recognize two approaches to the scientific understanding of complexity. These have been specified by Morin 2006 in terms of 'restricted complexity' which admits the reality of complexity but always seeks to derive it from rule based interactions among simple components of a system, and 'general complexity' which permits both whole system emergence which is not reducible to component interactions and recognizes the distinctive significance of human agency in the future of social systems and all the intersections of social systems with natural ecologies. What follows is written absolutely in relation to the programme of general complexity.

The programme has not confined itself to debates in social theory but has developed a methodological framework for actual empirical investigation and intervention. Of particular significance here have been the simultaneous integration of complexity informed approaches with critical realist perspectives, especially in relation to formal evaluation, and the endorsement by researchers working with these approaches of the value of multi-method empirical work. The implications of these developments have included a rejection of any notion of a hierarchy of methods in the description of social reality, a commitment to multiple qualitative and quantitative descriptions of complex systems as they are, and an engagement through action research with active processes of change in complex systems. It is important to note that these approaches have not been confined to the social sciences but have also been important at the interface of the bio-physical and / or ecological, and the social. Two excellent examples of this are provided by Lemon (ed) (1999) and Gerrits (2008) dealing respectively with water management and agriculture in the Argolid plain in Greece and with the management of the estuaries of the Unterelbe and Westerschelde serving the ports of Hamburg and Antwerp. Blackman (2006) provides an example of a review using this multi method complexity informed framework, of the inter-relationships among neighbourhood change, policy interventions informed by performance indicators, and the emergence of states of health. Byrne (2002) has developed an approach to the general deployment of quantitative methods in the social world which is founded on a complexity framed understanding of the complex systems which are objects which we measure and of the causal processes which lie behind stasis and change in the state of those systems.

In the critical realist / complexity interface an interesting and important set of examples are provided in Carter and New (eds) (2004) with contributions by Pawson and Williamson and Dyer addressing exactly the issue of 'what works' in relation to complex interventions in complex social systems. Byrne (2005) has developed these arguments with specific reference to clinical governance in relation to evidence based health care practices. Complexity approaches to evidence construction are now common and are represented in numerous articles in relevant journals for example: Stevens et al. 2008, Cooper and Geyer 2008, Haynes 2008, Noteboom 2005, Doak et al. 2007.

A particularly fruitful mode of addressing complex systems which is based on the combination of qualitative and quantitative modes of investigation is systematic case comparison, particularly using Ragin's (1987) Qualitative Comparative Analysis (QCA) tools. The comparative method and the case study are both key tools of any social investigation. Essentially both are concerned with the establishment of cause. The single case study works in ideographic mode. It explores the whole history of the case, which we can consider as a discrete complex system which is nonetheless embedded in and intersected with other systems in its environment. Causes of present state of the system are explored through the presentation of a narrative in which they are identified but understood as generally acting in a complex and multiple fashion. The typical mode of representation of the specific case study is the historical narrative. The comparative method attempts to understand cause by looking at multiple cases and often at all the cases which exist, for example in macro-social considerations of the trajectories of nation states. The key technique is usually the identification of differences in terms of the historical trajectories. Traditionally this was done in terms of developed multiple narratives as texts but QCA offers an alternative which usually moves from detailed qualitative understanding of cases, through the specification of measured attributes² of those cases, into the establishment of multiple and complex causes for the present state of those cases.

Typically QCA is a small to medium N method although it can also be deployed (see Byrne and Ragin 2009) with very large number of cases. Often, indeed more often than not, it works with all the cases in the population of interest rather than with samples drawn from populations.³ Conventionally the method starts with a very careful and detailed engagement with all of the cases in order to establish a qualitative understanding of what attributes seem to be interesting in relation to the cases and generates a quantitative description of all of the cases in terms of those attributes. However, it is possible to start with a large quantitative data set describing all the cases and construct attributes from that data set. Of course the two approaches can be combined if both sorts of material are available. The method is most straightforward when attributes can be regarded as dichotomous, that is as either present or absent, but it has been extended to multiple categorical values and to fuzzy representations of the degree of possession of an attribute. From the attributes we then construct a truth table consisting of a series of configurations. Each configuration in a binary or dichotomous set indicates a possible combination of the presence or absence of the attributes we consider to be important set in relation to an outcome. For example Blackman and Wistow are presently working on a data set describing Spearhead (i.e. deprived locality) Local Strategic Partnerships in England in relation to the ability of the LSPs to narrow the gap i.e. reduce the health inequality, between their locality and the English mean values in relation to cancer deaths, deaths from coronary heart

² It is necessary to emphasize that the terms attribute and variable are not synonymous. Attributes are certainly characteristics of cases which vary and can be measured but they are not 'variable forces' which exist external to the cases under consideration. It is for this reason that Byrne (2002) has proposed the use of the term variate traces.

³ Conventional statisticians often seem not to notice that we have all the cases in a data set as we often do have when we have data about institutions or agencies. They apply methods of statistical inference when they are wholly inappropriate. If we have all the cases we do not need probabilistic estimates derived from samples!

disease, and teenage conceptions. Here the dichotomous outcome variable is whether or not the gap is narrowing for that LSP over a three year period.

It is very important to note that QCA allows for complex causes. Outcomes are not the product of single causes but of multiple causes in interaction and in context. This accords with Pawson and Tilley's realist understanding of cause (1997) in terms of mechanism and context in interaction. Each configuration is a combination of mechanism and context. Equally QCA recognizes that causes may be multiple – different combinations may generate the same outcome. In other words causes may be necessary or sufficient but are not often both necessary and sufficient. This is not to say that specific interventions may not make a difference but that difference has to be located in context. Byrne (in Byrne and Ragin eds 2009) has identified that an intensive mentoring policy can improve overall educational performance in a specific kind of state secondary school in the North East of England i.e. schools with a high proportion of poor children and children with special needs. Likewise Blackman and Wistow are finding that smoking intervention policies in particular kinds of deprived localities are having a positive effect on narrowing the coronary heart disease death rate in those localities. We cannot establish universal laws applicable always and everywhere but we can find what works in particular sorts of places or institutions and transfer this understanding to other places or institutions of the same kind. This of course reflects the reality of path dependency in any social causation. The approach has been applied in development contexts by Olsen (in Byrne and Ragin eds 2009).

The value of a complexity frame of reference for action research was suggested by Byrne (1998) and has been developed by Burns who remarks:

Systematic action research opens up the possibility of strategy development that can meaningfully engage with the complexities of the real world. In this respect it is a challenge to the rolling out of 'best practice', to 'strategic planning', and to the models of linear causation that dominate our organizational and political landscape. These consistently fail because they are based on an assumption that intervention outcomes are relatively straightforward to predict if only we can get enough of the right sort of evidence. (2007 1)

It is important to note that this is not a dismissal of evidence. On the contrary Burns argues cogently for the deployment of evidence in relation to context, an approach which corresponds precisely with realist conceptions of causation. Moreover, his emphasis on action recognizes that social contexts are not passive and unchanging. Rather they are transformed interactively by intervention. The importance of the term interaction here is considerable. In this sense it means that interventions interact with the agency of those in the social context where the intervention is applied. We can use systematic case comparison, typified by QCA, to establish what might work in a context – a meaningful and necessarily limited mode of the transfer of best practice – but that intervention will always acquire a new and shifting context through the combined agency of those who deliver it and those to whom it is delivered.

This of course, as Burns asserts, means that effective action research is always participatory and dialogical. These terms derive from the work of Freire and dialogical /participatory research is necessary because any social intervention involves the mutual creation of a new social reality, a new state of the relevant complex systems, by all who are engaged in any way with it. It is worth noting that in ongoing work in Primary Care Medicine at the University of Warwick, Griffiths and her colleagues (2006) have shown that this applies not only in relation to communal interventions involving large numbers of participants, but it is also relevant even at the level of the interaction between physician and patient in relation to the trajectory of the patient through the course of chronic and multiple conditions.

To conclude, the complexity frame of reference provides the basis for a research programme which is able to combine quantitative and qualitative data without privileging either mode of representation of reality, to establish through systematic case comparison guidelines for the complex and multiple ways in which interventions might achieve desired outcomes in a way which fits interventions to the different kinds of contexts in which they might be applied, and recognizes not only the inevitability but the absolute necessity of social engagement and transformation in the context of any research dealing with complex social systems. It is worth noting here that Cilliers has remarked that the only investigation of complex social systems which can be regarded as ethically appropriate and morally justifiable is research in which the researchers are embedded within the systems they are investigation and seeking to change. That is to say the complexity frame of reference provides a basis for meaningful praxis as a necessary component of research. It is also appropriate to remark that as Burns notes we have a long record of massive failure in relation to social research practices which have failed to recognize the implications of the complex nature of social systems. So complexity framed action research not only can tell us what works, we can say with some authority that it is the only way in which we can find out what works.

References

- Blackman, T. 2006 *Placing Health* Bristol: Policy Press
- Burns, D. 2007 *Systematic Action Research* Bristol: Policy Press
- Byrne, D.S. 1998 *Complexity Theory and the Social Sciences* London: Routledge
- Byrne D.S. 2002 *Interpreting Quantitative Data* London: Sage
- Byrne D.S. 'Evidence based? What constitutes valid evidence?' - in *Governing Medicine* edited by A. Gray and S. Harrison for Open University Press 2005
- Byrne D.S. and Ragin C. (eds) 2009 *Handbook of Case Based Methods* London: Sage
- Carter, R. and New, C. 2002 *Making Realism Work* London: Routledge
- Cilliers, P. 1998 *Complexity and Postmodernism* London: Routledge

- Cooper, H. and Geyer, R. 2008 'Using Complexity for improving educational research in Health Care' *Social Science and Medicine* 67 1 177-82
- Doak, J. and Karadimitriou, N. '(Re)development, complexity and networks: A framework for Research' *Urban Studies* 44 2 209-229
- Gerrits, L. 2008 *The gentle art of Coevolution* Rotterdam: Erasmus University
- Griffiths, F., Green, E., and Bendelow, G. 2006 'Health professionals, their medical interventions and uncertainty' *Social Science and Medicine* 62 5 1078-1090
- Gulbenkian Commission 1996 *Open the Social Sciences*, Stanford CA: Stanford University Press
- Haynes, P. 2008 'Complexity theory and evaluation in public management - A qualitative systems approach' *Public Management Review* 10 3 401-419
- Kiel, L.D. and Elliott, E. (eds) 1996 *Chaos Theory in the Social Sciences*, Ann Arbor: Univ. of Michigan Press
- Khalil, E.L., and Boulding, K.E. (eds) 1996 *Evolution, Order and Complexity* London: Routledge
- Lemon, M. (ed) 1999 *Exploring Environmental Change Using an Integrative Method* Amsterdam: Gordon and Breach
- Maurin, E. 2006 'Restricted Complexity, General Complexity' at: <http://cogprints.org/5217/1/Morin.pdf>
- Noteboom, S. 2007 'Impact assessment procedures for sustainable development: a complexity theory approach' *Environmental Impact Assessment Review* 27 7 645-665
- Pawson, R. and Tilley, N. 1997 *Realistic Evaluation* London: Sage
- Ragin, C.C. 1987 *The Comparative Method: Moving beyond Qualitative and Quantitative Strategies* Berkeley CA: University of California Press
- Rosen, R. 1987 'Some epistemological issues in Physics and Biology' in Hiley, B.J. and Peat, D. (eds) *Quantum Implications* London: Routledge and Kegan Paul
- Smith, J. and Jenks, C. 2006 *Qualitative Complexity* London: Routledge
- Stevens, I. and Cox, P. 2007 'Complexity Theory: Developing New Understandings of Child Protection in Field Settings and in Residential Child Care' *British Jnl of Social Work* 38 7 1320-1336