

Quantification and realist methodologies

Wendy Dyer & Malcolm Williams

To cite this article: Dyer, W. & Williams, M. (2021) Quantification and realist methodologies, *International Journal of Social Research Methodology*, Vol.24(1), pp.109-121, DOI:10.1080/13645579.2020.1803527

To link to this article: <https://doi.org/10.1080/13645579.2020.1803527>

Abstract

The use of quantitative methods within realist methodologies are fairly rare. This is perhaps because a realist understanding of the social world as complex and dynamic (messy but not chaotic) does not sit well with traditional variable based causal analysis which test specific theoretical assumptions, yet cannot account for interaction, moderation and emergence. In this paper we explore the ontological challenges and epistemological issues which underpin the development of our complex realist approach to quantitative data analysis. We provide an example of its application to a large case-based time-ordered dataset and the resultant discovery of the deep patterns that underlie what happened to similar and different mentally disordered offenders as a consequence of the implementation of a new policy of custody diversion.

Introduction

The methodological problem of realism is that of empirical closure. At the broadest of levels, realists can make a convincing case for the existence of complex mechanisms, multi-dimensional arrays of social configurations that can be shown to have historical or macro-level effects. At a micro level realists are good at uncovering meanings and meaningful actions that provide insights into deeper and broader social realities. These are worthwhile enterprises, but essentially they are *qualitative* in nature. This divides much of social science realism from two natural allies¹: realists working in the natural sciences and non-realists or (what we will term) unreflective realists in social science.

The aim of this paper is to demonstrate how realists can use quantitative methods to achieve empirical closure. This is not intended to be the only or exclusive quantitative empirical programme for realists, mainly because it must fulfil certain data requirements, but we contend that in many respects, it could eventually become a conceptual platform for realist empirical research. Furthermore, this way of analysing and thinking about data need not be just for realists, though one might say that doing things this way makes you a realist!

This is how we will proceed. In the first half of the paper we will set out what we think the problems of quantitative closure are how closure is supposedly achieved in more traditional empiricist approaches and why they are inadequate, but not irrelevant.

We will then focus on what it is we are up against as social researchers, when we attempt to provide descriptions and explanations of a ‘messy’ social reality, where relative stability is created and maintained, but also disrupted by attempts to bring about change or resist change and the introduction of new processes that bring about unexpected outcomes.

In the second half of the paper we will show how a large case-based time-ordered quantitative dataset can help us search for patterns or similarities while at the same time acknowledging the existence of difference, between cases or groups. What makes this approach different to more ‘traditional’ empiricist analyses, is that we begin with the case, not the variable and follow their trajectories through time, in order to identify mechanisms, often the hidden or deep patterns underlying perceived social reality. It is at this individual level that choices, actions and constraints are manifest and it is at this level, observed through time, that feedback loops, disruption, change and invariance can be observed.

Before proceeding with our task, it is worth saying why any of this matters. The answer is both methodological and political. Methodologically the kind of broad, yet detailed, view of historic change (of the kind proposed by Byrne and Callaghan 2009) is a necessary approach for methodological realism, but it is not fine grained enough to demonstrate specific, more contemporary, change or stability in specific policy areas. For example, we may propose a credible mechanism that explains why improved IT skills, in the past twenty years, have not raised wage levels (Lauder et al 2019), but the mechanism is no more than a theorised black box, unless we can open that box and measure its contents. Conversely methodological interpretive investigation at a micro level can provide valuable clues, that may generate mechanistic hypotheses, but there is no measurement of prevalence or trajectory. There is a political need for the policy maker, in local or national government, public agencies or the third sector to know and put a number to prevalence and trajectory. Longer term changes in policy (say) on mentally disordered offenders and the historic macro level consequences of such policy or, the individual experience of particular offenders are useful background, but the identification of particular patterns and trajectories is what the policy makers want and are more likely to fund. Realism needs quantitative methods to be relevant, but equally we believe quantitative methods are enriched by realism.

Quantitative Closure

What do we mean by empirical closure, or more specifically quantitative closure? Everyone beginning philosophy learns about David Hume’s billiards and scepticism. One billiard ball hits another and the second one moves. Hume and the empiricists said that our assumption that the first ball made the second move, is a function of our psychology and thus our expectations (Hume 1911: 76). A scientific realist, had they been around then, would have said – inference to the best explanation (Lipton 1991), the first ball hitting the second was the most *likely* cause of it moving and indeed this, as Hume acknowledges, is precisely what we do. Such an everyday common sense

assumption and inference work at a micro and observable level, but at a macro level, the association of two (or more) variables does not necessarily indicate a causal relationship, or if it did, the direction of the cause. And this characteristic, for most quantitative social scientists, is canonical.

Yet the desire to find causes has always come to the fore. Lazarsfeld's associationism and Dodd's 'pan sample' (Platt 1996: 86) never assuaged the craving. What developed came to be called 'causal analysis' and depended on the multiple association of variables in a statistical model. This approach copied the logic of the experiment, where through manipulation the experimenter can isolate the effects of particular independent variables upon the dependent variable. Of course, even in the best run laboratory experiment, there are violations of assumptions, where extraneous effects change the results, but because – at least in the physical world - there is an ultimate grounding in natural necessity, it is usually possible to establish necessary and sufficient conditions (Williams 2011). Observational data in the social world enjoys no such stability and moreover associations and causal conclusions are probabilistic. The most sophisticated variant of this approach is in the analysis of large sample datasets, through causal analysis. In causal analysis usually linear regression models are constructed to show the cause of an outcome by 'explaining' as much of the statistical variance in the model by fitting the independent variables to the model to give the best 'fit'. See for example Asher 1983, Freedman 2007, Rubin, D and Imbens 2015) In such models some variables will be strongly associated, others less so and some possibly not at all (or negatively associated). This is, admittedly, a simplified description and causal models will incorporate other sophisticated methodological devices, such as path analysis, the theorisation of latent variables, random assignment, bootstrapping etc. However, David Freedman (2011), amongst others has been sceptical as to whether such technical advances in modelling methods have successfully closed in on causes. See also Byrne 2002 and Porpora 2008.

The methodological problems might be briefly summarised:

Firstly the approach is successionist, or atomistic. The successionist view is that we cannot directly observe causes, but only the sequence of events. Variables are simply measurements, with no assumed relationship to each other, just a succession of local matters, just one thing after another (Lewis 1986 ix –x). The association between variables is only statistical and never substantive, so a cause becomes that of multiple association, where the additional of variables into a model reduces variance and produces a probabilistic estimate of likely cause.

But here's the rub. For all the sophistication of the models, the causal analyst must interpret the results and indeed design the research in the light of some theoretical assumptions. As Hubert Blalock, one of the pioneers of causal analysis put it, in 1961:

One *thinks* in terms of a theoretical language that contains notions such as causes, forces, systems and properties. But one's *tests* are made in terms of covariations, operations and pointer readings'

Blalock 1961: 5 (emphasis in original)

You can't escape theory! The problem is that, for the causal analyst, theory is little more than the interpretation of the action of one variable upon another, perhaps in the context of several other variables. As Freedman (2007: 152) notes, there is a circularity, that the variables and their relationship are theorised beforehand and the subsequent model measures that relationship. Now it is not the logic of this thinking that realists might object to (at some point variables must be defined) but the poverty of its imagination. We shall return to this.

The second problem is that of 'naive realism', the belief that there is a direct relationship between reality and that which can be operationalised as variables and then measured. One may measure ethnicity, but the decision to do so will be driven by a view that it is in some way important to subsequent explanation. Then, having decided to measure ethnicity, one must operationalise the variable. What is measured is not a thing in nature, but rather a theorisation of what that nature *is*. For example, one might say that in a given location only 5% of the population are from ethnic minorities, but this will depend on what counts as an ethnic minority in the derivation of the indicator (and indeed the subjective response from the respondent (Williams 2003)). In this particular instance, analyses of large datasets are often replete with assumptions that ethnicity has been captured by a handful of categories, measured across diverse populations and that once measured as an individual attribute it remains thus, like blue eyes or size 38 feet! Longitudinal data demonstrates this to be a myth (Platt et al 2005). People 'change' their ethnic identification over time. For the researcher it can be an objective, reliable indicator, but for its bearer it is a subjective and intersubjective cultural category.

The third problem is the assumption of linear relationships between variables, that a change in one variable or variables, produces changes in other variables, which can be described by a linear equation (or equations). Information about one or more independent variables is used to predict the 'variability' of a dependent variable(s). But, aside from the issue of operationalisation, the relationship between 'variables' in the actual social world is far from linear and nearly always mediated by other 'variables' (Byrne 2002: 70).

Finally, the analyses are variable and not case based. What happens to people, or their attributes, may follow patterns, may even be path dependent, but the variables are inevitably idealisations (Williams 1999), whereas the 'cases', particularly if they are individual agents, are real

All of these criticisms of empiricist quantitative analysis and particularly causal analysis, are prerequisites to showing how realism might do it better. But in our haste

to assert our own superior thinking about method, we should consider some inescapable facts that realists cannot avoid.

The way we theorise the world inevitably requires measurement to test such theories, however imaginative they are. We cannot avoid variables – even if we begin from cases, because the variables represent the attributes, behaviour and attitudes that we theorise belong to the cases. Realists might do it better (one of us, for example, has suggested how this might be done with ethnicity (Williams and Husk 2013), but we have to do it.

Some form of aggregation is necessary, because although we can theorise the complexity of the social world, we have to ‘capture’ that complexity. Arguably, it is only in aggregation we can see how the individual creates the social and vice versa (Goldthorpe 2016).

It follows from this that some kind of ‘sorting’ is required, where we say that some Xs are Ys and some are Zs and how transformation or stability is represented in our sorting.

It is the felicity to these facts or principles, that emerged from empiricism its purity perhaps compromised by yielding to inevitability of theory, that produces ‘empirical closure’ in causal analysis, however unsatisfactory this is to realists (Porpora 2008). Can realism improve on this closure, through a different methodological approach and different assumptions about reasoning from data?

We might say that the aim of realist method is to capture real complexity, but with precision. Or as they said in in the Laundry Files ‘help visualise dizzying multidimensional arrays of data without oversimplifying it into uselessness.’ (Stross, 2014, p.35)

The Messiness of the Social World and the difficulties of empirical closure

Realists in physics and chemistry have an easier time of it, at least in respect of empirical evidence that can support or refute a theory. Indeed, something like Hempel’s covering law model. In this the *explanandum* is deduced from a set of true statements, the *explanans*, of which at least one should be a law. Thus, the rate of cooling of an object can be deduced from the known properties of that object, but in relation to the second law of thermodynamics. This model works very well in the relatively simple instances where reference can be made to fundamental physical laws. Many philosophers of science have challenged this somewhat simplistic schema and some, such as Nancy Cartwright (Cartwright 1983) have questioned the veracity of the laws of physics. Others, such as Roy Bhaskar, have questioned the artificiality of experimental intervention (Bhaskar 2008). Nevertheless, the ability of experimenters to isolate, manipulate and control a relatively small number of variables is a form of closure that can demonstrate real effects. As Ian Hacking confessed, he

became a realist when he saw that experimenters could 'spray' electrons. If you can spray it its real, sums up his conversion (Hacking 1983: 22).

We don't have anything like that. Biologists, on reading this, might complain they don't either and would plead complexity. Indeed, and rightly so, but in the social world our complexity is compounded by the intentional nature of agent beliefs, desires and actions, that are subject to multiple feedback mechanisms.

Ray Pawson (2006:18) in his critique of evidence based policy sums up the dilemma. The social world is an open system composed of endless components and forces. When social science focuses on what seems like uniform patterns of behaviour, the historical forces that shape them produce different manifestations in different cultures. Institutional forces produce different behaviour patterns under different organisational arrangements and on top of this patterns are changed by the volitions and choices of individuals themselves. The following serves as an example of this 'messiness'.

During the 1990s responding to reports about the prevalence of psychiatric disorder in sentenced and remand prison populations and concerns that this proportion may be increasing (within a context of asylum closure, criminalisation of mental illness, and a transcarceral approach to social control, Lowman, Menzies and Palys, 1987) the Government proposed that 'mentally disordered offenders' should receive care and treatment from health and social services rather than in custodial care (The Department of Health and Home Office, 1991: Community Group para. 2.1).

The solution appeared simple: too many people with mental illness in prison... then divert them away from the justice to the health system (i.e. 'transcarcerate' them back to hospital from prison). A number of 'Custody Diversion Teams' were established whose job it was to identify mentally disordered offenders and divert them at the earliest opportunity. However, in practice, the aims of the policy of diversion evolved over time and what outcomes could or should be expected soon became uncertain. For example, one Custody Diversion Team in the North East of England adopted a broad definition of 'mentally disordered offenders' and offered a wide-ranging service from police arrest to court sentence. This meant that referrals did not necessarily fit neatly with a diversion policy whose aim was to divert individuals away from the criminal justice system and custody, and into the health system and psychiatric hospital. Many of those referred did not have a severe mental disorder – a significant proportion were 'misusing drugs and/or alcohol' or had a more vague 'mental health problem' – and did not require admission to hospital. Despite the fact that many were committing significant offences (violence against the person, burglary, and theft), many were not at risk of a custodial sentence. A discontinuation of criminal proceedings was also not appropriate for most, being neither ill enough and committing fairly serious offences. In other words, there was not one type of person referred to the team but instead many different types of people with different psychiatric and criminal histories. There was no one single aim but instead many different aims including diverting people to health and social care whilst criminal

charges were processed. There was not only one type of outcome but instead many variations on outcomes, including admission to hospital and for some a prison sentence. The difficulty in capturing this complexity with variable based models can be readily appreciated.

Nevertheless as Pawson observes (2006:18-19) the main response, from social science, has been to ignore the kind of messiness of context, as in the above example, and attempt interventions, as if they operated in a closed system. Pawson (as in our example above) is talking about interventions and the basis of evidence of their efficacy, or otherwise. But the same logic applies methodologically in more 'traditional' quantitative methods. Whilst few defend the existence of social laws, the logic of analysis is that a dependent variable can come to stand in for a complex set of attributes, beliefs and actions and the independent variables, themselves often operationalised from multifaceted characteristics can demonstrate change or stability.

Now, this is not to suggest they demonstrate nothing. Some relatively simple analyses can be very powerful, but mostly these are descriptive, for example those that show occupational mobility over time (Goldthorpe 2016), but such analyses cannot tell us why, or anything about the context.

The methodological approach we are advocating, in what follows, is that of *Complex Realism* (Williams and Dyer 2017). In short, this approach begins from the the assumption that the reality of the social world is that it is ontologically complex. What follows from that, for us, is that whilst the social world might possess conceptual necessity, that is things are what they are by virtue of their dispositional social properties, there is no natural necessity – that is things could be otherwise under different social arrangements (Williams 2011). It further follows that the social world's relative stability and change is probabilistic, with some things very much more likely than others and furthermore these likelihoods change as a result of the realisation of actions or events. These actions or events can be thought of as bifurcations, where A or B will happen and in turn, this changes the future probability of C or D occurring.

A complex realist methodology, unlike an empiricist one, is more than manipulation and a literal interpretation of the ontological characteristics of variables. It requires more – it requires lateral thinking that takes us beyond 'the data' and may even draw on trans-disciplinary imaginations, though in this paper we only touch upon these.

Beginning with the 'case': complexity and application of a method

The following is an illustration of how empirical research can begin to capture the complexity of social reality in one particular policy context. The North East Custody Diversion Team, described earlier and in partnership with one of us (Dyer, 2001), developed a time-ordered, case-based relational database which was designed to capture the complexity of the intervention they were providing: different mentally disordered offenders, different decisions made, and different outcomes experienced. Over 30 months the dataset recorded 1011 cases referred 1305 times (20% of people

were re-referred to the team two or more times and two thirds of these had allegedly committed another criminal offence) and described using a minimum of 138 variables measuring three time points: history (including psychiatric and criminal history); current (including sociodemographic details, mental health diagnosis and criminal offence, decisions and actions taken by the Custody Diversion Team, and health and social care needs identified); and outcomes (including health and justice outcomes, and re-referral to the custody diversion team).

Mentally disordered offenders, the custody diversion intervention they received, and the outcomes they experienced were not all the same. As Peay (1994) argued, “mentally disordered offenders...are not a single, easily identifiable group” (p.1120). In order to make sense of this we need to understand the complex ways in which these cases were channelled through particular trajectories – or patterns that emerge over time. In other words, to find patterns in the data and explain them. The aim was to relate original differences in the mentally disordered offenders referred to the Custody Diversion Team to differences in outcomes as mediated through differences in the way they were processed, contained or regularised.

It was clear that the approach offered by the general linear model (would be inadequate because it is unable to deal with the concept of complex ‘interaction’ (between the people referred to and the decisions and processes undertaken by the custody diversion team, leading to different outcomes, over time and within wider social, political and economic contexts) in any meaningful way². Any turn to a reductionist analysis would be imposing a linearity and order that did not exist. The search for such linearly founded laws is the search for predictive ability. As Byrne (1998) argues:

If we can establish the relationships so that our formalised linear mathematical models are indeed isomorphic with the real world...then we can predict what will happen in a given set of circumstances...Once we can predict, we can engineer the world and make it work in the ways we want it to....the trouble is that much, and probably most, of the world doesn't work in this way

Byrne 1998: 19

and it doesn't work this way because of the effects of interaction. Interaction, as it is referred to here, is what happens when superposition or the summation of the effects of individual variables breaks down. Complexity theory, which has developed from accounts of chaos theory, deals with such non-linear relations and changes that do not fit into a simple linear law (Gleick, 1988; Byrne, 2002; Byrne and Callaghan, 2013; Gentili, 2018). Along with the ideas of interaction and emergence, complexity theory provides an account of movement from one state to another through a process of bifurcation, divergence or change, which is dependent on or moderated by key changes in the magnitude of underlying causal variables. The process of bifurcation implies neither simple linear determination (constant conjunction where if A happens

then B happens), or random process where anything can happen. Instead what is implied is complex change, so that starting with A, in the first bifurcation if B or D happens then C or E happens depending upon initial variations in the form of A (as in a Markov chain).

An initial exploration of the custody diversion team database indicated trajectories would be complex, based on the number of cases involved and the number of potential combinations of cases, custody diversion intervention, and outcomes (1011 individual cases x 138 variables x three time points). In order to overcome feelings of being overwhelmed by the amount of data ('drowning in data' – or as expressed in the Laundry Files, "drinking from the data firehose" Stross, 2014, p.34), interaction and emergence, it is useful to take a step back and visualise the existence of various potential complex mentally disordered offender trajectories in the 'minds-eye' using two helpful concepts that originated in the natural sciences and mathematics, Chaos and Complexity theories. Phase space or possibility-space is an imaginary multi-dimensional space within which all of the possible states in which a system (mentally disordered offender trajectories) might exist in theoretical terms. It was the French mathematician Henri Poincaré who invented a way for the human brain to 'see' or imagine dynamics in the mind's-eye. As Cohen and Stewart (1994) argue it is enormously useful to represent dynamic concepts visually:

"The geometry of dynamical systems takes place in a mental space, known as phase space. It's very different from ordinary physical space. Phase space contains not just what happens but what might happen under different circumstances. It's the space of the possible." (p.200)

Within possibility-space information can be turned into pictures making a flexible map or trajectory(s) of all of the data available. The patterns which emerge are known as Strange Attractors or possibility-space portraits – "*nature constrained, disorder channelled into a pattern with a common underlying theme, stability*" (Gleick, 1988). The strange attractor (first discussed by David Ruelle and Floris Takens in a paper they published in 1971 entitled 'On the Nature of Turbulence') abstracts every bit of essential information from a system of moving parts and makes a flexible road map to all its possibilities. The state of the system is defined in terms of a set of n co-ordinates in n dimensional space when we have n parameters. In other words what information is required at each time point form the axes of a multi-dimensional plane within which the state of case can be plotted. Every piece of information or variable needs another dimension in possibility-space, in order to plot the state of the system at that point in time, for example two variables would be need two dimensions with horizontal and vertical (X-Y) axes, three variables X-Y-Z axes, and so on (Gleick, 2011). The most complex systems have many independent variables needing spaces of four, five or more dimensions. Here the 1011 mentally disordered offenders are the cases which can be plotted over three time points: history (64 dimensions), current (50 dimensions), and outcome (24 dimensions), using a minimum total of 138 data points.

The possibility-space portraits or mentally disordered offender trajectories can be charted by mapping the moving point through possibility-space over time – where ‘time’ indicates single important instances which then moves and changes to the next important point, e.g. the mentally disordered offender’s histories move to the current state at referral to the custody diversion team. Making pictures of strange attractors is not easy:

The points wander so randomly, the pattern appears so ethereally, that it is hard to remember that the shape is an attractor. It is not just any trajectory of a dynamical system. It is the trajectory towards which all other trajectories converge. Gleick, 1988: 150

In other words, the search for strange attractors is the search for patterns which are shared by a number of cases. Imagining the potential mentally disordered offender possibility-space portraits is the search for common trajectories, threads through the data which suggest pathways which are ‘walked’ by a number of cases. It reduces the unmanageable 1011 individual portraits down to a manageable number without losing any of the detail (more than one but less than too many to cope with).

These multi-dimensional attractors can then be turned into flat pictures (return maps or Poincaré maps) by taking slices or samples from the portraits at each important interval. The most informative interval in our imaginary mentally disordered offender’s possibility-space portraits corresponded to the three time-ordered states of the custody diversion system available to us in the case-based dataset (history, current, and outcome). Figure 1, later in this paper, is our (clumsy) attempt to demonstrate our ‘minds-eye’ visualisation of mentally disordered offenders possibility-space portraits or trajectories as they emerged over-time in multi-dimensional space and the three Poincaré sections we used to plot these. It is not easy, or some have argued ‘possible’, to represent multi-dimensional space on a 2-dimensional page – but we hope you can close your eyes, use your imagination, and get the idea!

From Theory to Method

The question now becomes one of applied method or technique, how to uncover the pictures of these trajectories. The technique of cluster analysis, we argue, fulfils the concepts and practices outlined above. Essentially the procedure is used to classify a set of cases into a number of relatively homogenous subsets in which the members of these subsets are more like each other than they are like the members of other subsets. Cluster analysis allows us to use all of the information we have available about all of the mentally disordered offenders referred to the Custody Diversion Team in order to chart a trajectory for each case and then identify trajectory typologies or patterns from within all cases from one stage or time-point to the next, without requiring any prior knowledge of cluster characteristics or even of how many clusters would emerge.

All the real knowledge which we possess, depends on methods by which we distinguish the similar from the dissimilar. The greater number of natural distinctions this method comprehends the clearer becomes our idea of things. The more numerous the objects which employ our attention the more difficult it becomes to form such a method and the more necessary.

Linnaeus, 18th century Swedish botanist, in his publication 'Genera Plantarum', 1737) cited in Everitt, 1974:2

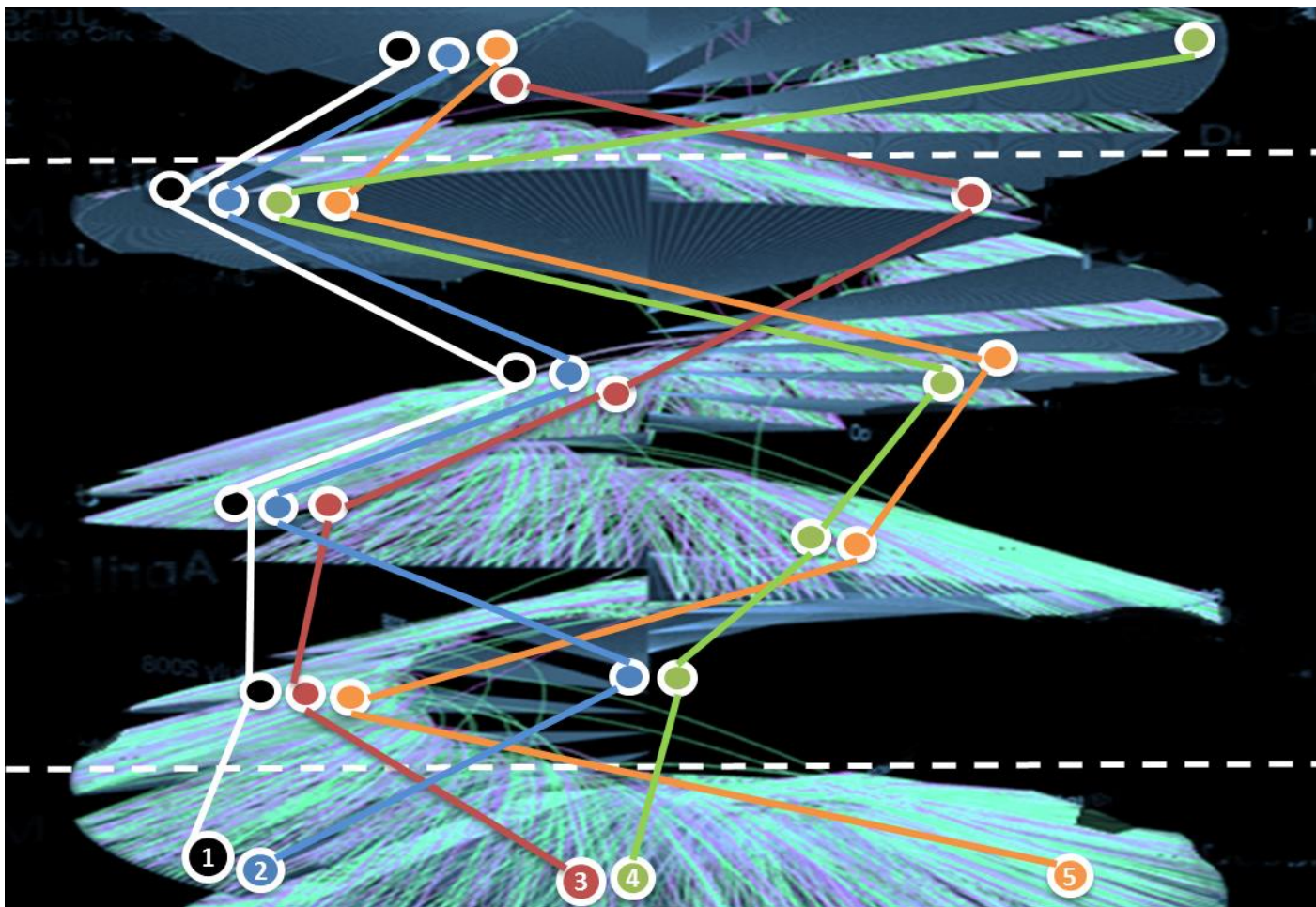
While clustering methods were not developed with the strict intent of resolving the methodological quandaries posed by a growing understanding of the complex and emergent nature of social order, we can see how a procedure developed for and used to classify a set of cases into a number of relatively homogenous subsets in which the members of these subsets are more like each other than they are like the members of other subsets can equally be applied to a biological dataset describing plant characteristics as to datasets describing the characteristics of mentally disordered offenders. The application is not different although the subjects to which it is applied may be. Beyond this and in this particular instance, the interpretation of its application goes further than the explanation of classification in a simple sense to one which encourages us to begin thinking about cases as located within an n dimensional space – where the dimensionality is equal to the number of variables used in the clustering procedure and when applied to a time-ordered dataset, it is possible to generate a time-ordered typology – so that in brief typological analysis applied to time discrete subsets of the dataset enable the identification of trajectories, regularities or patterns by mapping movements between groups from one set of clusters to the next. As discussed above, the concept of a trajectory or pattern carries an implication of time. The importance of this is that it enables us to identify key periods in the trajectories of cases which mean that specific clusters can be identified within given periods, and movement between them mapped over time. Movement is restricted to a unidirectional event because within one set of clusters representing one discrete time period cases do not move between one group and another, instead progress occurs between the first set of clusters and the next set representing the following discrete time period.

The cluster analyses of the mentally disordered offender dataset was undertaken separately within three key periods (Poincaré slices), using all of the cases and variables available: history (64 variables), current (50 variables), and outcome (24 variables), producing three sets of clusters. We elected to use the hierarchical techniques and particularly the agglomerative hierarchical methods for the analysis of the mentally disordered offender dataset as criteria have been developed for determining the level in a cluster hierarchy at which there is an optimum number of clusters present. This is an important consideration as a problem common to all clustering techniques is the difficulty involved in deciding the number of 'natural groups' in the data or clusters which best reproduce the underlying natural structure. Lorr (1983) described this as the 'stopping rule'. He goes on to describe the rule developed by Mojena (1977) named 'Mojena's Rule', which uses the distribution of the

clustering criterion (the within-group sum of squares) to determine when a “significant change from one stage to the next implies a partition which should not be undertaken” (p.99). Everitt (1974) similarly suggested that an examination of the dendrogram for large changes between fusions would be useful. The emergent clusters describe the state of the system at discrete periods of time. Each cluster or Poincaré section is a slice through the mentally disordered trajectory, bringing into high relief each discrete time period used to describe the trajectories but losing an overall portrait of longitudinal patterns. Mapping or tracing movement between clusters (clustering the three cluster results) brings into focus each complete trajectory or possibility-space portrait.

The four stage cluster analysis resulted in four history, ten current, two outcome stage clusters, and a final stage clustering the cluster memberships resulting in five overall trajectories identified (see figure 1).

Figure 1. A visualisation of mentally disordered offender trajectories in multi-dimensional possibility-space.



(Adapted from an image created by Hingorani (2014): <http://vislab.mat.ucsb.edu/2014/p3/Mohit/index.html>).

These five trajectories are described in Table 1 using the key features around which clusters appeared to group: beginning with evidence of a history of mental health problems and/or previous criminal convictions; through to current referral to the custody diversion team and profession of the team case-worker (a psychiatric nurse or the social worker/or probation officer), whether a full health and social care needs assessment was carried out, evidence of a current mental health problem and/or a criminal offence, and if health or social care needs were identified; and ending with if individuals were re-referred to the custody diversion team following discharge indicating needs were or were not met or another criminal offence had or had not been committed.

Table 1. A description of mentally disordered offender trajectories.

Not Re-Referred	Not Re-Referred	Not Re-Referred	Re-Referred	Not Re-Referred	Outcomes
No Need	No Need	Need	No Need	No Need	Current
Criminal & Psychiatric	Criminal & Psychiatric	Criminal & Psychiatric	Criminal	Criminal	
Assessed	Assessed	Assessed	Not Assessed	Not Assessed	
Psychiatric Nurse	Social Worker or Probation Officer	Psychiatric Nurse	Social Worker or Probation Officer	Psychiatric Nurse	
Criminal	Criminal	Criminal & Psychiatric	Criminal & Psychiatric	Neither	History
1	2	3	4	5	

In brief, trajectory 1 included people who had violent previous convictions but no psychiatric history. They had gone on to commit a further, often violent, offence. On referral to the custody diversion team they were assessed by a psychiatric nurse and identified as misusing drugs and/or alcohol or having a vague ‘mental health problem’. Trajectory 2 was very similar to trajectory 1. Both trajectories included people who were simply criminal offenders prior to their selection for referral to the custody diversion team, although overwhelmingly violent offenders. The main difference around which the trajectories diverged was the profession of the custody diversion team member of staff responsible for the assessments; in this case it was the custody diversion social worker or probation officer. There seemed little reason to sustain referral to the custody diversion team for those experiencing these trajectories – they had no history of psychiatric problems and little evidence of a significant mental disorder following assessment by the team. This argument was supported by the fact that no health or social care needs were identified by either the nurses or social worker/or probation officer based on their assessment and what they considered the psychiatric services could and should become involved with. Trajectory 5 includes referrals which were requests for information from the team’s psychiatric nurses. No further actions were taken and minimal information was recorded. Common to trajectories 1, 2 and 5 was individuals were not re-referred to the custody diversion team following discharge indicating referral to the team could not be sustained and the identification of no mental health or social care needs was considered appropriate at that time.

Of the five trajectories, two (numbers 3 and 4) were particularly interesting and worthy of note here. Both included people who had a significant psychiatric and criminal history. The similarities between the cases and differences between the trajectories revolved around the profession of the team case-worker and the decision taken by them to carry out a full health and social care needs assessment or not to carry out an assessment. The consequence of that decision was that those experiencing trajectory 3 were provided with a full assessment by a psychiatric nurse, their health and social care needs were identified and referrals made to other agencies and services were provided to meet these needs so that those experiencing this trajectory did not become a revolving door patient or repeat offender (within the 30 months data collection). For those experiencing trajectory 4, the custody diversion social worker or probation officer responsible for the case did not carry out an assessment, therefore no needs were recognised and no extra services were involved. Everyone in this cohort became a revolving door patient or repeat offender (within 30 months data collection period). While this trajectory was one of the potential possibility-space portraits imagined as described earlier, that it was actually realised was an unexpected outcome. Digging within the data to find potential explanations for this decision to assess or not to assess, it seems that the people in trajectory 3 had a more significant psychiatric history, as they were more than twice as likely to have been held under the UK Mental Health Act 1983 and spent time as a compulsory hospital in-patient when compared with those in trajectory 4. Conversely, the people in trajectory 4 were more likely to have been previously more 'criminal' than those in trajectory 3. However, at the point of referral to the diversion team the reverse tended to be true. A larger proportion of the people in trajectory 3 had been charged with a serious offence of violence (40%) compared with only a quarter (25%) of those in trajectory 4, in other words their offending behaviour appeared to be escalating. In comparison, twice as many people in trajectory 4 had been charged solely with public nuisance type offences, for example causing an affray – 32% compared with 18% in the first trajectory – in other words their offending appeared to be de-escalating. Perhaps this apparent reduction in seriousness of offending paired with a less significant psychiatric history persuaded the custody diversion social worker or probation officer that a full assessment was not warranted.

The aim was to uncover the trajectories of mentally disordered offenders and the impact of referral to the custody diversion team. A mentally disordered offender trajectory is equivalent to a possibility-space portrait or Strange Attractor. The mentally disordered offender possibility-space portrait exists within multi-dimensional possibility-space or Phase-Space. Structure was uncovered by constructing Poincaré maps – taking sequential sections from the possibility-space portraits or mentally disordered offender trajectory and plotting or clustering the state of the system at each point using n axes/variables and n co-ordinates/data. Pattern was uncovered by mapping movement from one point to the next. In this way we were able to identify potential mechanisms, the hidden or deep patterns underlying the perceived social reality involved with the impact of referral to the custody diversion team. It was at this

level that choices by the custody diversion team nurses and social worker or probation officer to assess or not to assess became manifest and it was at this level, observed through time, that feedback loops, disruption, change and invariance in the creation of revolving door patients or repeat offenders could be observed.

Conclusion: limitations and advantages

In this paper we have tried to show, through what is empirically a relatively simple example, how the complex real can be captured. How empirical closure might be achieved. A challenge for a realist methodology is the search for patterns or similarities while at the same time acknowledging the existence of difference. A challenge, yes, but one that reframes the 'closure' question. Presented with a large case-based time-ordered quantitative dataset, realism provides a framework within which we can begin to imagine the hidden or deep patterns that underlie the social world. These regularities are complex and dynamic. Individuals or cases are not homogenous (they have variations in circumstance and experience, both historic and current), and the services or agencies which process people make choices and act on those choices (albeit bounded by contexts), leading to different experiences and outcomes³. Such a realist methodology and its analysis strategy therefore need to keep it case-based while searching for patterns over-time; the issue addressed in this paper is how to do this. Concepts and ideas which originate in disciplines outside of the Social Sciences but which share commonalities with a realist understanding of the social world, can inspire and act as a catalyst to develop new and exciting approaches to imagining and understanding these regularities and irregularities. The Complex Realist inspired approach presented here, although primarily aimed at showing prevalence and trajectory in a 'realist closure' was also inspired by more abstract ideas and concepts, including possibility-space or Phase Space, possibility-space portraits or Strange Attractors, and Poincaré maps, which originated in the natural sciences and mathematics. We say 'inspired by' as we are by no means claiming an accurate application of these concepts as true to their origins. However we argue that the ideas behind the concepts helped us think more creatively about the dataset and the complex social process it represented, and underpinned the subsequent search for techniques and application of method. This paper shows how this methodologically plural approach unearths a number of important causal accounts for service providers including highlighting actions which appear to maintain negative trajectories.

Complex realist, case based approaches are methodologically in their infancy. To reiterate, we do not claim that this is the only quantitative approach that can be used to describe or explain social reality. Indeed, as one of has argued (Williams 2019) more 'traditional' variable based methods can be used to identify large scale or relatively simple mechanisms⁴.

Moreover the method we describe here has some limitations. It requires a longitudinal dataset with enough cases and data points to be able to model trajectories and 'strange attractors'. Though because this method does not rely on tests of significance,

as in variable based linear models, what is 'enough' is a question yet to be answered and likely not through a measure of significance (which itself is a function of the law of large numbers), but rather sufficient cases for successful manipulation. Furthermore, though one could use sample data, one of the valuable features of the dataset we describe, is that because it contains records of all of the population of interest, the possibility space can be calculated, moreover these are 'real' individuals, rather than those emerging from a probability sample (Williams 1999). Secondly it is primarily descriptive of what happens to people. That is not to say that causal narratives, linked to postulated mechanisms – such as those created by policies, cannot be made. Indeed, ultimately all quantitative research, as Byrne (2002) maintained, requires interpretation.

Our approach is, as we said above, that of complex realism. Our theoretical and methodological descriptions are an attempt to make clear the reasoning for using this approach that shows how it captures complex reality, but we acknowledge that most researchers and policy makers just want a method that can capture the complexity of prevalence and trajectory through time. One does not have to sign up to complex realism! But what is important to us is that the approach we describe and the assumptions and tools it depends on, are by their nature *essentially* realist!

References

- Asher, H (1983) *Causal Modelling* 2nd edition. Thousand Oaks, Cal. Sage.
- Blalock, H (1961) *Causal Inference in Nonexperimental Research*. Chapel Hill, NCA: University of North Carolina Press.
- Byrne, D. (1998) *Complexity Theory and the Social Sciences*. London: Routledge.
- Byrne, D. (2002) *Complexity Theory and the Social Sciences: An Introduction*. Taylor and Francis.
- Byrne, D. and Callaghan, G. (2013) *Complexity Theory and the Social Sciences: The state of the art*. Taylor and Francis.
- Castellani, B, Griffiths, F, Rajaram, R, Gunn, J (2018 'Exploring comorbid depression and physical health trajectories: A case-based computational modelling approach' *Journal of Evaluation in Clinical Practice*.
<https://doi.org/10.1111/jep.13042>
- Cohen, J., & Stewart, I. (1994.) *The Collapse of Chaos: Discovering Simplicity in a Complex World*. London: Penguin Books.
- Department of Health and Home Office (1991) *Review of Health and Social Services for Mentally Disordered Offenders and Others Requiring Similar Services - Report of The Community Advisory Group*. London: HMSO.
- Bhaskar, R. (2008) *A Realist Theory of Science*. 3rd edition. London: Routledge.

- Byrne, D and Callaghan, G (2009) *Complexity Theory and the Social Sciences: The State of the Art*. London: Routledge.
- Cartwright, N (1983) *How the Laws of Physics Lie*. Oxford: Clarendon.
- Castellani, B, Griffiths, F., Rajaram, R, Gunn, J (2018 'Exploring comorbid depression and physical health trajectories: A case-based computational modelling approach' *Journal of Evaluation in Clinical Practice*.
<https://doi.org/10.1111/jep.13042>
- Dyer, W. (2001) *The Identification of the Careers of Mentally Disordered Offenders Using Cluster Analysis in a Complex Realist Framework*. PhD, University of Durham, Centre for Applied Social Studies, Department of Sociology and Social Policy.
- Elliot, J (2005) *Using Narrative in Social Research*. London: Sage.
- Everitt, B. (1974) *Cluster Analysis*. London: Heinemann Educational Books Ltd.
- Freedman, D (2007) 'Statistical Models for Causation' in Outhwaite, W and Turner, S *The Sage Handbook of Social Science Methodology*. London: Sage.
- Gentili, P.L. (2018) *Untangling Complex Systems: A Grand Challenge for Science*. Taylor and Francis.
- Gleick, J. (1988) *Chaos: the amazing science of the unpredictable*. London: Minerva.
- Gleick, J. (2011) *Chaos: Making a New Science*. Open Road. Integrated Media, New York.
- Goldthorpe, J (2016) *Sociology as a Population Science*. Cambridge: Cambridge University Press.
- Hacking, I (1983) *Representing and Intervening: Introductory topics in the philosophy of natural science*. Cambridge: Cambridge University Press.
- Hingorani, M. (2014) *Chasing Programming Languages: Extruding Circos*. MAT 259, 2014. Available at: <http://vislab.mat.ucsb.edu/2014/p3/Mohit/index.html>
- Hume, D (1911) *A Treatise of Human Nature* Volume One. London: Dent.
- Lauder, H., Brown, P. and Cheung, S.Y. (2018) 'Fractures in the Education–Economy Relationship: The End of the Skill Bias Research Programme?' *Oxford Review of Economic Policy*, 34 (3): 495-515.
- Lewis, D (1986) *Philosophical Papers II*. Oxford: Oxford University Press.
- Lipton, P (1991) *Inference to the best Explanation*. London: Routledge.
- Lowman, J., Menzies, R. J., & Palys, T. S. (1987) Transcarceration: Essays in the Sociology of Social Control. In A. E. Bottoms (Ed.), *Cambridge Studies in Criminology*. Aldershot: Gower.

- Lorr, M. (1983) *Cluster Analysis for Social Scientists: techniques for analyzing and simplifying complex blocks of data*. London: Jossey-Bass Publishers.
- Lawson, T (1997) *Economics and Reality*. London: Routledge
- Mental Health Act (1983), c. 20. Available at:<http://www.legislation.gov.uk/ukpga/1983/20/contents>
- Mojena, R. (1977) Hierarchical Grouping Methods and Stopping Rules: An Evaluation. *Computer Journal*, Vol.20, pp.359-363.
- Pawson, R (2006) *Evidence Based Policy*. London: Sage.
- Peay, J. (1994) Mentally Disordered Offenders. In M. Maguire, R. Morgan & R. Reiner (Eds.), *The Oxford handbook of Criminology*, pp. 1119-1160. Oxford: Clarendon Press.
- Platt, J. (1996) *A History of Sociological Research Methods in America 1920-1960*. Cambridge: Cambridge University Press.
- Platt, L; Simpson, L and Akinwale, B (2005) 'Stability and Change in Ethnic Groups in England and Wales. *Population Trends* 125 pp 31 -46.
- Porpora, D (2008) 'Sociology's Causal Confusion' in Groff, R (Ed) *Revitalizing Causality: Realism about causality in philosophy and the social sciences*. London: Routledge pp 195-204.
- Ragin, C and Fiss, P (2016) *Intersectional Inequality: Race, Class, Test Scores and Poverty*. Chicago: Chicago University Press.
- Rubin, D and Imbens (2015) *Causal Inference for Statistics, Social, and Biomedical Sciences: An Introduction*. New York: Cambridge University Press
- Ruelle, D., & Takens, F. (1971) *On the Nature of Turbulence*. Harper and Row.
- Stross, C (2014) *The Rhesus Chart: A Laundry Files novel*. Orbit: Little, Brown Book Group, London.
- Williams, M (2019) 'Making up Mechanisms in Realist Research' in Emmel, N, Greenhalgh, J, Manzano, A, Monaghan, M and Dalkin, S (eds) *Doing Realist Research*, London: Sage. Pp 25-40
- Williams, M (2011) 'Contingent Realism – abandoning necessity' *Social Epistemology* 25 1 37-56.
- Williams, M (2003) 'The Problem of Representation: Realism and Operationalism in survey research' *Sociological Research On Line* Vol 8 1. <http://www.socresonline.org.uk/8/1/williams.html>
- Williams, M (1999) 'Single Case Probabilities and the Social World: The Application of Popper's Propensity Interpretation.' *Journal for the Theory of Social Behavior* 29:2 pp187-201

Williams, M and Dyer, W (2017) 'Complex Realism in Social Research'.
Methodological Innovations Online.
Williams, M and Husk, K (2013) 'Can we, Should we measure ethnicity?'
International Journal of Social Research Methodology. 16 4 285-300.

Notes

¹ These are its natural allies, because realism is a naturalistic doctrine and realist social research is (or therefore should be a scientific enterprise).

² The GLM can 'cope' with a relatively small number of interaction terms, but if many are added in the number of possible covariates and thus possible models rapidly escalates (Elliot 2005: 102)

³ Charles Ragin and Peer Fiss (2016), in a book which challenges simplistic understandings of intelligence test scores, propose not simply an intersectional approach (which incorporates – for example, ethnicity, class, gender, family background etc.), but an intersectional *methodological* approach, that utilises Qualitative Comparative Analysis (QCA). Similarly, Brian Castellani and his colleagues (Castellani and Hafferty (2009) have devised a toolkit (the SACS Toolkit) that is case-based, mixed-method, system-clustering, data-compressing, theoretically-driven toolkit for modelling complex social systems. An empirical example of this can be found in Castellani et al 2018. Though each of these approaches is methodologically different to the one we outline here (particularly QCA), they share the same methodological adherence to complexity, realism and intersectionality.

⁴ The critical realist economist, Tony Lawson (Lawson 1997), has been very sceptical about the success of aggregate models. His argument is that all statistical models must contain an error term, and the amount of variability in social life renders such models useless. He believes quantitative analysis should limit itself to the use of descriptive statistics. In principle, we agree with this view (and we have argued as much elsewhere (reference removed for anonymity), but in practice even empiricist causal models, interpreted as inference to the best explanation, can provide valuable clues to mechanisms (reference removed for anonymity).