

Complexity and the human sciences: beyond reductionism and relativism?^{*}

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I would like to start this talk with two quotes that illustrate the tension that constitutes the philosophical terrain onto which I will be wading today.

The goal of science is to make the wonderful and complex understandable and simple—but not less wonderful. —Herb Simon, *Sciences of the Artificial*.

That which is complex cannot be pinned down. To pin it down is to lose it. —Annemarie Mol and John Law, *Complexities*.

We are faced with a fundamental problem for any science of complexity. To render the complex world understandable it is necessary to simplify it,

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but how can we render the complex simple without losing that which is distinctive and interesting about it? If complex systems are indeed ‘irreducible’ and therefore cannot be represented in ‘simple’ analytical models (Cilliers, 1998:9), is scientific reflection on complex systems doomed to be uninteresting reductions that can never grasp what is truly important? And if we insist on the irreducibility of complexity, can we avoid superficial accounts that are prone to relativist interpretations?

This is a problem with which Paul was well-acquainted, which is why he dealt extensively with models of complex systems in his book, and also explicitly addressed their epistemological in his Inaugural Lecture “Do modest positions have to be weak?”. He seemed comfortable on the tightrope between reductionism on the one hand and paralysing relativism on the other.

In addressing these questions—even in the restricted domain of the human sciences—we cannot but reflect on the nature of the scientific enterprise itself. It is relatively easy to show that traditional analytical models—like the exhaustive mathematical models that dominate economics, the most resolutely ‘scientific’ of the human sciences—are usually inadequate when dealing with complex social systems. What is harder is bringing into relief the epistemological foundations of the various approaches to complexity and strategies for modelling it that have come to the fore in recent years. One prominent approach is computational models of social systems, which includes agent-based models that place (much simplified) virtual individuals within simulated social worlds and observe the system-level outcomes of their interactions over time. Other approaches

include connectionist models of cognition (as apposed to more traditional 'rule-based' artificial intelligence), social network analysis and the study of 'social capital'. All of these approaches attempt, in a sense, to replicate the complexity of the social worlds that they represent, while—in order to be useful—they must also reduce that complexity to manageable proportions. They therefore necessarily operate in fraught epistemological terrain: which elements of the complex reality are 'inessential' and can be discarded in the model? What kind of knowledge about reality can these models provide?

Of course, the various approaches to modelling complex social systems do not operate in an intellectual vacuum. The postwar human sciences—and in particular the 'harder' social sciences like economics, sociology, political science and psychology—were dominated by a current of 'methodological positivism' characterised by a striving for empirical groundedness and for universal, generalisable results (see review in Steinmetz, 2005). In many cases this dominant positivism found expression in the preference for formal (mathematical) models and data-driven quantitative techniques. Likewise, some approaches to complexity reflect a positivist yearning for objective knowledge and exhaustive, formal specification of models, like those of the Santa Fé School. But other theorists of complexity, like Paul and Edgar Morin, draw on the continental philosophical tradition and link complexity to a more 'modest' epistemology in which the status of scientific knowledge is problematised (see Cilliers, 2002; Heylighen et al., 2006; Cilliers, 2005; Morin, 2007).

I will argue that it is not necessary to succumb to either positivist re-

ductionism or to a relativist ‘weak epistemology’. Rather, it is possible to develop accounts of social phenomena that are sensitive to irreducible complexity and acknowledge the limits of scientific knowledge—and that can therefore never claim to be complete—but that nevertheless allow us to ‘get a handle on’ a complex reality by making strategic use of ‘simple’ models and reductive techniques.

While this is not my central concern today, it is necessary to emphasise that the epistemological choices we make have profound ethical and political implications. I have argued elsewhere that an epistemological stance that recognises complexity can inform a critical philosophy (Grebe, 2010). The intellectual tradition of the Enlightenment, with its reductive impulse, is (despite its many achievements) ill-suited to coping with contingency and difference—something which is essential if we are to avoid ‘totalitarian’ thinking and its political correlates.¹ This is an insight that came to me and many others from Paul, whose unrelenting emphasis on the ethical and political dimension of philosophical positions, be they epistemological, ontological or aesthetic, theoretical or applied, stands as a testament to his deeply humanistic and compassionate impulse.

¹Two powerful critiques of the Enlightenment’s denial of difference and the ethico-political implications of this denial are those of the Frankfurt School, principally Horkheimer and Adorno (1947/ 2002) and, more recently, that of Zygmunt Bauman (1989) (see also discussion in Mol and Law, 2002). Both these critiques link the horrible abuses of twentieth century Europe to an intellectual tradition that evacuated difference and uncertainty in favour of an uncritical notion of scientific and social progress.

Ockham's Razor: 'simplicity' and reductionism in modernist science

A central norm in modernist science—and one that remains highly favoured—is what is usually referred to as the Simplicity Principle (or sometimes the Principle of Parsimony), often invoked in the form of 'Ockham's Razor', formulated by William of Ockham² (c. 1285-1348). The most common formulation of Ockham's Razor is "Don't multiply entities beyond necessity" (Spade, 2006) and expresses succinctly the notion that, other things being equal, simpler theories are better. While Ockham used it to counter over-elaborate metaphysical theories, simplicity has become a norm in all of science and most of philosophy. I have called it a 'norm' because the emphasis on reducing theories to the simplest form possible is often not explicitly stated (nor examined), but is rather deeply embedded in the epistemological and methodological framework of the sciences.

In fact, versions of the Simplicity Principle date from long before Ockham (e.g. Aristotle formulated a version of it in the Posterior Analytics). It was accepted by influential Enlightenment philosophers, like Kant, but perhaps most significantly by scientific pioneers both medieval—like Newton, whose classical mechanics can be seen as the starting point of modern science—and more recent, like Einstein who strove for the simplest possible formulations in his theory of General Relativity (Einstein, 1920, cited in Edmonds, 2007:65). Newton's physics is also a paradigmatic expression of the Cartesian principle of analysis or reduc-

²Also spelt 'Occam'.

tion: that to understand a complex phenomenon one must understand its constituent parts (Heylighen et al., 2006:3). There is therefore a close link between the Principle of Simplicity and reductionism: often the best way to arrive at the simplest possible theory is through the method of reduction: find the simplest elements and processes that give rise to the complex phenomenon you wish to explain and describe them in the simplest possible way.

Two questions, however, present themselves: (1) do the justifications for the Simplicity Principle hold up? and (2) are the Simplicity Principle and the analytical method appropriate methodological and epistemological norms in the study of complex social systems? We must therefore look a little more closely at the tradition of analytical/reductive science and the place therein of simplicity and reduction, before we turn to positivism (closely linked to reductionism) and antipositivism in the human sciences.

Despite the fact that the Simplicity Principle is well-established and implicitly or explicitly accepted by most scientists, there is a surprising degree of vagueness and philosophical uncertainty over what it in fact means (or should mean) and how it can be justified. Oddly, many philosophers of science—especially those in the analytical and logical-positivist traditions—seem more interested in the question ‘what is the correct justification for the Simplicity Principle?’ than in the question of whether the principle is valid and universal in the first place. Rather than review all the important debates around this topic, the focus here will be on the central claims of adherents of the Simplicity Principle and whether one would be

justified in discarding it. Interested readers may wish to consult one of a number of good philosophical surveys of Simplicity: Hesse (1967), Zellner et al. (2002a) or Baker (2010). If, however, as Edmonds (2007) suggests, simplicity is not truth-indicative, these debates become largely moot, and the simplicity principle becomes largely a matter of practical convenience.

While the formulation of the Simplicity Principle cited earlier merely suggests that, *ceteris paribus*, simpler theories are 'better', more often than not this is assumed to mean that simpler theories are more likely to be 'true'. The latter corresponds with an *epistemic interpretation* of the principle—i.e. all things being equal, reason requires that one *believe* a simpler theory—as opposed to a *methodological interpretation*, suggesting that it is rational to adopt a simpler theory as a working theory for scientific purposes (Baker, 2010). To complicate matters further, a number of further distinctions are possible, including between syntactic simplicity (simplicity of hypotheses/theories about the world, often called 'elegance') and ontological simplicity (number and complexity of postulated things in the world, often called 'parsimony'), with the two notions of simplicity frequently pulling in opposite directions (Baker, 2010). For the purposes of this discussion, I am mostly referring to syntactic simplicity, though the distinction is hard to maintain rigorously.

Which interpretation of the simplicity principle we are employing is of the utmost importance for determining whether the justifications offered in support of it are valid and to what extent the principle is binding. The question of justifying a Simplicity Principle is connected to the broader problem in the philosophy of science known as the 'underdetermination'

of theory by empirical data (i.e. empirical observations can be explained by multiple theories that are not compatible with one another and do not in themselves imply that a specific theory must be the correct one). When the principle is given in its (stronger) epistemological form ('simpler theories are more likely to be true') it requires *a priori* justification, whereas in its (weaker) methodological form it merely requires pragmatic *a posteriori* justification. *A priori* justifications of simplicity can take the form of theological and metaphysical justifications, appeals to the 'intrinsic value' of simplicity or via 'principles of rationality'. However, since the latter simply shifts the problem to the justification for a more fundamental *a priori* rational principle, these justifications often boil down to an appeal to philosophical intuition or the self-evident value of simplicity. As Cartwright (2010:90) points out, 'epistemic virtues' are often invoked in an attempt to 'solve' the problem of underdetermination. But there is no real basis for labelling these specific virtues as 'epistemic':

If the phenomena in a domain are complex or diverse, why should choosing the simplest claim or the one that unifies the most help in arriving at true claims? We may suppose that truth and our favourite epistemic virtues march hand-in-hand, but that looks to be one of those grand 'metaphysical' assumptions not confirmed by the detailed scrutiny demanded of proper scientific claims. (Cartwright, 2010:91)

A priori justifications seem to keep the Principle of Simplicity firmly in the realm of metaphysics (Zellner et al., 2002b:1), which may explain why nat-

uralistic justifications based on an appeal to scientific practice have gained currency, even in analytical philosophy (Baker, 2010). But naturalistic justifications of simplicity move us firmly into the realm of pragmatic justifications and adherents of simplicity can no longer sidestep the question that complexity poses: are simpler theories really better at making sense of complex phenomena? It is relatively easy to see, however, why simpler theories would have practical advantages: they are simply easier formulate, understand and communicate. However, once we abandon *a priori* epistemic justifications, simplicity in many ways stops being a principle is superseded by the question of which theory ‘works best’ given the object of study and the purposes of the theorist. If simplicity is not a fundamental truth-indicative principle, and if the object of study is a ‘complex system’, simplicity is at most a guideline that can help us choose between more than one ‘equally good’ theory—assuming that all are sufficiently capable of reflecting (replicating) the complex features we are interested in.

Many will respond to this line of inquiry with charges of relativism (and indeed Cartwright does take a radically relativist position with respect to the status of scientific knowledge), but this is not a necessary implication of questioning the value of reductionism. Saying ‘simpler theories are not necessarily better’ is not the same as saying ‘any one theory is as good as another’ or ‘the value of a theory can only be measured relative to arbitrary values’.

As Smaling (2005) argues, the Simplicity Principle as a norm of scientific quality is closely linked to the ‘empirical-analytical tradition’, to which there exists alternatives like the ‘hermeneutical-interpretive tradition’ in

the human sciences. In the latter, paying attention to context, alternative meanings—in short, complexity—is emphasised:

Within the hermeneutical-interpretive tradition ... simplicity is not posed as a separate norm. ... For this reason and because of other differences, the adherents of the empirical-analytical approach do not take the hermeneutical-interpretive approach very seriously. Hermeneutical-interpretive and also critical (neo-Marxist or otherwise) approaches belong to the collection of regrettable victims of Ockham's Razor. Regrettable, because the justification of the use of Ockham's Razor is doubtful. (Smaling, 2005:50)

I would argue, therefore, that it is not a question of the wholesale acceptance or rejection of the Simplicity Principle, but rather of balancing in theory or model selection the benefits of simplicity (which are very real from a pragmatic perspective) with the advantages of allowing greater theoretical complexity. (In statistics, this is sometimes described as the 'trade-off between parsimony and goodness-of-fit'.) When studying phenomena that exhibit complexity (and especially those that involve human agents), the advantages of more complex theories are clear (i.e. 'goodness-of-fit' is improved by allowing the complexity of the object to be mirrored in the theory). Adopting this pragmatic approach implies, however, a more modest epistemology than that which characterises positivist science or the 'empirical-analytical tradition'—one in which the context and the concerns of the observer become relevant. I will return later to the question of

whether this plea for ‘pragmatic simplicity’ can be accepted without descending into a self-defeating scientific relativism.

One of Paul’s most distinctive contributions was to trace, despite their origins in very different traditions, the affinity between a complex systems perspective and poststructuralist philosophy. When complexity is viewed in this light, its potential for informing a ‘postpositivist’ critical perspective in the human sciences—i.e. one that rejects the self-understanding of social reflection as autonomous of the social phenomena that are its objects and of its methodology as universal, contextless and value-free—becomes clear.

In the written version of this paper I review some of the ways in which a complex systems perspective has been employed in the human sciences. I won’t do so here, except to emphasise that neither a complex systems perspective nor connectionist or computational models of complex social systems is a panacea for our epistemological ills: on the one hand the problem of underdetermination persists and on the other it raises the spectre of relativism. Is there a way out of this double bind?

Conclusion: Is there an alternative to reductionism and relativism?

It would be disingenuous to claim that the arguments I make in this paper do not have relativising implications for scientific modelling. By abandoning the Simplicity Principle as a truth criterion we are losing one of the most widely used criteria for model selection. In making a plea for ‘prag-

matic simplicity’—i.e. opting for simpler theories only *where and when they make the most practical sense*—we are necessarily raising questions such as ‘make sense to whom?’ and ‘make sense for what?’. Practical concerns such as intelligibility and communicability are by definition relative to the researcher and the (social) context within which she works.

Speaking descriptively, it is hard to disagree that that model selection in the world of practical science is be guided more often by heuristics than by *a priori* principles like *simplicity* or *falsifiability*, leaving more room for the process to be ‘contaminated’ by the social world of the scientist (see, for example, Latour, 1999). Further, as Edmonds (2007:70) points out, we are highly selective in *what we attempt to model*—i.e. “we usually concentrate on that tip of the natural world iceberg which is not too complex for our abilities”. Recognising that bias exists not only in *how* we select to model the world but also in *what* we select to model implies that, to a certain degree, models are relative to the modeller. Furthermore, conceiving of the object of the human sciences as a complex social system implies that the very constitution of that system is impacted by the ‘framing’ processes performed by the observer (scientist). For example, the level of analysis and units of analysis, as well as the level of detail captured in the data gathered empirically, are ‘chosen’ (not necessarily consciously) by the researcher. This means that the observer in an important sense provides the context that is necessary for the system to be constituted as a system. Clearly, this implies that in an important sense the system is ‘relative to the observer’ although this claim should not be construed as a claim that the system is ‘determined’ by the observer, and that meaning is simply ‘projected’ onto the data.

But does recognising the sociality of science and its inability to live up to the positivist dream of unbiased reflection of the world imply that science is simply 'yet another internally validated discourse'? I would argue not: admitting to the relativising implications of a complex systems perspective does not imply that we have to adopt a self-defeating relativist position in which any one model is as good as another. In hermeneutical terms both the observation and the modelling of complex systems could be described as a Gadamerian 'fusion of horizons' between the reader and the text, or even as a Derridean 'reading' of the text (read: world). Seen in this way, the limits imposed by context are precisely what enable meaning, including scientific meaning. Perhaps this position is best characterised as 'modest' (as opposed to 'weak') in the sense that Cilliers (2005:263) uses the term: conscious of its own limitations, but not claiming that any one model is as good as another or that the scientific enterprise is doomed. Rather, it is a claim for pragmatism in the face of the limitations of scientific knowledge and of the fact of that knowledge's social, contextual and temporal situatedness.

A key challenge, however, remains saying something useful about complex systems, other than merely that they are complex. Approaches such as relational models of society—while no doubt able to illuminate certain aspects of certain kinds of complex systems and therefore very valuable—still attempt to develop what are in essence analytical models of complex systems and therefore remain vulnerable to charges of unjustified reductionism. Mol and Law's (2002:7-11) notion of 'multiplicities' may be helpful in conceiving of an approach that moves us beyond the

dilemma of *complex and opaque* vs. *analytical and reductionist*. But such an approach must be elaborated *in practice*—i.e. in new knowledge practices and methodologies that bring complexity to light in those spaces where analytical ‘orders’ meet and coexist in unresolved tension.

References

- Baker, A. (2010). *Simplicity (Stanford Encyclopedia of Philosophy)*. Available from: <http://plato.stanford.edu/entries/simplicity/>.
- Bauman, Z. (1989). *Modernity and the Holocaust*. Polity Press, Cambridge.
- Cartwright, N. (2010) 'Relativism in Philosophy of Science'. In Krausz, M., ed., *Relativism: A Contemporary Anthology*, pages 86–99. Columbia University Press, New York.
- Cilliers, P. (1998). *Complexity and postmodernism*. Routledge, London.
- Cilliers, P. (2002) 'Why We Cannot Know Complex Things Completely'. *Emergence*, 4(1/2):77–84. Available from: <http://www.informaworld.com/openurl?genre=article&doi=10.1207/S15327000EM041&2-07&magic=crossref|D404A21C5BB053405B1A640AFFD44AE3>.
- Cilliers, P. (2005) 'Complexity, Deconstruction and Relativism'. *Theory, Culture & Society*, 22(5):255–267. Available from: <http://tcs.sagepub.com/cgi/doi/10.1177/0263276405058052>.
- Edmonds, B. (2007) 'Simplicity is Not Truth-Indicative'. In Gershenson, C., Aerts, D., and Edmonds, B., eds., *Worldviews, Science and Us: Philosophy and Complexity*, pages 65–80. World Scientific, River Edge, NJ.
- Grebe, E. (2010) 'Negativity, Difference and Critique: The Ethical Moment in Complexity'. In Cilliers, P. and Preiser, R., eds., *Complexity*,

- Difference and Identity: An Ethical Perspective*, volume 26 of *Issues in Business Ethics*, pages 95–111. Springer, Dordrecht. Available from: <http://www.springerlink.com/index/10.1007/978-90-481-9187-1>.
- Hesse, M. (1967) 'Simplicity'. In Edwards, P., ed., *The Encyclopaedia of Philosophy (Vol. 7)*, pages 445–448. Macmillan, New York.
- Heylighen, F., Cilliers, P., and Gershenson, C. (2006) 'Complexity and Philosophy'. Available from: <http://arxiv.org/abs/cs/0604072>.
- Horkheimer, M. and Adorno, T. W. (2002). *Dialectic of Enlightenment*. Stanford University Press, Palo Alto, CA.
- Latour, B. (1999). *Pandora's Hope: Essays on the Reality of Science Studies*. Harvard University Press, Cambridge, MA.
- Mol, A. and Law, J. (2002) 'Complexities: An Introduction'. In Mol, A. and Law, J., eds., *Complexities: Social Studies of Knowledge Practices*, pages 1–22. Duke University Press, Durham.
- Morin, E. (2007) 'Restricted Complexity, General Complexity'. In Gershenson, C., Aerts, D., and Edmonds, B., eds., *Worldviews, Science and Us: Philosophy and Complexity*, pages 5–29. World Scientific, River Edge, NJ. Available from: <http://arxiv.org/abs/cs/0610049>.
- Smaling, A. (2005) 'The Chatton-Ockham Strategy: an Alternative to the Simplicity Principle'. In Aerts, D., D'Hooghe, B., and Note, N., eds., *Worldviews, Science and Us: Redemarcating Knowledge and Its Social and Ethical Implications*, pages 38–58. World Scientific, Singapore.

- Spade, P. V. (2006). *William of Ockham (Stanford Encyclopedia of Philosophy)*.
Available from: <http://plato.stanford.edu/entries/ockham/>.
- Steinmetz, G., ed. (2005). *The Politics of Method in the Human Sciences: Positivism and Its Epistemological Others*. Duke University Press, Durham.
- Zellner, A., Keuzenkamp, H., and McAleer, M., eds. (2002a). *Simplicity, Inference and Modelling*. Cambridge University Press, Cambridge.
- Zellner, A., Keuzenkamp, H. A., and McAleer, M. (2002b) 'The enigma of simplicity'. In Zellner, A., Keuzenkamp, H. A., and McAleer, M., eds., *Simplicity, Inference and Modelling: Keeping it Sophisticatedly Simple*, pages 1–10. Cambridge University Press, Cambridge.