Consciousness In Rather than Of: Advancing Modest Claims for the Development of Phenomenologically Informed Approaches to Complexity Theory in Criminology.

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Abstract

In taking a modest approach to studying complexity and making the case for phenomenologically informed approaches I will do so from the vista of the Newtonian-Cartesian paradigm and examine some of the fractures that emerge from within its own logic. To make this case I will discuss Kurt Gödel's Incompleteness Theorems in conjunction with developments in our understanding of emergence and consciousness with particular reference to David Bohm's version of quantum mechanics. This discussion will argue for a new dialogue based around complexity theory through discussing (1) the inherent problems that classical mechanics reveals within its own paradigm, (2) what recent developments in complexity theory adds to these arguments, and (3) to suggest that an increased understanding of complexity informed by developments in mind-matter relationships should in turn inform the ethics of justice.

Key words

Complexity Theory, Newtonian Paradigm, Complex Adaptive Systems, Gödel's Incompleteness Theorems, Quantum Mechanics, David Bohm, Phenomenology, Criminology

Introduction

The purpose of this paper is to utilise developments within complexity theory to make modest arguments for phenomenological informed approaches in criminology (and social science more broadly). Following the work of Paul Cilliers (Cilliers, 1998, 2005) the term 'modest' describes "reflective positions that are careful about the reach of the claims being made and of the constraints that make these claims possible" (Cilliers, 2005:256). This approach is needed because forms of positivism (randomised controlled trials, experimental method etc) are still dominant in criminological research so it helps to explore the limits of those ontologies and epistemologies. But also despite advances in complexity theory across positivist, post-positivist and constructionist approaches (see e.g. Pycroft and Bartollas, 2014) there is still a tendency in criminology to identify complexity theory with chaos theory, which is in itself a different version of positivism. This gives rise to a performative contradiction (positivism offering a critique of positivism) which may help to explain Milovanovic's (Milovanovic, 2013) complaint that there has

been a decline in receptivity and integration into criminology of complexity theory; and notwithstanding the fact that a decontextualized positivism cannot provide us with a meaningful ethic of justice.

After relativity and quantum mechanics complexity theory has been proclaimed as the third revolution in human thinking but central to this discussion is the question of whether complexity (non-linearity, see below) is inherent within the Newtonian paradigm of classical mechanics or whether it represents a break from enlightenment based reductionist and positivist approaches in science and social science. Discussions concerning the potential for performative contradiction are important for criminologists because arguments for various deterministic relationships *contra* human agency within that paradigm are *condiciones sine quibus non* in our claims to be able to measure, predict and change social phenomena. To stress the point social scientists are children of the determinism of Newton and Descartes *but* the logic of these approaches lack an understanding or even awareness of human consciousness as a basis for human actions (see Milovanovic, 2014). These debates are not peculiar to complexity theory and in challenging the traditions of classical mechanics and asserting the importance of complexity theory in literally helping us to rediscover our minds and moral agency it becomes apparent that there are divisions and problems within the 'house' of complexity. Complexity theory has not fulfilled the promise of a unified theory, with key debates focussing on familiar arguments apropos positivism, realism and post-modernism concerning the establishment of laws, regularities and determinism and their relationships to human consciousness and agency. In addressing these debates I will argue for a focus on the importance of complex adaptive systems (CAS) as a heuristic device that reveals the continuities and discontinuities between those differing perspectives, but furthermore for the concept as a locus for debate and study to allow for the possibilities of developing insights from apparently diverse ontological, epistemological and methodological approaches.

To achieve this I will explore the broad parameters of the key debate concerning the reducing of the system to rules and laws (a process of relative disjunction) against complexity as something to be embraced and that is concerned with understanding things only in relation to other things (a

process of relative conjunction). An important focus will be on the transformational potential of human consciousness to overcome but importantly not deny or refute determinism within a *given* phase space. The concept of 'gift,' 'given,' 'givenness' is a key hermeneutical link (developed by Marion (Marion, 2002) building on the work of Husserl, Heidegger and Levinas) – see below) that adds a key ethical dimension to arguments for a relational or empathetic criminology (see e.g. Millie, 2016).

The argument will be made that evidence from within scientific method itself demonstrates that a unified theory of everything that allows us to identify, measure, predict and explain does not exist, and that increasingly post-modern and phenomenological and hermeneutically informed perspectives are required to address the gaps that are left. This argument is not predicated on waiting for 'science' to catch up to prove our speculation right or wrong, but to assert that consciousness is itself a constituent part of the unfolding of the nature of not just social life, but the universe itself; as Michel Serres has argued we always dream science before actually doing it (see Dupuy, 2013 for a discussion of this in relation to science, religion and metaphysics).

The modest approach in addressing these questions and making the case for phenomenological approaches in complexity theory is I argue from the vista of the Newtonian-Cartesian paradigm itself so as to examine some of the fractures that emerge from within its own logic. To make this case I will discuss Kurt Gödel's Incompleteness Theorems in conjunction with developments in our understanding of emergence, consciousness and quantum mechanics. This discussion will argue for a new dialogue based around complexity theory through discussing (1) the inherent problems that classical mechanics reveals within its own paradigm, (2) what complexity adds to these arguments, and (3) to suggest modestly that an increased understanding of phenomenologically based approaches can and should in turn inform our ethics of justice. The key assumption made within this paper is that criminology is fundamentally concerned with human beings who are biological, conscious, moral in nature and existing within evolutionary (dynamic) phase spaces. It is hoped that this discussion will enable us to understand some of the differences and

commonalities in the study of complexity, and hopefully provide for fruitful discussion and dialogue to move this relatively youthful area of study forward.

Complexity theory

Whatever our view of complexity e.g. a problem to be solved or something to be embraced it is ubiquitous and in reality simple systems do not exist even in so called 'simple life forms' (see Ochman and Raghavan, 2009). In the words of Jaques Derrida

"One shouldn't complicate things for the pleasure of complicating, but one should also never simplify or pretend to be sure of such simplicity where there is none. If things were simple, word would have gotten round…" (Derrida, 1988:119).

Complexity theory is the study of non-linear dynamical systems (NDS) and the understanding that changes within a system is not necessarily proportional to inputs. In developing innovative solutions to social problems complexity theory challenges the reductionism inherent in cause and effect approaches that have dominated western thought predicated upon the Platonic-Cartesian-Newtonian traditions in science and social science. It is argued by Bar-Yam (Bar-Yam, 1997:5) that:

"*The study of complex systems in a unified framework has become recognized…as a new scientific discipline, the ultimate of interdisciplinary fields…strongly rooted in the advances that have been made in diverse fields ranging from physics to anthropology, from which it draws inspiration and to which it is relevant*."

However in practice despite early aspirations complexity theory has not provided a unifying framework and splits along traditional positivist, post positivist (realist) and post-modern (constructivist) perspectives (see Pycroft and Bartollas, 2014). To conceptualise these developments Morin's (2005) categories of 'restricted' and 'general' complexity are useful. The former refers to the type of complex systems theory, mathematically based that has developed from rather than representing a break from the Newtonian paradigm of classical mechanics; the latter challenges an implicit reductionism in establishing rules and regularities that is inherent in the restricted paradigm by arguing for open systems and a principle of conjunction rather than

disjunction and is therefore more concerned with the relationships between the parts and the whole. Byrne in advocating general complexity (1997:2) states

"*that we now have available an account of dynamics which centres on non-linear changes in the properties of systems as a whole rather than the linear trajectories of the elements which are located within those systems…we should replace mechanics with thermodynamics as our central analogy…systems are inherently evolutionary and…changes over time are not reversible…systems are essentially historical*."

An important question of self-reflexivity for complexity theorists who are embedded in the systems they study is whether higher order solutions (solutions which transcend independent disjointed and static categories within the system) can be found within the subject itself to avoid polarisation, fragmentation and reductionism and whether we can move out of silo based thinking that has historically been a consequence of Cartesian 'ghost in the machine' dualism. It is argued for example by Mikulecky (2001) that in the 'natural sciences', and through the analogy of the machine, Cartesian reductionism (in the form of Randomized Controlled Trials and experimental methods for example) does not work in making models of complex systems because it merely reduces them to an aspect of the overall system. In these methodologies by reducing the complexity through abstracting from the whole to understand it, we cannot understand it because we only have a part and not the whole. This is a major paradox that runs throughout the study of complexity and with respect to criminology provides arguments for relational understandings of justice.

Complex Adaptive Systems

It is useful to think of the term 'Complex Adaptive System' as a heuristic metaphor[1] that helps us to understand behaviours of multi-agented systems, made up of multiple interacting elements. This use of metaphor is useful in providing epistemic access to dynamic systems and not only fits

[1] I refer to metaphor as a practical modelling device rather than making any clear statement about isormorphism. The former is figurative whereas the latter is literal. The relationship between the two is ambiguous (see Paniagua, 1982) and for the purposes of my argumentrelates to the problem of epistemic fallacy (see below).

with the mathematical nominalism of Bishop Berkeley who saw mathematical symbols as a kind of linguistic convention (see Avigad, 2007) but also post-modernist perspectives on the reflexivity of language and the ways in which it is essentially a local phenomenon which has validity in a certain time and space (see Cilliers, 1998). The use of metaphor is argued for example by Proctor and Larsson (2005:1065):

"It may be helpful to consider complexity, and related terms such as "self-organization," as recent metaphors deployed to advance knowledge on fundamental questions…including the relationship between parts and wholes, and between order and disorder. Though not commonly viewed as such, metaphors are an indispensable component of science, and should not be appraised as true or false, but rather in terms of how they help or hinder knowledge. By understanding metaphor as a necessary ally and not a threat to…knowledge, we may enrich our contextual understanding of complexity while continuing to invoke it in useful ways."

The use of metaphor as mental models then allows us to engage in a rich and deep interpretation of the world, whilst acknowledging that we can only ever have a partial picture of "reality." Mikulecky (Mikulecky, 2001) reminds us that through observing the world around us and using mental activity to make sense of and interpret sensory information this 'modeling relation', argues that the 'natural system' and the events of causality are our objects of study, which we then, however, translate or encode into another system that we cognitively construct and call a 'formal system'. We then use this system in various ways to identify and copy the changes in the natural system. The real world is complex, and critically, the modeling relation is forgotten because the formal system has become reality. This is an example of epistemic or ontic fallacy, with the model being seen as reality rather than the reality itself.

The Newtonian paradigm views the universe as complicated and acting essentially like clockwork (making model building a reasonable option) whereas the distinction between complicated and complex is fundamental to understanding the nature of complexity theory. CAS allow us to distinguish with clarity the differences between systems that are complicated and those that are complex. Pycroft, (2014:21) makes the following distinction:

"Merely (but, nonetheless, often impressively) 'complicated' engines, for example, are complicated in that they can be understood by identifying and describing their component parts, which follow a linear process from ignition through to cruise control; however, complex systems and the interaction between the component parts and their openness to their environments mean that they cannot be fully understood by identifying their components (see Cilliers, 1998), making it very difficult to predict how they will act…In this sense, complicated systems are actually quite simple once you understand how they work and you have a manual that describes their interactions."

Within differing perspectives on complexity theory there is some consensus about the key features of CAS (see Byrne, 1998; Cilliers, 1998; Morçöl, 2012; Byrne and Callaghan, 2013; Wolf-Branigin, 2013) which allows a focus for debate (see Pycroft and Wolf-Branigin, 2015 for this application to social work). The properties of CAS are as follows:

- CAS have multiple elements, and the larger the number of elements the more difficult and impractical it becomes to analyse and describe the system mathematically due to emergent behaviour which makes the system more than the sum of its parts.
- CAS are capable of learning and change and emergent properties may arise through the lower-level interactions between agents and such properties cannot be understood at the level of the agents themselves. This becomes the focus for a whole systems approach which looks at the behaviour of the overall system and the ways in which component parts however small have the potential to change the behaviour of the whole.
- CAS are evolutionary in nature and there is no guiding hand or template for their development rather they develop through a process of 'order for free' and as per evolutionary processes some systems achieve equilibrium, some exist on 'the edge of chaos', some are chaotic and some eventually die; with some systems cycling through all or some of these stages determined by their attractor states.
- An attractor (see Guastello and Liebovitch, 2009 for a full discussion) is a space in which movement can take place or not; it effectively acts like a magnet to attract other objects

into its basin unless they have sufficient energy to move away. Attractors are stable structures because all of the points within it follow the same rules of motion and different attractors determine different types of motion: fixed point (gravitation towards an epicentre), limit cycle (a cyclical orbit), toroidal (is a limit cycle that travels along two axes rather than one and becomes unpredictable) and strange/chaotic (within a bounded space there are high levels of unpredictability and sensitivity to initial conditions meaning that small changes within the motion of the attractor can have a big effect). As well as attractors there are also repellors which as the name suggests has the opposite effect by deflecting objects away from the epicentre often in an unstable manner. Importantly within attractor states bifurcations can be created which bring instability through a system attaining more complexity by accessing new dynamical states.

- The interaction of these elements is then dynamic and changes over time; CAS have a history and because of the arrow of time are non-reversible (classical mechanics assumes reversibility).
- The exact behaviour of the system is not quantifiable to the precise amount of interactions allocated to individual elements. The different elements in the system can be connected to a greater or lesser degree but still have significant impact on the overall behaviour of the system.
- These interactions can be non-linear in nature in so far as their behaviour is not necessarily proportionate to inputs into the system; this behaviour defines the behaviours of complex systems.
- Complex systems are open systems that interact with their environments and are usually nested within other systems, and also made up of sub systems, making the boundaries of the system unclear. The elements in a system mediate the environmental impact on that system to either strengthen or weaken the impact, with output from one system/sub system providing the input for another
- The interaction of the elements can create negative and positive feedback loops that either dampen or stimulate the system. Importantly, the system can adapt to changes in the

internal and external environment and there is an overlap between subcategories and because of this connectivity, the existence of fuzzy boundaries and overlap, it is difficult to simply remove a part of the system and to replace it; the system has a history, which determines its current structure, internal organisation and behavior; this is known as sensitivity to initial conditions.

Addiction for example is best understood as a complex adaptive system (see Pycroft, 2010, 2015) which is highly deterministic with the real possibility of a spiraling down leading to entrenched and socially exclusionary factors. These deterministic factors cover a range of biological, psychological and social issues which can become "locked in" with the system having an ability to accommodate perturbations such as treatment interventions which poses significant challenges to interventions and their necessity of being as dynamic as the problems they are trying to solve. Some of these factors are changes in the cortico-mesolimbic dopamine system (CMDA) which distorts the brain's reward system that gives us motivation in the evolutionary environment leading to compulsion; drug seeking is initiated outside of consciousness; addiction is 50% heritable; most people with addictions have other psychiatric disorders as well and addiction is a chronic relapsing condition in the majority of people who seek help (Sellman, 2009). In addition we know that drug use and particularly deaths from drug use are linked to social characteristics such as being male, young, unemployment, having lower educational achievement, being unmarried, from lower socio economic status, experience of family conflict, parents with positive attitudes towards drug use and overall experiencing individual, family and community disadvantage (Darke, et al 2007). The challenge is to find solutions to address these apparently intractable problems.

However CAS are by nature adaptive, transformational and unpredictable, with random (chaotic) behaviour occurring as a result of rather than as an exception to deterministic rules. The evolutionary nature of these systems means that over time they are able to respond to both internal and external forces leading to indeterminate change. This means that from the complexity perspective and to move beyond the positivist paradigm we need to address the problem of

structural determinism that is left unresolved within the Cartesian approach and its implication for ethics

Classical Determinism and complexity

Within positivist and post positivist (realist) approaches to complexity there is a focus on determinism, formal rules and regularities that give rise to complexity and which are encapsulated in the concepts of sensitivity to initial conditions and attractor states. All of these systems can theoretically be mapped mathematically and based upon axiomatic principles. There are however (at least) two problems with these approaches; firstly the limitations of establishing universal and deterministic laws of mathematics and logic as identified by Kurt Gödel and secondly the role of human consciousness within mathematical models. I want to briefly address the first point and then address the second by reviewing important developments in the relationships between quantum mechanics, biological life and human consciousness.

The positivist and post-positivist (realist) argument is that not only does the universe appear to work with a remarkable degree of regularity but it is precisely this determinism which allows us to measure and to some extent predict future behaviour of systems and the properties of those systems. To a large degree positivism and the reification of science would seem to be largely justified in this approach; completing the periodic table, establishing a standard models of physics and cosmology that are able to predict the existence of the Higgs-Boson particle or quantum gravity and then to find to find the evidence for them are remarkable. This would seem to suggest that we are on our way to discovering a complete theory of everything that exists or is derived from a Platonic realm of ideal mathematical models. Determinism and therefore measurability and predictability are akin to Leibniz's *Calculus Ratiocinator* (Peckhaus, 2009) whereby algorithms and formulae can be applied to rules and statements to determine whether they are true or not. However to demonstrate the limits to mathematical models and rule based systems we can use two well-known examples; firstly Newton's 'Three body problem' and secondly Bertrand Russell's Barber's Paradox. In the first example it is very straightforward to predict the elliptical orbit of one planet around the sun, but as soon as another planet is introduced exact prediction becomes

impossible due to deterministic chaos brought about by arbitrarily small changes in position and velocity. The system is deterministic but it is inherently unpredictable (Jennings, 2014).

The second example is as follows:

"Suppose you walk past a barber's shop one day, and see a sign that says

"Do you shave yourself? If not, come in and I'll shave you! I shave anyone who does not shave himself, and no one else."

This seems fair enough, and fairly simple, until, a little later, the following question occurs to you - does the barber shave himself? If he does, then he mustn't, because he doesn't shave men who shave themselves, but then he doesn't, so he must, because he shaves every man who doesn't shave himself... and so on. Both possibilities lead to a contradiction." (https://plus.maths.org/content/mathematical-mysteries-barbers-paradox)

This paradox challenged so called "naïve" set theory which argues that any clearly phrased condition defines a set; that is the set is made up of all things that satisfy the condition. Clearly according to the paradox some sets are not members of themselves and appears to conform to the Law of the Excluded Middle; within standard logic if A is true, then B is false (and vice versa) with the excluded middle stating that both A and B are true, which is an apparently contradictory statement (The Copenhagen interpretation of quantum mechanics appears to conform to the Law of the Excluded Middle (see below) with the famous Schrödinger's Cat thought experiment used by Schrödinger himself to demonstrate the absurd consequences of the Copenhagen version of quantum mechanics when you have a cat that is both dead and alive (see Gribben, 1994)).

The problem of whether any coherent condition could determine a set was addressed by Gödel's Incompleteness Theorems (see Raatikainen, (2015). These theorems demonstrate that it is not possible to find a complete and axiomatic set across all mathematics. The first theorem states that within a mathematical system it is not possible to find a system that is capable of proving all truths about the relationships of the numbers within that system: There must be statements about

natural numbers that are true but are not provable within the system. The second theorem states that such a system cannot demonstrate its own consistency.

The findings of Gödel have been nothing short of revolutionary in mathematics and beyond and has led to the view that a complete theory of the universe is not possible; in part due to our lack of overall observer status (e.g. a rejection of the 19th Century's Pierre-Simon Laplace's positivist conceit of the Daemon; the intellect that could know all past events, predict all future events and understand any composite entity through a process of atomising the constituent parts), thus our systems are always self-referential, but also because as Gödel demonstrates it is not possible to formulate a theory of the universe in a finite number of statements (http://www.hawking.org.uk/godel-and-the-end-of-physics.html).

Positionality (as demonstrated by Einstein's Theory of Relativity (albeit the laws of physics remain constant)) and the subjective nature of experience is identified as significant within mathematics and physics as well as post-modern thought with for example Paul Cilliers seeking to avoid an approach to complexity theory that is purely relativistic but arguing that 'it is not possible to tell a single and exclusive story about something that is really complex' (Cilliers, 1998: viii). For Cilliers it is far more important to think in terms of relationships between the parts of a system and its whole rather than deterministic rules. This is because of the significance of the observer within the system which is open, and has unclear boundaries which in themselves should not be confused with the limit or influence of the system; that the diversity of the system is the best resource for understanding the system rather than a reduction to component parts; significantly self-organisation and social construction undermine the concept of self-contained atomised subjects; and because we do not have neutral observer status we have to make choices and engage in normative considerations. Cilliers (1998: 35) in arguing for connectionist rather than representational models looks to quantum mechanics and the relational descriptions of sub atomic particles and argues that 'The significance of each atom is … not determined by its basic nature, but is a result of a large number of relationships between itself and other atoms'

Gödel's mathematics is inherently complex and reveals the limitations of classical mechanics and knowledge. In addressing these 'problems' his philosophy is also complex in which he defended both the rationalist idea that mathematics is a description of Platonic objective reality *and* the realist concept of the impossibility of interpreting empirical laws due to the fact that our sense data are bound up with the conditions under which they are experienced. This gives rise to the fascinating tension that the objective platonic realm exists but we do not have access to it. This means that no correspondence or verification about those conditions and the statements that we want to prove can be made. To try to overcome this dualism Gödel looked to phenomenology, and stated as follows:

…there exists today the beginning of a science which claims to possess a systematic method for such a clarification in meaning, and this is the phenomenology founded by Husserl. Here clarification of meaning consists in focussing more sharply on the concepts concerned by directing our attention in a certain way, namely onto our own acts in the use of these concepts, onto our own powers in carrying out our acts, etc. But one must keep in mind that this phenomenology is not a science in the same sense as other sciences. Rather it is (or in any case should be) a procedure or technique that should produce in us a new state of consciousness in which we describe in detail the basic concepts we use in our thought, or grasp other basic concepts unknown to us. I believe there is no reason at all to reject such a procedure at the outset as hopeless…not only is there no reason for the rejection (of phenomenology), but on the contrary one can present reasons in its favour (Gödel, 1995: 383 cited in http://plato.stanford.edu/entries/goedel/goedel-phenomenology.html).

Consciousness and human agency

Husserlian phenomenology argues that reality and its objects are constituted by consciousness and are immanent in and inseparable from consciousness (Morçöl, 2012). This mitigates against the possibility of objective knowledge. In this approach our consciousness structures what we experience on the basis of previous experiences and the context of our current experience. In discussing the ways in which our consciousness constructs reality Polizzi (Polizzi, 2016) for

example considers the fatal shooting of black teenager Trayvon Martin by Neighborhood Watch Volunteer George Zimmerman. In this situation Zimmerman's understanding of the world was

"…framed by a set of contextually situated taken-for-granted expectations that are constructed or recognized as being most consistent or normal to that locality." (Polizzi, 2016:30).

In this case Polizzi argues that within all the accounts provided of this shooting no one questioned the basic rationale that was constructed of Martin being dangerous and criminal given that he was a black teenager and was present in that particular neighbourhood.

A key question for criminal justice and ideals of rehabilitation is whether change is possible for the individual perpetrator. There are no guarantees of this even in repeat encounters and again this uncertainty is a feature of complexity theory. In respect of knowledge based on previous experience Husserl uses the terms "Noesis" and "Noema" with the former referring to the act of apprehending an object and the latter the object that is apprehended. Within this approach there is an "I-pole" and an "object-pole" that allows for consciousness of something (see Rassi and Shahabi, 2015). However Morçöl (Morçöl, 2012) argues that whilst this may resemble for example Kant's synthetic a priori they are far more malleable than Kant's fixed categories in that the knower can change his/her world view based upon experience. It is argued by Needs and Adair-Stantiall (Needs and Adair-Stantiall, 2017:35) that not only is this capacity for adaptive change essentially characteristic of social systems but that

" The boundaried network of mutually generating and sustaining processes that comprise a system ensures its continued self-generation and self-organisation; interactions with other systems are necessary for its growth, learning and survival…"

They further argue that to allow for the emergence of a coherent self (a viable agent) within complex systems that a person needs a sense of distinctiveness through time (autonomy within connectedness) that provides viability and continuity. What complexity theory shows us is that this change is only made possible through the evolutionary nature of the arrow of time which allows for

the development of new phenomena (see Priogogine and Stengers, 1997) but that a sensitivity to initial conditions is also a real possibility.

In examining the relationships between quantum mechanics and human agency, choice and freewill it is important to follow the logic of naturalised phenomenology. An utilisation of the power of quantum mechanics has transformed the world with respect to finance, the global economy, computing and digital innovations, but the implications of an understanding of the quantum level have yet to inform our understanding of human agency (see Bartollas, 2014). This is because (1) to have a unified theory of everything we need to have an agreed theory of consciousness but we do not know what consciousness is; (2) but we can say that the Cartesian 'Ghost in the machine' approach splitting the universe between thinking substances (res cogitans) and the mechanical world (res extensa) does not help to solve the problem of the structure-agency divide; (3) quantum level indeterminacy looks, and is weird in comparison with classical physics, with Einstein famously questioning whether God plays dice with respect to the indeterminacy of the Copenhagen Interpretation of quantum mechanics.

The quantum level is not only where 'consciousness' meets potential 'structure', but is from where reality emerges into the realm of classical physics and is therefore an essential area for discussion, theorising and exploration for social scientists. Some of the most recent work on complexity, phenomenology and quantum mechanics has arisen in the domain of evolutionary biology. Whilst complexity might seem an intuitively reasonable approach (for example in the study of eco systems) quantum mechanics has long been seen as being unrelated to biology (Arndt, Juffman and Vedral, 2009) (and even more so, social science); but also attempts to 'naturalize' phenomenology have challenged Cartesian dualism and scientific method. In developing this area of study Kauffman and Gare (2015), Pylkkänen (2015) and Longo, Montévil and Kauffman (2012) combine their work with postmodern philosophical insights to help explain complex evolutionary processes, and enhance our understanding of consciousness and social life.

Pylkkänen (2015) points out that despite the philosophically radical implications of quantum theory and relativity there has been little discussion of this in the phenomenological literature

despite for example Merleau-Ponty's engagement with physics and Heidegger's discussions with Heisenberg. Quantum mechanics seems to provide another fracture in the Newtonian paradigm given that for example the decay of radioactive atoms takes place randomly; that the position and momentum of a quantum system cannot be measured at the same time; and the 'double-slit experiment' demonstrating that light and matter exist in a state of superposition whereby they exist simultaneously as waves and particles (see below). The implications of this are profound as:

"…Evidence obtained under different experimental conditions cannot be comprehended within a single picture, but must be regarded as complementary in the sense that only the totality of the phenomena exhausts the possible information about the objects." (Bohm, 1949 cited in Pylkkänen, 2015:8).

When it comes to predicting human behaviour the brain as the most complex system that we know of simply has far too many particles to make this mathematically possible. But Longo, Montévil and Kauffman (2012) also argue that the *strong determinism* (my emphasis to stress that this is not a complete absence of determinism) and hence reductionism of the Newtonian paradigm of physics breaks down when explaining the evolution of the biosphere (and by extension features such as the human brain); it has come into existence without an entailing law, moreover given this is the case then no such law is necessary for such extraordinary complexity to arise and thrive. The key points of their arguments are as follows:

- In physics we can not only pre-state the phase space (trajectory) of a given system, but the dynamics of that system are measurable.
- In biological evolution the phase space changes persistently and in ways that cannot be pre-stated or predicted.
- Due to not being able to pre-state the changing phase space of biological evolution we cannot clearly identify the boundary conditions or the relevant observables and parameters to be measured.
- If this is true then no law entails the evolution of the biosphere

- If we understand 'cause' as that which gives a differential effect, entailed by law then we can assign no cause in the evolutionary changes within the biosphere.
- Rather than 'cause' the authors use the concept of 'enablement', of making possible.
- Importantly their thesis does not take away the need for reductive explanations of organisms existing as whole at a given point in time to explain a physical account of behaviour once evolved; for example organs of the body such as a heart (see the discussion on David Bohm's work below with respect to explicate order).

Strange attractors

A strange attractor is one in which patterns and regularities do exist in the phase space, but the system never follows the same trajectory (see Pycroft, 2014a). There are processes of both expansion and contraction and the chaotic motion operates in more than one dimension. There is order and control although each order parameter is affected by the behaviour of other order parameters. These attractors are prone to bifurcate, that is become increasingly complex by accessing new dynamical states in their environment; this is effect and effect rather than cause and effect. In addition the sub systems of a strange attractor may exist as strange attractors or as other types of attractor in conjunction with each other. This makes the evolution of the whole system and its trajectories fundamentally uncertain.

Complexity theory is fundamentally concerned with the concept of multiplicity apropos multi-agented systems, and the need for a whole systems perspsective. In phenomenology Husserl sees multiplicity related to a unified consciousness (see Gödel above) and by Bergsonism which differs by arguing that consciousness is not *of* something, but rather *in* something[2] (Milovanovic, 2014). The process philosophy of Bergson and the development of his concept of time and consciousness as *la durée*, or 'duration' (Bergson, 1988) are useful in our approach to understand connectionist complex systems as examples of strange attractors. Within *la* durée Bergson differentiates

[2] Bergson's philosophy was an attempt to overcome Kantian antinomies by asserting the possibility of absolute knowledge. My position is that Gödel should be the starting point in this debate. Moreover it is not the intention of this paper to examine the debates between differing schools of phenomenology. Bergson represents a distaff tradition seeking to integrate both analytic and phenomenological approaches (see Hodges, 2008).

between quantitative (discrete) and qualitative (continuous) multiplicities. These differences are described by Hodges (Hodges, 2008: 409) as follows:

Quantitative multiplicities are numerical in nature, and take the form of the one and the many: their chief differences are homogeneous differences of ***degree*** *(emphasis retained), and such multiplicities can therefore be divided without occasioning a difference in kind. Qualitative multiplicities, by contrast, on division create heterogeneous differences…they comprise an interrelated (i.e. relational) infinite whole, where any multiple is fused with all other multiples and any one cannot either be isolated or change without all others changing…*

Strange attractors are examples of qualitative and quantitative multiplicities, containing infinite possibilities that are not foreseeable, with the realisation of the possible only existing in retrospect. This then allows for understanding the divergence and convergence and complexity of human lived experience grounded in *la durée* of relational time. Importantly within Bergsonism we can platonically reconstitute the subject of our study after the event, but this does not give us the thing itself. According to Bergson we have to engage in a process of intuition that allows us to enter into the thing that will allow for absolute knowledge. However in line with Gödel we have to say that this absolute knowledge is not possible as intuition (to be understood as self-sympathy and empathy for the other) only gives us knowledge of *la durée* as a contracted part of the whole, but nonetheless is related to the whole, and it's becoming[3]. Within Bergson's approach *"there is no direction in which flux or process is moving, and there is no one river of time that flows"* (Hodges, 2008:415) which would appear to be consistent with Einstein's theory of relativity but again the dynamics of the system are relative to the arrow of time as a quantitative multiplicity; evolution is not reversible.

Longo, Montévil and Kauffman's (Longo, Montévil and Kauffman 2012) are effectively using the concept of strange attractors to underpin the uncertainty and non-linearity of biological processes,

[3] This becoming is linked with different phase spaces relative to energy and the arrow of time e.g. chaos, edge of chaos, equilibrium and entropy (the third law of thermodynamics states that absolute entropy is not possible).

and by extension the nature of evolutionary and social life. The concept of strange attractors is evident in the work of Deleuze and Guattari (as a development of Bergson) (see Massumi, 1996) and I am arguing that this concept is essential in our understanding of whole systems approaches to understanding social life. I would also suggest that all social phenomena as CAS exist in a strange attractor state, and it is to this concept that we need to look to in finding a common language that allows for the development of complexity theory. This language in itself needs to try and not reduce complexity to one perspective but to reflect the evolutionary becoming that is the social world.

This is self-evidently not straight forward but we can construct an argument supporting naturalised phenomenological approaches based around Longo, Montévil and Kauffman's work and the quantum mechanics of David Bohm.

Longo, Montévil and Kauffman (Longo, Montévil and Kauffman 2012:2) argue for cells and organisms as Kantian wholes which they define thus:

"*the whole exists for and by means of the parts, and the parts for and by means of the whole…Kantian wholes married to self-reproduction and Darwinian evolution are part of the non-ergodic, historical becoming of the Universe, and, we claim beyond entailing law. A deep aspect of the freedom from entailing law in the evolution of organisms is that the possible 'uses' of a given part or process of an organism are, both indefinite and un-orderable, in our views, thus a fortiori, no effective procedure or algorithm can list them*."

They argue that new parts, processes and adaptations and Darwinian pre-adaptations arise all the time often caused by quantum indeterminate, acausal, random mutations, develop uses and novel functions as parts of the organism and become a part of it within the un-prestatable selective environment. It is only by looking at the whole that the features of a new niche are revealed demonstrating that the organism and its niche are co-constituted in a circular way that cannot pre-stated. For Longo, Montévil and Kauffman (Longo, Montévil and Kauffman, 2012) evolution represents radical emergence, from life to life whereby that evolution creates, without selection

acting to do so new adjacent possible empty niches thus enabling possible new evolutionary directions; again due to sequences of quantum events at the molecular level which are acausal. Thus the niche is not causal but enabling of radical emergence meaning that "If correct, reductionism reaches a terminus at the watershed of life." (Page 3). They argue that within this post entailing law explanatory framework new Actuals constituting boundary situations evolve and that allow for historical evolution but in a process of persistent becoming.

This analysis gives us a powerfully new understanding of the fluidity of attractor states, and the transfer of energy within and between systems; however we still need to address the problem of human consciousness and agency, and the question of whether this can be rescued from both Cartesian and biological determinism. Central to these discussions is the notion of the 'arrow of time' and non-reversibility as essential components of CAS. However there are three arrows of time; thermodynamic, psychological and cosmological (Hawking, 1988) with complexity having focussed on thermodynamics and the transfer of energy between systems, and the movement towards cycles of entropy and disorder (driven by attractor states). The psychological arrow is how we subjectively experience time and why we remember the past and not the future and is inextricably linked with thermodynamics. The cosmological arrow of time indicates an expanding rather than contracting universe. Hawking (Hawking, 1988) argues that all three arrows need to be pointing in the same direction to allow for the creation of intelligible life, indicating a high level of determinism.

It is argued by Kauffman and Gare (2015) and also Milovanovic (Milovanovic, 2013, 2014) that we need to do quantum mechanics to break the Cartesian problem of the human brain and mind having no real purpose within a closed and deterministic universe. In progressing from the vista of classical mechanics it is not clear what the relationship is between the quantum and the classical physical world and what the limits of each are, and how consciousness is related to these. In the quantum world there is no chaos only regularities and the explanation for the existence of chaos (and by extension complexity) in the physical world is the size and mass of systems, which cannot be disaggregated from their environments and also quantum decoherence (Berry, 1989). Quantum

decoherence functions to bring a system into a classical state whereas previously it has existed in a state of superposition (e.g. existing as both wave and particle until following observation there is a collapse of the wave function into or the other).

This brings us to a key debate in quantum mechanics with respect to the Copenhagen and the de Broglie-Bohm interpretations and for our purposes the relevance to criminology and social research. In the development of a quantum holographic approach to criminology the work of Dragan Milovanovic (Milovanovic, 2013, 2014[4]) has been ground breaking and provocative. In assessing the status of that work then the review by Raymond Bradley (Bradley, 2015) a pioneer of quantum holography has been useful and helps to understand the complexities of this important field and to seek to develop it further. In his review Bradley highlights some issues with Milovanovic's concept, two of which are pertinent to my argument: Firstly he points out that quantum holography is not a branch of quantum physics as implied by Milovanovic; secondly he has reservations about Milovanovic's use of the concept of the 'collapse of the wave function.' Both of these issues are linked and stem from Milovanovic's reliance on the Copenhagen version of quantum mechanics (for which he states (Milovanovic, 2013) that there is the most evidence. Bradley (Bradley, 2015) argues firstly that quantum holography has much wider scope than quantum physics as it applies to the macro as well as micro (quantum) worlds for which it can completely and accurately measure communication of energetically encoded information but secondly that human consciousness cannot be reduced to quantum physics vis a vis the collapse of the wave function. I would argue with respect to understanding the relationships between consciousness and matter the de Broglie-Bohm approach to quantum physics may be more helpful to our understanding of consciousness *in something rather than of something* and is of particular relevance to complexity theory, as it gives back reality itself in the form of objectivity, patterns and regularities in the phase space of any given system.

[4] In his work Milovanovic rightly and courageously seeks to introduce the concept of the meaningful subject into criminology through the development of Schema QD. The intra and inter construction of the subject is an essential area for development in social science and complexity theory adds to this debate.

The key to Bohm's argument is;

"...the notion of the enfolded or implicate order. The essential feature of this idea... (is)...that the whole universe is in some way enfolded in everything and that each thing is enfolded in the whole. From this it follows in some way, and to some degree everything enfolds or implicates everything, but in such a manner that under typical conditions of ordinary experience, there is a great deal of relative independence of things. The basic proposal then is that this enfoldment ***relationship*** *(emphasis retained) is not merely passive or superficial. Rather it is active and essential to what each thing is. It follows that each thing is internally related to the whole, and therefore to everything else. The external* ***relationships*** *(emphasis retained) are then displayed in the unfolded or implicate order in which each thing is seen, as has already been indicated, as relatively separate and extended, and related only externally to other things. The explicate order, which dominates ordinary experiences as well as classical (Newtonian) physics, thus appears to stand by itself. But actually it cannot be understood properly apart from its ground in the primary reality of the implicate order. Because the implicate order is not static but basically dynamic in nature, in a constant process of change and development, I called its most general form the holomovement. All things found in the unfolded, explicate order emerge from the holomovement in which they are enfolded as potentialities and ultimately fall back into it. They endure only for some time, and while they last, their existence is sustained in a constant process of unfoldment and re-enfoldment, which gives rise to their relative stable and independent forms in the explicate order" (Bohm, 1990:3).*

Within Newtonian/Cartesian dualism there is the assumption that matter occupies discrete space whereas mind does not. Quantum mechanics challenges that assumption with Bohm's theory developing the argument that the particles of physics have primitive mind like qualities thus it is not possible to make an absolute distinction between mind and matter. In developing accounts of reality that correspond to contextual, qualitative and connectionist models (contra independent, quantitative and representational models) then Bohmian theory offers real potential. He argues (see Bohm, 1980; Bohm and Hiley, 1987 and Bohm, 1990) that particles do follow a well-defined

trajectory but that it is always accompanied by a new kind of quantum field. In physics these quantum fields can be represented as potentials which describe a field as a potentiality, present at each point of space acting on a particle which is at that point. In Newtonian physics the effect is always proportional to the intensity of the field, but in Bohm's theory the quantum potential is dependent only on the form and not the intensity of the quantum field; consequently even a weak field can strongly affect the particle as can distant environmental factors. This affect from a distance (non-locality) is new, and reintroduces determinism (contra indeterminism) into quantum theory. For Bohm (1990) the key element in understanding this non localism is the notion of active communication which puts form into the energy (quantum potential) that the particle has. Crucially it is the active communication from within the whole system (quantum field) that gives shape and form to the particle. The ways in which these particles interact is dependent upon the pool of information within the whole system but in ways that cannot be pre-assigned. The quantum potential for a whole system is then non-local and brings about order or form (or 'emergence' to use the language of complexity theory).

With respect to what we experience in the classical world of physics as opposed to quantum level behaviour Bohm (Bohm, 1990) argues for wholeness at the quantum level and objective significance. He argues that active information is the rudimentary mind like behaviour of matter, given that the essential quality of mind is the activity of form rather than substance. In this theory active information is both physical and mental in nature in a relationship that continues to exist at infinite levels of subtlety, and our consciousness and thought forms are present at the quantum level. The implications of this approach are profound in which there is no division between mind, matter and consciousness with our whole beings engaging in a "a flux of fundamental participation" (Bohm, 1990: 9). Bohm (Bohm, 1990) argues that both 'mind' and 'matter' serve only as terms for analysis, which help us to understand things, but cannot be seen as separate substances in interaction with each other, or reduced to serve as a function of the other.

An important contribution to this argument is the work of Penrose and Hameroff (see for example Hameroff, 2012) on the human brain, quantum biology and the rescuing of the concepts of free

will and agency from the Cartesian tradition. Their arguments for quantum brain biology address the deterministic problems of (1) reducing consciousness and causal agency to neurobiological mechanisms, and (2) that our perceptions which occur after an event are too late for us to respond meaningfully to them (e.g. top tennis players respond to a served ball travelling at 120 MPH before they are aware of the need to act);. Penrose and Hameroff present a theory of Orchestrated Objective Reduction (Orch OR) in which moments of conscious choice are experienced as a collapse of the quantum wave function in microtubules inside neurons. These microtubules which are the protein skeletal structures within neurons provide two or more image states that exist in quantum coherence (superposition) with each other; in this state of pre-conscious superposition there exists a number of possibilities which collapse into an objective reality when a choice is made. Due to the problem of the conscious perception occurring after we have responded to it, consciousness has been seen as illusory. However the evidence from quantum mechanics and from backward time effects in the brain suggest that quantum state reduction in Orch OR can send quantum information back in time in the order of hundreds of milliseconds. Under the effects of quantum gravity the moment of choice causes a bulge in the space-time fabric to the smallest possible measure on the Planck scale of 10^{-33} cm.

This rescues consciousness from being epiphenomenal by providing feedback loops through axonal firings that occur in real time when a conscious choice is made. They argue that if the universe is unfolding rather than human actions occurring due to algorithmic processes, then free will and agency becomes possible; moreover they argue that their theory is testable and compatible with neuroscience and physics.

Mind, matter and ethics; implications for criminology

Paul Cilliers (Cilliers, 1998, 2005) argues that complexity theory reveals both the limits of our knowledge and also the irreducibility of meaning but in a non-relativistic way. This limitation is brought about because we inhabit the systems that we study and therefore we can have no absolute and objective knowledge of our lived experience. Meaning and knowledge is contingent and contextual and because it cannot be represented and the context is not transparent we have

to choose our hermeneutical frameworks and therefore we cannot escape what is ethical or normative. With respect to both complexity theory and Bohm's work on quantum mechanics we are all co-constitutive of each other's lived experience and therefore have shared responsibility for each other (see Bartollas (2014) for a discussion in respect of peacemaking and constitutive criminologies).

For Bohm (see Bohm, 1968) the implicate order reveals the potential for creativity to social problems whereas the mechanised approach to the universe and the consequent lack of an approach to consciousness and mind has induced at best confusion and at worst a lack of awareness or being in a state of sleep. However Bohm's work supports much that is progressive within criminal justice practice and rehabilitative social work more broadly. The connectedness of complex systems can lead to constructive change whereas mechanistic approaches to crime, punishment and social problems reduces possibilities for change through closing down the phase space.

This closing down of possibilities within the phase space is best evidenced by the historical selection of a utilitarian version of teleological ethics in politics and economics emphasising the free and calculating individual engaged in the pursuit of pleasure and avoidance of pain. In this Newtonian clockwork universe the rational, atomised, isolated individual in a state of nature consents with other people to create order; these powerful myths drive the development of liberalism, democracy, human rights, enlightenment, science, humanism, and criminal justice. The consequences for criminal justice (and social policy more broadly) gives rise to the principle of less eligibility. This principle in asserting that if imprisonment is to act as a deterrent then the treatment given a prisoner should not be greater than that provided to a member of the least significant class in the free society imposes an identity on the poor. The utilitarian argument that the principle is necessary to combat human nature while providing incentives to work (see Sieh, 1989) reaches its denouement over the gates of Auschwitz "Arbeit macht frei" (Work will set you free). In contemporary justice Carlen for example (2015) has been highly critical of the ways in which the class bias effect of less eligibility returns poorer disadvantaged lawbreakers to their place and

keeps richer more powerful criminals in theirs, and so undermines any advances. Also the platonic implication of the 're' in rehabilitation suggests a return to a desirable place/state which is clearly not the case for the majority of criminals (notwithstanding the problem of the arrow of time). More over economic disadvantage is used to economic advantage with prison building, the out sourcing of functions for surveillance and rehabilitation being used to stimulate local economies (see e.g. Blakely, 2005). The principle as applied to the Work House now applies to prison (and to community sentences where it is more often referred to as 'less superiority) whereby the prisoners or those on community sentences should not receive a standard of lifestyle or services superior to a non-criminal.

Current approaches to statistically based 'frequentist' risk management approaches further contribute to the locking in of retribution and the failures of rehabilitation precisely because these approaches mean that for an individual who has committed a crime the slate cannot be wiped clean because of what they might do in the future requiring information to remain on file.[5] Consider the following scenario outlined by a trainee probation officer in England (Clare Robson, 2015:25) when discussing a case that she is supervising in the community:

"I have…used my sessions with Stan[6] to explore his view about identity, boundaries and what situations he finds challenging…it was clear…that he identified himself as a rapper, and a successful upcoming rapper as well. His pride and motivation was evident in his language and recollection of various projects he has worked and the positive feedback he was receiving. Twice during supervision he burst into song, 'spitting' his new lyrics to give me a flavour of the type of music he was making. His confidence in his identity and ability clearly gave him the type of 'hope' that (desistance theory) suggests offers an offender a stake in their future and increases desistance. In relation to risk registration and assessments probation policy recognises the serious risk of harm posed by perpetrators of domestic violence and as such offenders like Stan are

[5] Interestingly Bayes Theorem is a highly reputable risk assessment method based on conditional probabilities rather than frequentism and that will allow for a deleting of prior information once this is deemed not relevant to the situation. See Jennings (2014).
[6] Not real name

automatically registered as Medium Risk of Harm at the very least. They cannot be reduced to low risk during the currency of their Order. This poses an ethical dilemma, whereby I expect Stan to demonstrate change but cannot mirror the change to him with a review of his risk. I effectively label him as Medium Risk no matter what he achieves. He successfully completed a domestic abuse programme with excellent feedback from his tutors, he demonstrated a high level of remorse and ended the abusive relationship, but I am still duty bound to keep him registered as Medium Risk."

The justification for this approach as Robson points out, is the consequences of a risk-averse and instrumentalist organisational culture which means that should further offences occur then at least the professional (or rather in these cases the organisation) has demonstrated defensible decision making with respect to the individual concerned. Robson goes onto argue that individual aspiration and potential needed to be routinely worked with and rewarded throughout the supervision of the order, so as to provide the foundations of hope. This an excellent example of the ways in which constructive aspects of rehabilitation are routinely undermined by the wider processes of less eligibility and risk and do not allow for a positive projection of potential for the individual either to themselves or to the wider community[7].

The evolutionary nature of complex adaptive systems reveals that change can never be retrospective; we can achieve some sense of equilibrium in the phase space (but see the discussion by Needs and Adair-Stantiall (2017) on the fragility of these states) which allows us to function (potentially through quantum brain biology) relative to the arrow of time however we need to return to Gödel and the problem of not being able to access the Platonic realm of objective knowledge. I am arguing that we access new dynamical states (the provision of energy, resources and creativity) through understanding not just that there is no distinction between mind and matter but that the processes of evolution give themselves to us as we emerge with them and feedback into them in the process of becoming. The work of Jean-Luc Marion is particularly insightful here

[7] For a discussion of the uses of complexity theory, continental philosophy and hermeneutics with respect to forgiveness as an opening up of phase spaces and the creation of new dynamical states see Pycroft and Bartollas (forthcoming).

especially his phenomenology of givenness (Marion, 2002) where he argues that "what *shows itself* first *gives itself* (emphasis retained) (Marion, 2002:5). He argues the priority of phenomenology to allow phenomena to reveal themselves and to counter any metaphysics by "recognizing, the meaning that the phenomenon itself gives from itself and to itself" (Marion, 2002:9).

Interestingly what happens though developing Gödel's logic and applying complexity theory and insights from phenomenology is the finding that arguments about determinism versus constructivism are outmoded because our understanding of the activities of phase spaces relative to the arrow of time, constituted by mind-matter relationships changes our understanding of what is deterministic and what is socially constructed.

These insights have profound implications for our understanding and practices of criminal justice given its fundamental concern with the arrow of time; past (the crime), present (exercise of justice and acquittal or punishment), future (limits of punishment and potential rehabilitation). To carry Marion's argument further (and based upon his conversation with Kearney (Kearney, 2016:188) I would argue that our concern is not with the essence of the implicate order but more "a matter of decision and response, not thought and proposition. Of event rather than of being and essence." In this sense a crime is an event within the context of the arrow of time that changes the trajectory of different phase spaces of the actors and networks involved; furthermore the processes of justice have to acknowledge the past and in an evolutionary sense the past makes us who we are, but not necessarily who we are to become.

Conclusion

Developments in our understanding of the relationships between matter and consciousness over the last 100 years have been profound with respect to the Newtonian paradigm, relativity and quantum mechanics with many of those relationships remaining unclear. Complexity theory has emerged from the positivism of chaos theory but as with other areas there have been significant developments in our understanding of non-linearity and particularly the non-linear nature of social life. The more recent developments in understanding complexity have looked to Bohmian

mechanics and the concept of implicate order to understand the ways in which mind and matter are co-constituted with reality having a structure that is "enfolded within and therefore available to human experience" (Nichol, 2003:5) meaning that we are active participants rather than detached observers. The implications for social research are profound, exciting and challenging with some fields (including criminological research) having barely got to grips with complexity theory itself, or having done so from (sometimes unwittingly) a positivist perspective. In modestly advancing arguments by stepping out and following the logic of positivism itself as it applies to complexity theory it is hoped that there will be an ongoing dialogue that moves us out of our ontological and epistemological silos. Complexity theory as an approach and particularly the concepts of complex adaptive systems and strange attractors in conjunction with David Bohm's work I argue provide us with a heuristic that allows for such a debate which is ultimately one of moral choice.

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