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Chaos Criminology: A Critical Inquiry

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By

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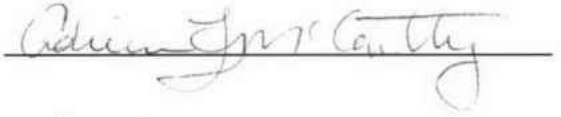
Signature 

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CHAOS CRIMINOLOGY: A CRITICAL ANALYSIS

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ABSTRACT

There has been a push since the early 1980's for a paradigm shift in criminology from a Newtonian-based ontology to one of quantum physics. Primarily this effort has taken the form of integrating Chaos Theory into Criminology into what this thesis calls 'Chaos Criminology'. However, with the melding of any two fields, terms and concepts need to be translated properly, which has yet to be done. In addition to proving a translation between fields, this thesis also uses a set of criteria to evaluate the effectiveness of the current use of Chaos Theory in Criminology. While the results of the theory evaluation reveal that the current Chaos Criminology work is severely lacking and in need of development, there is some promise in the development of Marx's dialectical materialism with Chaos Theory.

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INTRODUCTION

"There has to be a point where disentangling becomes mangling, where one suspects some other motive, scientistic and nomothetic, has taken over" – Jock Young (2011: 18)

Since the early 1980's, there has been a push from a small group of scholars for a paradigm shift in criminology from a Newtonian-based ontology to one of quantum physics (Milovanovic 1997; T.R. Young 1992). While still in its infancy, this push has revealed fundamental issues in the discipline of criminology and resulted in the creation of the new 'Chaos Criminology' paradigm. It is undeniably important for criminologists to recognize that making Newtonian linear assumptions of relationships between the variables of study is limiting and often detrimental to critical analysis. Post-modernist criminologist Dragan Milovanovic, who arguably spearheaded the nonlinear quantum physics movement in criminology, used this argument in the early 1990's to pave the way for more scholars to use nonlinear approaches in their research (Milovanovic 2014; Milovanovic 1997). This quantum physics movement has been dominated by the study of Chaos Theory from which the catchphrase 'order from disorder' derives. However, while the initiative taken by Milovanovic and others is thought provoking, the results have been dubious. Poor translation between disciplines has led to undefined, poorly defined, or even misdefined, terms, concepts, and phenomena, which yields not only confusion, but also jargon and neologism, which leads the reader gawking at a seemingly alien language. The fashionable terminology of using 'quantum physics' and 'chaos' itself breeds a fetishism of method, which Jeff Ferrell (2009) in his piece "Kill Method"

argues has led to the degradation of criminology. The ultimate products of the various studies themselves have offered almost no theoretical development and finally, these cumulative effects have for the most part only added more nuance, which as Kieran Healy (2015) in her paper “Fuck Nuance” has argued, has further led to the degradation of criminology. The purpose of this thesis is to 1) help bridge criminology and physics through a semantic analysis of rudimentary Chaos Theory, 2) highlight issues that have developed around the fetishism of method, 3) develop and employ criteria to evaluate the work of the major contributors of Chaos Criminology, and 4) illuminate where Chaos Criminology can be used effectively. While the results are especially grim for the quantum quantitative approach to criminology, there is some hope in the philosophical applications of Chaos Criminology in Marxism in the far reaching corners of academia and the internet.

LITERATURE REVIEW

A Prelude: The Semantics of Rudimentary Chaos

Foremost, Chaos is a phenomenon, not a theory: "chaos is a phenomenon that occurs in certain nonlinear dynamical systems. There is a theory of dynamical systems, one prediction of which is that chaos is possible, but there is no 'theory of chaos'" (J. Sprott, personal communication, January 21st, 2016). Hence referring to the study of Chaos as 'chaology', or as suggested here, Chaos within criminology as 'Chaos Criminology', may be more preferable than 'Chaos Theory'. What, then, is Chaos studied by Chaos Theorists? It is not chaos as in the folk sense of unpredictable and random disorder. Chaos Theory is the study of seemingly random (stochastic), nonlinear dynamical systems that are sensitive to initial conditions. Or in other words, Chaos Theory finds 'order in disorder'. 'Dynamical' indicates that time is a variable in the system being studied and having 'nonlinearity' indicates that the system's output is not directly proportional to the input (Cvitanović 2015). The outcome of Chaotic behavior often manifests as a fractal or infinitely repeating pattern that will be discussed further later in this thesis (Falconer 2013). While the chaology mathematicians readily see this Chaos phenomenon as a mapped iteration

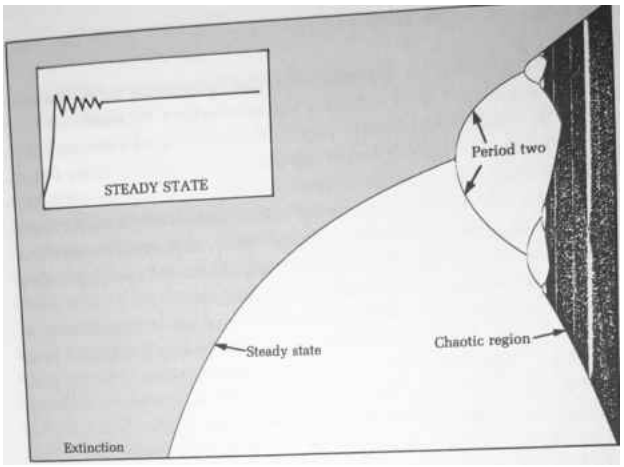

Figure 1 – Chaos

of a system of equations (Figure 1), the rest of us may see the double pendulum of a clock, the changes in the local bee population, meteorites, our heartbeat, or global weather patterns (Europäischen Forum Alpbach 2003; Falconer 2013; Gleick 1987). The 'grandfather' of chaology, Edward Lorenz, attempted to improve weather predictions in the early 1960's. While Lorenz was not the only one to use Chaos Theory to understand weather, his discovery of the sensitivity of initial conditions is still the classic story used to explain Chaos (Cvitanović et. al. 2015; Europäischen Forum Alpbach 2003; Gleick 1987; Lorenz 1993). Although our capabilities to predict the weather have progressed since the 1960's, trust in the forecast three days or so from now is dubious at best (Gleick 1987; Lorenz 1993). The forecast is understandably difficult though. Imagine a freeze frame of the weather outside your window. Now imagine each molecule of air as a trajectory, a coordinate position with directionality, in a plane moving in so many directions it is difficult to not attribute a 'chaotic' characteristic to weather. After every nanosecond (or any desired unit of time), the molecules have moved in the direction of their respective trajectories. Now ignoring that environmental conditions are complex and not static and will inevitably render your conclusions limited if not useless, fathom finding a set of equations to describe and predict these molecular trajectories and you will have accomplished what Lorenz attempted almost half a century ago.

Simply finding a system of equations of a simplified model was not sufficient for Lorenz though. Lorenz set up his 1960's desk computer to run iterations with his equations, which spit out its respective weather predictions. One day he restarted this

process with initial conditions from a previous printout that he selected arbitrarily. However, rather than typing in all five places past the decimal point, he only entered data to the one thousandth place. Unknowingly, Lorenz acted as a manual feedback loop and instead of receiving the same weather prediction, his minute .0001 change to the initial conditions drastically changed the weather prediction. This later went on to be infamously called 'the butterfly effect,' which is derived from Lorenz's famous speech in 1972 "Does a flap of a butterfly's wings in Brazil set off a tornado in Texas?" (Figure 2). This perturbation of the system created what is called a 'bifurcation' of the data that results in the drastic pattern depicted in figure two. An advanced model of Lorenz's work was used to predict weather for quite some time, however, it quickly became apparent that accurate predictions could only be made early on. As time continues, the error grows exceedingly large and it becomes impossible to predict where the trajectory will go next (hence you can only trust the first few days of the forecast). While the image of a tornado or hurricane resulting from a butterfly flapping its wings has been used endlessly, even in some scholarly work, it is most famously misconceived. Lorenz spoke not of the butterfly being the sole and main causation of the natural disaster, but rather tried to elucidate the delicate dependence of the weather on its initial conditions - that the flap of a butterfly's wings as a part of a

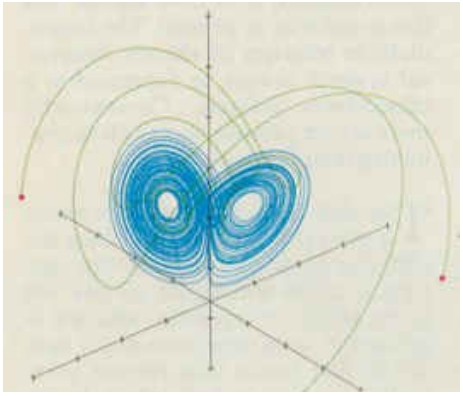

Figure 2 - Trajectory Model of the Lorenz Attractor (the Butterfly Effect)

very large and complex set of initial conditions can impact the weather (Gleick 1987; Cvitanović et. al. 2015).

Lorenz's work yielded two more important aspects of Chaos Theory: feedback loops and attractors. Feedback loops, such as the one Lorenz accidentally introduced into his study, often create Chaos. There are two general feedback types: positive and negative. A positive feedback loop in a system occurs when a disturbance amplifies or in some way magnifies the output of a system, such as the effect moral panics have on public opinion. Positive feedback tends to create instability in the output of a system (and thus often results in Chaos). A negative feedback loop occurs when an internal function operates to dampen the output of the system, such as our body's efforts to return to homeostasis. Contrary to the effects of positive feedback, negative feedback often results in the stabilization of the system's output. A given system will most likely have a combination of both types of feedback loops and a wide variety of effects may occur: multiple stable equilibria, quasiperiodicity (combination of periods), bifurcations (eg. Butterfly Effect), stable periodic cycles, linear[i] exponential decay, linear decaying oscillation, linear exponential growth, linear growing oscillation, hysteresis (irreversibility after bifurcation, unless there is a large change in the opposite direction), coexisting or hidden attractors (different dynamics are possible for a given set of conditions), and Chaos (Sprott 2014).

Almost all Chaos Criminology literature will attempt to incorporate the concept of an attractor into their analysis (Milovanovic 1997; Williams and Arrigo 2001; Young

1992). Attractors are exactly what they sound like - a set of conditions that the data is attracted to or 'sticks to' for a certain amount of time. This can be a set of coordinates or a similar fold or fractal pattern in the case of strange attractors. The Butterfly Effect in figure two contains two attractors, while the Mandelbrot fractal pattern in figure three contains infinite fractal attractors. Fractals are discussed frequently in the Chaos Criminology literature and are also found commonly in nature. They are infinitely repeating patterns of data simply put. Mathematically, they have partial dimensions, which mean they often have volume but no mass.

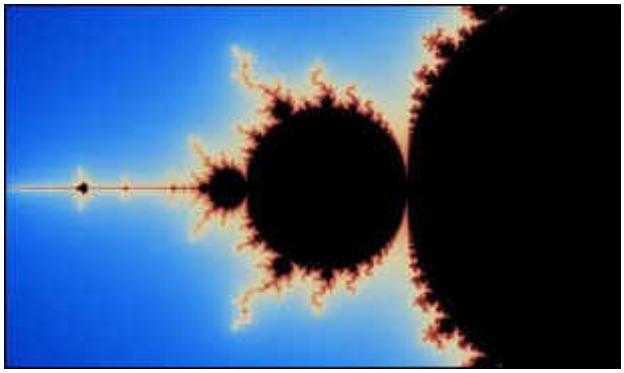

Figure 3 - Mandlebrot Fractal

From fractals and complex systems, much scholarly work also focuses on the characteristics of emergence, scaling, and self-similarity. If you imagine pouring sand slowly on an empty plane, the sand begins to pile but at a certain threshold, the addition of another grain of sand creates a cascade and another very similar looking pile forms at the base of the first pile. This self-similarity repeats endlessly (or until the sand runs out). The infinite nature of fractals implies that the fractal found at the molecular level occurs at the macroscopic level (Falconer 2013; Gleick 1987). When we talk about complex dynamic systems, however, conditions change at different scales; thus different properties emerge at different scales – a Chaos Theory concept appropriately called

'emergence'. Emile Durkheim's (1893) concept of Collective Consciousness is an example of emergent social behavior that exists at a certain scale of population.

Despite the rich analysis that can develop from studying these dynamical systems, two fundamental issues arise. First, as with any quantitative analysis, there is always the question of legitimacy whenever data is collected and converted into numerical values. Do the numerical values accurately reflect the qualitative data they are supposed to embody? Can you create a system of equations to accurately represent the data? Chaos requires a large dataset to discern if a system is Chaotic, which increases the difficulty of testing Chaos Theory in the social world. Secondly, Chaos is bound by a deterministic system. If one declares their data to be deterministic, they enter into a very long debate over the logic of human behavior and determinism. In addition to these hurdles, every mathematical theory or concept always has assumptions and principles. These aspects of Chaos are often ignored in the literature of Chaos Criminology. If Chaos Theory is to be adopted into criminology, then one must be careful to address the issues mentioned above and accept the conditions and principles of Chaos. As adapted from physicist Dr. Julien Sprott's lectures (1997), the following aspects of dynamic Chaotic systems should be heeded:

- Never repeats
- Are not stochastic (not random)
- Deterministic
- Depends sensitively on initial conditions (Butterfly Effect)

- Allows short-term predictions, but not long-term predictions
- Comes and goes with a small change in some control knob
- Topological transitivity
- Dense periodic orbits
- Usually produces a fractal pattern

These characteristics of Chaos as a part of what mathematicians call ‘complex systems‘ that describe natural systems, then, also indicate that we must acknowledge emergent behavior and self-organization (Sprott 1997). This however, is generally lacking in Chaos Criminology. Extensive and overly precise critiquing is a petty game; however, the merging of two fields is arguably one of the few exceptions where extensive critique may be appropriate. With the development of any new field that is a product of two different disciplines, the translation of pertinent terms from either field into one comprehensive language is essential. If one is to borrow a theory, term, or concept from another discipline, it is a trait of scholarly rigor and etiquette to ensure proper understanding of the term and to present it accurately in one’s research. Chaos Criminology has been riddled with such imprecision. The use of ‘Chaos Theory’ is mistakenly accredited to Chaos itself – even criminology articles that provide a substantial effort to describing the physical aspect of Chaos Theory turn around to apply Chaos without adhering to the underlying assumptions and principles of Chaos Theory as mentioned previously. However, the Chaos Criminology literature barely warrants the title of chaology because

of the difficulty to prove or determine if a given social phenomenon is an exemplar of actual Chaos.

In their paper “Anarchaos and Order: on the emergence of social justice”, Christopher Williams and Bruce Arrigo (2001) attempt to use Chaos as a platform for anarchism to supervene other more common paradigms of “justice”. The authors make a perspicuous argument distinguishing the principles of anarchism from a misconception of anarchy as chaos (folk chaos, not mathematical). But their argument deteriorates rapidly when they begin to use Chaos Theory. Drawing purely aesthetic parallels between the process of Chaotic data becoming ‘stable’ at an attractor and the different phases society will pass through in the pursuit of anarchy until a stable state is achieved; ultimately coming to the conclusion that anarchism is feasible because a new stable state will be achieved. However, this makes many assumptions about Chaos; as adapted from the Europäischen Forum Alpbach (2003):

- It is not clear that society or individuals behave deterministically
- The number of variables is large so that the phase space[ii] is enormous
- There is no low dimensional chaos[iii] at this level and no long-range predictions
- There are no known underlying equations. Even short range prediction is hard.

This suggests that the authors must undertake the philosophical question of determinism and somehow account for all the variables that would affect the enormous phase space, which may be outside of current human capacity. Finding a system of equations to explain a massive phase space is inextricably hard and having no long-term

nor short-term predictions renders analysis rather useless, however it should be acknowledged that the authors were not trying to make a quantitative study. Most importantly, there is no proven low dimensional Chaos (nor for the prior weather example), which indicates that Chaos, with or without an attractor, is weakly chaotic and not stable and thereby contradicts Williams and Arrigo's results.

Thus far, much of the social sciences have been restricted to visual metaphors, which when applied correctly, could provide profound philosophical; particularly by challenging "some of the existing notions and bring[ing] up new paradigms in the description of social systems" (Europäischen Forum Alpbach 2003: 17). However, without addressing the principles of Chaos as described above, much of Chaos Criminology falls apart. What exacerbates this issue is the over emphasis of method that follows suit.

Elitism and Fetishism

The perception of standing in the shadows of the greater empirical, 'hard science' has fostered an inferiority complex amongst the 'softer' social sciences. Chaos, nonlinear dynamics, quantum, physics, and other related platitudes are culturally seductive words and it is no wonder that chaology has become attractive field for criminologists to adopt. Jeff Ferrell's (2009) article "Kill Method" and Kieran Hearly's (2015) article "Fuck Nuance" independently make a similar plea to criminologists - that the fetishism and elitism of method and the resulting nuance has 'killed' method and degraded criminological inquiry respectively. While there are some sincere efforts to pursue Chaos

Criminology outside of the pursuit of methodology, the overall effect has not only exacerbated the disparity of coherence between scholars and the general public, but has also degraded criminology as the focus shifts from advancing the ability to solve and understand issues to the pursuit of advancing method for method. The greatest irony is that despite the effort to earn legitimacy of criminology is "that the quest for uncertainty[iv] among the so-called softer social sciences bears no resemblance to the acceptance of uncertainty in "harder" sciences" (Wheeldon 2014: 232).

An example of how over emphasis on method may detract from understanding and solving issues in criminology is Dragan Milovanovic's (2014) most recent book *Quantum Holographic Criminology: Paradigm Shift in Criminology, Law & Transformative Justice*. This book reads like a string of loaded mathematical and physics terms with little to no definitions such as uncertainty, wavical, quantum coherence, Euclidean, and holographically. Some concepts like holography and Chaos are a rather niche field within physics and thus even to students of physics, this book is confusing. Even worse is when there are terms that do not sound complicated, such as 'uncertainty', but in fact are a complicated topic within physics. In some cases in this book, Milovanovic uses the folk understanding of 'chaos' and mathematical Chaos without discerning which definition he was using. While reading this book aloud may make one sound sophisticated, it really is quite the opposite and has contributed much confusion and the depreciation of criminology as a legitimate field of study. To formally discern the applicability of Chaos in

criminology, this thesis will utilize criteria to evaluate theory on articles written by the major contributors to Chaos Criminology.

METHODS

Very little literature could be found on evaluating theory. Much of the criteria for evaluating theory have been found from Nursing and Health sciences (Fawcett 2005; Chao 2012). However, the few scholars that have developed a criteria for evaluating theory within criminology are similar to those developed by other academic fields such as the Nursing and health sciences (Akers and Sellers 2013; Alkin and Christie 2004; Fawcett 2005; Chao 2012). There are six basic principles:

1. Theory Origins: does the origin of the argument being made make logical sense?
2. Adequacy: do all the concepts within the theory work logically together and independent of their meaning?
3. Scope: how generalizable is the theory? Under what conditions does the theory stand true?
4. Parsimony (Occam's Razor): is the theory presented clearly and concisely to avoid confusion?
5. Testability: is the theory testable? Can it be supported by empirical evidence? Is it non-falsifiable? Does it contain tautological arguments or vague open-ended statements?
6. Applications and Usability: can the theory be translated into practice?

Using the above criteria adapted from the literature, this paper will evaluate major contributing works to Chaos Criminology by the following major scholars: T.R. Young,

Dragan Milovanovic, Bruce Arrigo, and Christopher Williams. This process will formally ascertain the usefulness of the dominant direction the field of Chaos Criminology is taking, however it does not intend to exclude any other approaches to Chaos Criminology. As discussed in the concluding thoughts, there are several directions of thought where Chaos Criminology has become promising. The first of which is surprisingly a quantitative approach to policing in the article, “The Fractal Dimension of Policing” by Arvind Verma (1998) and the other promising direction of Chaos Criminology is in the philosophical work of Marxist scholars on Chaos from their website www.marxists.org.

APPLICATIONS OF THEORY ANALYSIS

With the exception of a handful of nursing and psychology articles (Lett 2001; Haigh 2008) and one lone criminal justice paper (Verma 1998) on fractal analysis, Chaos Criminology papers have been almost exclusively qualitative. This qualitative use of a traditionally quantitative concept introduces a degree of difficulty when critiquing its application. In other words, Chaos Criminology often utilizes Chaos as a conceptual tool with no proof that the phenomenon being studied is truly Chaotic as this would need to be ascertained quantitatively. Those who have tried quantitative analysis subsume the same essential fallacies that all quantitative approaches to social phenomena have: choosing artificial parameters, variables, converting the resulting data into numerical values, and finally applying a model to analyze the data, which introduces another set of assumptions itself. Setting these issues aside, the following analysis of Chaos Criminology will begin with Chris Williams and Bruce Arrigo's (2001) article "Anarchaos and order: On the emergence of social justice" as it already been previously introduced.

As summarized previously, Williams and Arrigo's (2001) article is an attempt to demonstrate the viability of anarchy achieving a stable post-revolution society. The logical origins of the theory initially make sense; Williams and Arrigo make two strong arguments. First, they argue that anarchy is not in the folk sense, chaotic, but can actually be implemented with order. To prove that 'orderly' anarchy may indeed occur and eventually lead to a stable state, the authors then introduce Chaos Theory. While their general argument that criminology is in need of a paradigm change from a

Newtonian based ontology to one of quantum mechanics (or more generally, nonlinearity) makes logical sense, the inability to demonstrate that anarchy produces chaotic behavior merely leaves speculation rather than sound theory. The weakest criterion of analysis was adequacy when the authors attempted to use Chaos Theory as a solution for criticisms of anarchism.

The use of Chaos Theory as a solution for determining the outcome of anarchy makes little sense. Outside of visual comparisons, Williams and Arrigo (2001) do not provide evidence that anarchy in practice produces Chaotic behavior or have any similarity to Chaos outside of the use of chaos in the folk sense that crudely illustrates one's immediate reaction to seeing Chaos Theory data or post-revolution society. Foremost, there is an assumption that a society pushed into anarchy after a revolution would display Chaotic behavior. The second assumption is that anarchy would lead a post-revolution society to a 'stable state', or an attractor. An attractor, however, is not a stable state, just merely a point or pattern that the system moves towards. A stable equilibrium is possible, but it is not Chaotic. Because this system would most likely be high dimensional Chaos and therefore weakly chaotic, there is no way to tell if this 'stable state' would occur in six months, one year, 10 years, or 10 million years.

The scope, testability and utility, and applications will also fail for their assertions. The scope could either be incredibly vast or incredibly limited due to the lack of empirical evidence that anarchy is related to Chaos Theory. Thus, any social phenomena that could be speculated as Chaotic may then apparently achieve a stable

state. Equally suspect is the notion that anarchy would instigate Chaos cross-culturally and through time; in fact, sensitivity to initial conditions would indeed warrant the opposite effect. With no real empirical study that would define the conditions and parameters, it is rather impossible to generalize this study, or for that matter define its applications and determine testability and utility. Finally, in terms of parsimony, Williams and Arrigo (2001) did well explaining a complex topic simply but the failure of adequacy makes the paper confusing. As it will continuously be discovered in the remaining evaluations, more often than not the use of Chaos Theory seems to create more confusion and speculation than scientific gain. There are a plethora of theories from quantum mechanics and mathematics that could be used to describe nonlinear systems and why Chaos Theory has presided over the rest may have more to do with novelty rather than parsimonious function.

As mentioned prior, Dragan Milovanovic has been a prominent scholar in Chaos Criminology. His chapter "Postmodernist versus the Modernist Paradigm: Conceptual Differences" in the collective work of *Chaos, Criminology, and Social Justice: The New Orderly (Dis)Order* (1997) attempted to ground Chaos Criminology within criminology. He defines postmodernism by parsing out ontological differences with modernism by contrasting ideologies. In turn, Milovanovic (1997) then categorizes the paradigms as examples of Chaos Theory, (other) quantum mechanical theories, and other less-than-familiar theories to criminology (Milovanovic 1997: 4). There are eight categories or 'dimensions' that are used to contrast postmodernism to modernism: society and social

structure, social roles, subjectivity/agency, discourse, knowledge, space/time, causality, and social change (Milovanovic 1997: 5).

Similar to the Williams and Arrigo (2001) article, Milovanovic's (1997) piece falls apart most prominently in parsimony and in adequacy when Chaos Theory is attempted to be combined with criminology. Setting aside the ongoing debate about whether there truly is a departure from modernism into the postmodernism, Milovanovic's theoretical origins make a logical argument in the distinction between postmodernists and modernists. For example, Milovanovic argues that postmodernists are distinct from modernists in terms of subjectivity/agency: modernists view the individual as a "balance between egoism and altruism" and who's desires are "in need of synchronization with given social-political systems," (1997, 9) while postmodernists view the individual as more decentralized and independent of structural control and thus have greater agency. While Milovanovic's (1997) philosophies are clear, Chaos and other theories informal to criminology are not explained only name dropped, leaving the theoretical origins unclear:

> *Whereas roles in the modernist view would be similar to what chaos theorists refer to as limit attractors (they tend toward stereotypical closure), roles in postmodernist analysis would be very much like torus or strange attractors. A strange attractor can appears two butterfly wings where instances of behavior may occur in one (i.e., a person's conduct is situated in the illegal underworld), and in the other (i.e., a person's*

conduct is in the legitimate world). Where the two cross, maximal indeterminacy prevails (1997: 8).

Milovanovic provided an example of strange attractors within a social context, but provided no explanation as to why that was a valid argument or what a strange attractor is and completely glossed over the torus[v]. Milovanovic's (1997) article is a solid contrast of postmodernism and modernism, however the seemingly random notes of Chaos Theory and other similar theories as an extra label to already well established theories adds more nuance than making a theoretical argument. Thus, the scope of applicability remains possible for negotiation with the fundamental contrast between paradigms, but it would be difficult to apply the Chaos Theory paradigm to other theories and ideas without a valid argument as to why Chaos and other similar theories were used in the first place. It in fact, seems rather fruitless to continue discussing testability, applications, and usability because there is no true argument on Chaos Theory in this particular article.

Dragan Milovanovic's example of how Chaos Theory adds nuance to criminology is unfortunately not a singular example – Chaos Theory seems to be used to add a dimension of interest to an article and to fetishize method, but its use provides no real substance to the paper's argument. For example, Saci Newmarh's (2011) article "Chaos, Order, and Collaboration: Toward a Feminist Conceptualization of Edgework" makes a good argument about feminism and edgework with her sadomasochism (SM) ethnography. However the limited use of the Chaos Theory derived concept of 'being on

the edge of chaos' adds a rather insignificant metaphor especially compared to its rather significant presence in the article title and absorbs the same criticisms of Milovanovic's (1997) article. Newmarh (2011) tackles the notion that risk taking appears to be gendered by her work with SM, demonstrating that SM is an example of active participation in risk by women and also acts as resistance to gender binaries. The aspects of Chaos that Newmahr includes adds only to the metaphoric minutiae of how SM (and risk taking in general) walks on the fine boundary between desire and need. Her metaphor is a rather simple concept that does not need the rather complicated concept of Chaos to describe it.

In several of T.R. Young's articles regarding Chaos Theory, Young arguably provides the best and most readily understandable translation/description of rudimentary Chaos Theory for the curious criminologist. In particular, Young's (1997) article "The ABCs of Crime: Attractors, Bifurcations, and Chaotic Dynamics," provides a brief introduction into Chaos Theory with a particular focus on different types of attractors (1997: 30-32). Young's (1997) theoretical origins of Chaos theory are sound and immediately transitions from Chaos Theory basics to examples of Chaos in the social world. Like many of the previous articles, this 'transition' from Chaos Theory into Chaos Criminology is instead a logical gap in the overall argument. A few initial examples Young (1997) provides of population dynamics in the wilderness are from legitimate, quantitatively confirmed cases of Chaos. However, population dynamics (which are

easily quantifiable) are a far cry from understanding more complex topics like crime, thus not only failing adequacy but also scope and applications/usability.

Ultimately, Young's (1997) goal was to lead to the promising idea of pursuing crime control; with the assumption that crime (notably a very vague and complex concept) is Chaotic, Young then makes the assertion that it may be manageable because in certain conditions, Chaos is manageable. First, Chaos is an extremely fragile phenomena. The phase space that influences crime would theoretically be enormous and of course, ever shifting because it is a social construction. Instances where Chaos is manageable occurs in very regulated, artificial environments would lead to the conclusion that managing the phase space, even in limited amounts, would most likely lead to a collapse. Young (1997) argues further that if domestic violence decreased with decreasing unemployment, then such crime could be controlled by investigating the psychological variables that distinguish types of individuals who do and do not commit domestic violence. While Young (1997) is correct in speculating that these identifying variables would change in a Chaotic system at different stress levels (higher Chaos yields greater uncertainty), it is misleading and potentially a very biased criminological approach to controlling crime. Young's (1997) example removes systemic influences to domestic violence and weighs much criminal responsibility to the individual rather than utilizing his previous point about attractors. For example, perhaps society tends to gravitate toward conditions (attractors) that are patriarchal and hyper-masculine in nature as perpetrated into motion by historical masculine dominance. Neither example,

however, can be proven (or has yet to be proven) as Chaotic, so they cannot be tested and general testability is therefore impossible.

A criminology article that does succeed with all of the criteria of theoretical analysis is Arvind Verma's (1998) "The Fractal Dimension of Policing". Verma (1998) utilizes R/S analysis on police call data from 1991-93 that estimates something called the Hurst exponent, the inverse of which provides the fractal dimension of the data distribution. After some data manipulation, Verma (1998) compares the dimensions and Hurst exponents of the police call data and a scrambled (randomized) version of police call data. The results suggest that after randomizing the data, the Hurst Exponent decreases and thus the fractal dimension increases, ultimately leading to the conclusion that correlation between data is lost after randomization. This suggests that the time sequence is important to police calls or in other words, the police calls are correlated to each other. In Verma's (1998) case, the theoretical origins and parsimony of R/S analysis are concrete and are supported by the strong conclusions portrayed in the data. Verma's (1998) data was fortunately easily quantifiable without major implications since it was not social data or philosophical like the data from the articles discussed previously. Verma's (1998) conclusions produce profound questions that speculate at greater concepts that perhaps need to be addressed qualitatively. For example, why is it that a phone call for fire may depend on a phone call for a robbery months earlier? Questions similar to this question may lead to greater applications and usability of Verma's 91998) conclusions. Also, it begins to concretely prove that Chaos does exists socially, moving

optimistically to eventually proving issues of concern in the previous studies. The scope is still somewhat limited as future studies would be restricted to quantitative data, however, it provides a different approach to demonstrating Chaos in the social world by using R/S analysis rather than speculation of 'Chaotic' phenomena and assumed attractors.

The results of the theoretical analysis using the criteria proposed by this article is grim as summarized in Table 1 with the exception of Arvind Verma's (1998) article who met and passed every criteria.

Table 1: Summary of theory analysis from selected authors. The answers 'yes' and 'no' signify whether the article met the criteria or failed to do so or for whatever reason failed to be able to meet the criteria.

	Theory Origins	Adequacy	Scope	Parsimony	Testability	Applications and Usability
Williams and Arrigo (2001)	Yes	No	No	No	No	No
Milovanovic (1997)	No	No	No	No	No	No
Newmahr (2011)	No	No	No	No	No	No
T.R. Young (1997)	Yes	No	No	No	No	No
Verma (1998)	Yes	Yes	Yes	Yes	Yes	Yes

Verma's (1998) work departs from the other articles because it uses quantitative data and thus is not limited to using Chaos Theory as a metaphor. The larger and more difficult philosophical questions that are addressed by the other authors are undoubtedly important, using Chaos Theory as a metaphor has demonstrated to be difficult to use proficiently. There are many aspects of Chaos Theory as listed prior that need to be addressed by those who wish to utilize Chaos Theory as a metaphor. In

addition, some articles that did use metaphoric analysis were found to not use Chaos Theory as an essential aspect of their argument, but rather added nuance and confusion to an otherwise simple concept. Thus, if Chaos Theory is to be adopted into qualitative research, it should address if Chaos is essential to the argument being made and if all assumptions and conditions of Chaos Theory can be accounted for. In the disparity of the future for qualitative Chaos Criminology, there may be some promise within Marxist dialectic materialism.

CONCLUSIONS AND FUTURE CONSIDERATIONS

Chaos Criminology and Marxism

If there is a chance that the universe is Chaotic and the Chaos metaphor is valid, the case for Marxist dialectic materialism makes a profound conclusion. Perhaps if enough research like Verma's (1998) piece on police calls confirm that social data is actually Chaotic, then we can make the following case for Marxism. In Karl Marx's (1902) dissertation "The Difference Between the Democritean and Epicurean Philosophy of Nature", he critiques Democritus' atomic theory of the individual's relationship with society to that of the Epicurean philosophy. Simply put, Democritus asserted that individuals were like particles, or atoms, that have rather predictable, linear connections with each other in society. This could be envisioned as a crystal lattice structure of table salt (sodium chloride or NaCl) depicted in figure four (left photo). Salts and other solids that form crystal structures at the molecular level form rigid, strong, geometric bonds between atoms that are uniform and synchronous. While this linear connection may create complex structures, the atomic interrelations are very simple, orderly, and most importantly, predictable and thereby deterministic. Karl Marx rejected the deterministic outlook – he argued that this would imply then that there is no freewill or agency since our relationships to each other and to society are predetermined.

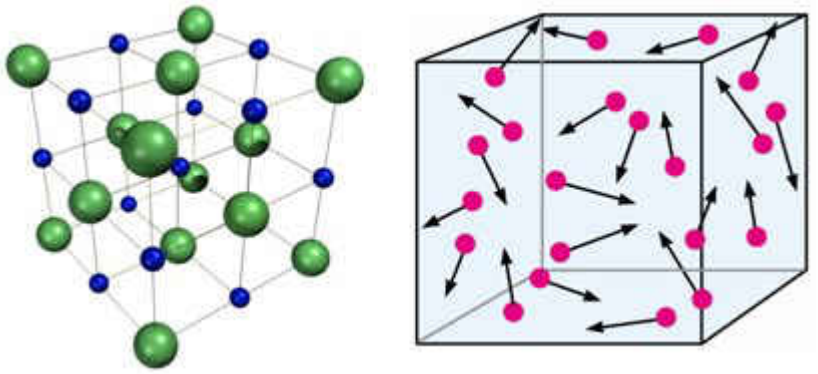

Figure 4 - The crystal lattice structure of sodium chloride (NaCl), or table salt (left). Gas particle interactions (right).

To contrast Democritus, the Epicurean philosophy understood the individual in society as particles that more closely resemble the behavior of gas as seen in figure four (right photo). The gas particles are still atomized, however, their interaction with each other is essentially random. They all share the same properties as gas and conform to their confines but their interaction with each other is unpredictable. This procures the Althussian (1962) idea of 'over determinism': that the general outcome is determined but the interactions of individuals are unpredictable and therefore individuals have freewill/agency. This model coincides as one could imagine with Chaos Theory. If society is Chaotic, the interactions between all variables within the system would be unpredictable and seemingly random, but the system itself may move toward an attractor. Thus, while the general direction of the system may be known, how the system reaches the attractor is unknown. This concept then could be incorporated into the discussion of Marxist dialectics as the Marxist scholars (Brand 2015) have done on their website Marxist.org; that rather than pure Manichean dichotomies, dialectics argue that

order and disorder are dependent and create a 'unity of opposites', eventually producing something new. This idea also coincides greatly with the emergent properties of Chaos Theory where properties emerge at different 'scales' of Chaos.

While outside of the scope of this paper, if we can discern that social phenomena do in fact behave Chaotically, it would be a formidable task for future studies to try and ground philosophical theories of the social world into reality. The implications of grounding Marx's dialectical materialism via Chaos Theory are great: the proof of an ontological orientation fundamentally changes the way humans could analyze the world. In fact future studies of Chaos Theory in Marxism Marx's work, *Grundrisse* (1973), could potentially enhance our understanding of the nature of social relations. In comparison to the linear portrayal of the historical progression of society into communism found in Marx's (1845) work *The German Ideology,* he described the historical progression as a multi-linear trajectory and thus the mode of production was not narrowly focused on the economy, "moving to a gradual separation of the laboring subject and the objective conditions of the worker" (Marx 1939). In contrast, the Democritus philosophy results in linear carnage: from the sense of predictability of human nature comes the compulsion to control it and impose a sense of order, quickly leading to theories of the State. Conclusively, that is not to say that linear dynamics do not have a place in criminology. Bernard Harcourt and Jens Ludwig (2007) criticism of Giuliani's reign of terror in New York City during the first major implementation of Broken Window's theory as Newton's Law of Crime is arguably one of the best examples of linear dynamics in criminal

behavior; sometimes there is no sense in trying to add complexity to something that is obviously and readily linear. However, in a grander philosophy, we would need to treat individuals independently and look rather at the systemic factors that drive the system towards a certain attractor.

BIBLIOGRAPHY

Akers, Ronald, and Christine Sellers. 2013. *A Student Study Guide for Criminological Theories: Introduction, Evaluation, Application.* New York, NY: Oxford University Press.

Alkin, Marvin and Christina Christie. 2004. "Evaluation Theory Tree". Retrieved Dec. 6th, 2015. (www.corwin.com/upm-data/5074_Alkin_Chapter_2.pdf).

Brand, Michael. 2015. "Dialectics, Complexity and the Crisis." Retrieved Nov. 13th, 2015. (https://www.marxists.org/reference/archive/hegel/txt/complexiti.htm).

Chao, Yann-Fen. 2012. "Theory Analysis and Evaluation." Retrieved Oct. 17th, 2015. (podcast.tmu.edu.tw/podcast/download/1307).

Cvitanović, P., R. Artuso, R. Mainieri, G. Tanner, and G. Vattay. 2015. *Chaos: Classical and Quantum.*Retrieved Nov. 4th, 2015. (www.chaosbook.org).

Durkheim, Emile. 1893. *The Division of Labor in Society.* Translated in 1983 by Lewis Coser, New York, NY: The Free Press.

Elert, Glenn. 2007. *Measuring Chaos: The Chaos Hypertextbook.* Retrieved March 16th, 2015. (http://hypertextbook.com/chaos/43.shtml).

Europäischen Forum Alpbach. 2003. "Chaos in the real world." Retrieved Nov. 8th, 2015. (math.arizona.edu/~shankar/efa/efa4.pdf).

Falconer, Kenneth. 2013. *Fractals: A Very Short Introduction.* Oxford, UK: Oxford University Press.

Fawcett, Jacqueline. 2005. "Criteria for Evaluation of Theory." *Nursing Science Quarterly* 18(2):131-135.

Ferrell, Jeff. 2009. "Kill Method: A Provocation." *Journal of Theoretical and Philosophical Criminology,* 1(1): 1-22.

Gleick, James. 1987. *Chaos.* New York, NY: Viking.

Haigh, Carol. 2008. "Using chaos theory: the implications for nursing." *Australian Journal of Advanced Nursing*16(3): 298-304.

Harcourt, Bernard and Jens Ludwig. 2007. "Reefer Madness: Broken Windows Policing and Misdemeanor Marijuana Arrests in New York City, 1989-2000." *Criminology and Public Policy,* 6(1): 165-182.

Healy, Kieran. 2015. "Fuck Nuance." Presented at the American Sociological Association Meeting 2015.

Lett, Margaret. 2001. "A Case Study for Chaos Theory in Nursing." *Australian Journal of Advanced Nursing* 18(3): 14-19.

Lorenz, Edward. 1993. *The Essence of Chaos.* Seattle, WA: University of Washington Press.

Marx, Karl. 1845. "The German Ideology." Retrieved Jan. 20th, 2016. (www.marxists.org/archive/marx/works/1845/german-ideology/).

Marx, Karl. 1902. "The Difference Between the Democritean and Epicurean Philosophy of Nature. With an Appendix." In *Marx-Engels Collected Works* vol. 1, Progress Publishers.

Marx, Karl. 1939. "Grundrisse: Foundations of the Critique of Political Economy (Rough

Draft)." Retrieved Jan. 30th, 2016. (www.marxists.org/archive/marx/works/1857/grundrisse).
Marx, Karl. 1973. *Grundrisse.* Translated by Martin Nicolaus, New York, NY: Penguin Books in association with New Left Review.
Milovanovic, Dragan. (Ed.) 1997. *Chaos, Criminology, and Social Justice: the New (Dis)Order.* Westport, CT: Prager.
Milovanovic, Dragan. 1997. "Postmodernist versus the Modernist Paradigm: Conceptual Differences." Chapter 1 in *Chaos, Criminology, and Social Justice: the New (Dis)Order,* Edited by Dragan Milovanovic. Westport, CT: Prager.
Milovanovic, Dragan. 2014. *Quantum Holographic Criminology: Paradigm Shift in Criminology, Law, & Transformative Justice.* Durham, NC: Carolina Academic Press.
Newmahr, Staci. 2011. "Chaos, Order, and Collaboration: Toward a Feminist Conceptualization of Edgework." *Journal of Contemporary Ethnography* 40(6): 682-712.
Sprott, Julien. 2014. "Lessons Learned from Twenty Years of Chaos and Complexity." Retrieved Sept. 16th, 2014. (sprott.physics.wisc.edu/pubs/paper429.htm).
Sprott, Julien. 1997. "The Science of Complexity." Presented to the First National Conference on Complexity and Health Care, Dec. 3rd, Princeton, NJ. Retrieved Jan. 18th, 2015. (http://sprott.physics.wisc.edu/lectures/complex/sld001.htm).
Verma, Arvind. 1998. "The Fractal Dimension of Policing." *Journal of Criminal Justice* 26(5):425-435.
Wheeldon, Johannes. 2015. "Quantum Holographic Criminology: Paradigm Shifts in Criminology, Law, and Transformation Justice Review." *Criminal Justice Review,* 40(2):231-233.
Williams, Christopher and Bruce Arrigo. 2001. "Anarchaos and order: On the emergence of social justice." *Theoretical Criminology,* 5(2): 223-252.
Young, Jock. 2011. *The Criminological Imagination.* Malden, MA: Polity Press.
Young, T.R. 1992. "De Novum Organum." Retrieved Dec. 3rd, 2015. (http://www.critcrim.org/redfeather/chaos/001intro.html).
Young, T.R. 1997. "The ABCs of Crime: Attractors, bifurcations, and Chaotic Dynamics." Chapter 4 in *Chaos, Criminology, and Social Justice: The New Orderly (Dis)Order,* edited by Dragan Milovanovic. Westport, CT: Prager.

FIGURES

Figure 1: Chaos. Source: Gleick, James. 1987. *Chaos.* New York, NY: Viking. Pg. 71.
Figure 2: Trajectory model of the Lorenz Attractor (the Butterfly Effect). Retrieved Jan. 20th, 2016. (http://csc.ucdavis.edu/~chaos/courses/ncaso/Readings/Chaos_SciAm1986/Chaos_SciAm1986.html).
Figure 3: A Mandelbrot Fractal. Retrieved Dec. 8th, 2015. (www.math.stackexchange.com).

Figure 4: The crystal lattice structure of sodium chloride (NaCl), or table salt (left picture). Retrieved Jan. 21st, 2016. (http://www.dreamstime.com/royalty-free stock-photography-crystal-lattice-structure3d-image-25562887). Gas particle interactions (right picture). Retrieved Jan. 25th, 2016. (Socratic.org/questions/how-does gas-exerts-pressure-on-its-container).

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[i] Even though we are studying dynamical systems, which does not exclude that linear dynamics may occur within the system being studied. In fact, linear systems should not be completely tossed away as useless and have their place in analysis. Where linearity fails as an analysis is when scholars set parameters to their analysis that narrows their analysis so much so that it ignores the larger dynamical system that accounts for behavior more than the attempted linear dynamics. For further reading, refer to Sprott 2014.

[ii] Phase space is the coordinate space that the given system's data occupies/will occupy.

[iii] High dimensional and low dimensional chaos is defined by the Lyapunov exponent of a system. Essentially, the lower dimension, the more stability a system has and the stronger Chaosticity. For further reading, refer to Elert (2007).

[iv] Uncertainty is a term that is often used to less formally address Chaos Theory. It refers to the rather sporadic and unpredictability that is associated with Chaos as it is highly sensitive to initial conditions.

[v] A torus is a circular tube of data orbiting around a point, akin to a kind of tubular Mobius strip that can be a chaotic attractor.