University of North Carolina Asheville
Journal of Undergraduate Research
Asheville, North Carolina
December 2017

A Critique of Sokal and Bricmont's *Fashionable Nonsense: postmodern intellectual's abuse of science*

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Abstract

During the late 20th century certain trends in French postructuralism and postmodernism were deemed anti-intellectual for criticizing scientific methodology and characterizing science as a social construction. But, if these intellectual groups espoused social constructionism, it was not an attempt to devalue the scientific enterprise or to deny science as the best means of understanding reality. This paper critiques the polemics of physicists Sokal and Briemont against the intellectual malaise of postmodernists, science and technology studies, and cultural studies. Through wrongful generalizations and lackluster argumentation, their polemics overlooked crucial terms used by postmoderns. This oversight shows the mistakes stemming from overgeneralizing postmodernism, science and technology studies, and cultural studies—and from treating them as a single homogenous ideological group.

1. General Introduction

This paper is a critique of the criticism made in physicists' Alan Sokal and Jean Bricmont's book *Fashionable Nonsense: postmodern intellectual's abuse of science*[1] made against postmodern intellectuals who study science, and claims that Sokal and Bricmont wrongfully based their accusations of such intellectuals on generalizations made about a group that defies the categorizations of such generalizations. It goes on to critique the way that the authors claim the term "chaos" is unintelligibly used in philosopher's Gilles Deleuze and Felix Guattari's joint work *What is Philosophy?*[2] by explaining how the usage of "chaos" is intelligible via Arkady Plotnitsky's article *Chaosmologies: Quantum Field Theory, Chaos and Thought in Deleuze and Guattari's What is Philosophy?*.[3] It then argues that the intelligible use of the term renders Sokal and Bricmont's critique of Deleuze and Guattari's usage of the term untenable. Furthermore, I argue that the term chaos, as given by Plotnitsky, to mean that it is being used equivocally, with respect to Deleuze and Guattari's three definitions of the term, understood as chaos as the virtual, incomprehensible, and disorder.[4] The equivocal usage of chaos means that Deleuze and Guattari have a justification, and therefore a reason for using the term that is not nonsensical, contrary to Sokal and Bricmont's accusations. So, the thesis is twofold: to show how the criticisms put forth about an entire academic subfield—which holds varying intellectual interests and ideologies—was wrongfully generalized, and that the term chaos as explained by Arkady Plotnitsky, if interpreted as used equivocally in *What is Philosophy?*, proves that Deleuze and Guattari are not propagating nonsense and are at the least using their interpretation of the term intelligibly. So, if Sokal and Bricmont want to claim Deleuze and Guattari abuse the term, they need a different and stronger critique.

The goal of *Fashionable Nonsense* was to criticize a group of intellectuals for their misunderstandings of science in the production of theory and for the conclusions drawn because of the group's standpoint as non-scientific commentators on science. *Fashionable Nonsense* explains both the alleged misusage and abuse of scientific terminology by those in the social sciences who espoused trendy thinking coming from postmodernism, postructuralism, science studies, and cultural studies in America and how they were influenced as well as part of a

malaise coming from contemporary French thinkers. According to Sokal and Bricmont, the misuse of scientific concepts in influential intellectual circles encouraged the "intellectual confusion" they oppose.[5]

I begin the argument of the paper by giving a background of Sokal and Bricmont's project, and then by explaining how they understand how scientific concepts ought to be used. Specifically, I explain what Sokal and Bricmont mean by the abuse and misuse of a scientific concept, how they categorize science studies, social critiques of science, feminist critiques of science, postmodern literary theory, the history of science, and the philosophy of science (among others) as all guilty of producing nonsense. One concept abused by non-scientist genre's critiques of science is the term chaos. I explain the general confusions Sokal and Bricmont have with the way those critiqued used the term. I then explain how Sokal and Bricmont mistake an entire group for promoting anti-intellectualism, all being accused of having the same stance regarding their metaphysical beliefs, and therefore as a broad classification of thinkers who are allegedly abusing scientific terms. This leads to my first criticism of *Fashionable Nonsense* (i) which states that Sokal and Bricmont commit the fallacy of composition which I borrow from Stephen Hilgartner's *The Sokal Affair in Context.* [6] After showing the fallacious criticism about a whole group made in *Fashionable Nonsense,* I present my second criticism (ii) which explains how through Arkady Plotnitsky's interpretation of Deleuze and Guattari's usage of the term chaos, as understood equivocally, provides an intelligible usage of the term and refutes this portion of Sokal and Bricmont's direct criticism against Deleuze and Guattari. The paper concludes by reaffirming that the fallacy of composition and misunderstanding of Deleuze and Guattari's equivocal usage of the term chaos in *What is Philosophy?*, as used in its three ways (the virtual, the incomprehensible, and disorder), and thus refutes the criticism given in *Fashionable Nonsense.*

2. Issues with Postmodern Themes, The Sokal Hoax, and the Abuse of Concepts

Fashionable Nonsense was written as a response to the infamous "Sokal Hoax"[7] where NYU physicist Alan Sokal submitted a bogus article titled *Transgressing the Boundaries: Toward a Transformative Hermeneutics of Quantum Gravity*[8], which then was published in *Social Text,* a popular journal for the then emerging body of cultural studies literature.[9] The reason it was bogus was that Sokal knowingly used concepts from physics that he would later claim were untrue.[10] Sokal's article was submitted with quotes from popular intellectuals in postmodernism and poststructuralism which he claimed held epistemologically relative views. Sokal says in *Fashionable Nonsense* that the ideas expressed were "nonsensical, but unfortunately authentic quotations about physics and mathematics by prominent French and American intellectuals"[11] Sokal believed that the ideas in his hoax article were wrong because they espoused the wrong usage of scientific terms. For Sokal, the article was bogus in part because it asserted that facts such as Newton's law of gravity were historically situated instead of universally constant.[12] Once made public, published in *Social Text's* spring/summer edition of 1996 titled "Science Wars"[13], featured on the front page of the *New York Times* in an article titled *Postmodern Gravity Deconstructed Slyly*[14], Sokal and Bricmont decided to work together in response to the "deleterious effects of relativism, constructionism, and postmodernism"[15] to write *Fashionable Nonsense.* Bricmont says "we wanted to explain, in non-technical terms, why the quotes are absurd or, in many cases simply meaningless…also *we wanted to* discuss the cultural circumstances that enabled these discourses to achieve such renown and to remain…unexposed."[16] So, the physicists wrote *Fashionable Nonsense* to unearth the cultural causes of nonsense and the reason for their supposed popularity.

Sokal and Bricmont claim that the authors of the late 20th century were careless in respect of "context", "justification", and "meaning" of scientific terms, and that the "extrapolations" of such concepts without rationale is what they are against.[17] Sokal and Bricmont think that the excessive use of scientific jargon in non-science writers' works promoted a false sense of authority which readers buy into, and that such false authority is dangerous because it promotes a set of "intellectual practices" which they claim encourage "intellectual confusion".[18] One belief that Sokal and Bricmont believed promoted intellectual confusion was epistemic relativism and its ties with postmodernism.

Sokal and Bricmont then say that they are not opposed to cross disciplinary approaches to knowledge between science and other disciplines, so long as those approaches provide an explanation for the purpose and use of the scientific concept imported. They say they are "not against extrapolating concepts from one field to another, but only against extrapolations made without argument."[19] They believe non-science disciplines need a rationale for using scientific concepts in their work. However, they do assert that there is only one correct way to use scientific concepts which involves using them in accordance with their corresponding definition. This stance is why I am criticizing Sokal and Bricmont because it overlooks possible terms which might have many meanings or which have a lack of consensus about meaning in science.

Sokal and Bricmont's target of *Fashionable Nonsense* are postmodernists, those who study postmodernism, and those who study its relationship with science. They define postmodernism as,

> an intellectual current characterized by the more-or-less explicit rejection of the rationalist tradition of the enlightenment, by theoretical discourses disconnected from any empirical test, and by a cognitive and cultural relativism that regards science as nothing more than a "narration", a "myth", or a social construction among many others.[20]

They claim that postmodernism is pushed in American humanities and social science groups. For Sokal and Bricmont, then, the purpose of *Fashionable Nonsense* is to expose how concepts from mathematics and physics have been abused by postmodernists. The physicists provide a list of four characteristics that all individually count as "abuse" of a term or concept.[21]The abuse of a concept involves either: 1) the disregard for the meaning of the terms, or 2) improper concept importation from a scientific discipline, or 3) the irrelevant usage of many scientific concepts for the sake of academic legitimacy, or 4) the skilled manipulation of meaningless language presented as profound.

The first type of abuse involves disregarding the meaning of a scientific term as given in a scientific theory or concept. This happens when someone using the theory has an "exceedingly hazy idea" about it, and is also regularly accompanied by a pseudo-scientific jargon.[22] This type of abuse eschews the widely-accepted version of a scientific concept's meaning for a meaning that does not match up with the definition either provided by the Sokal and Bricmont or the Scientific community.

The second type of abuse defined is the importation of scientific concepts into the humanities without empirical or conceptual justification.[23] They say that a biologist could not get away with only a vague analogy as her justification for introducing mathematical topology into her research, she would need a justification.[24] An example of this kind of abuse is when philosopher Jean Baudrillard claims that modern warfare takes place in a non-Euclidean space without any explanation as to why he joined the mathematical concept of non-Euclidean geometry to the social and political concept of modern warfare. [25]

The third type of abuse involves displaying a false erudition of science by using irrelevant technical terminology to the subject being discussed by those critiqued. It is focused on the way scientific jargon boosts the authority of the speaker as well as the lack of relevance to the topic being discussed. It is in a nutshell using scientific buzz words to sound more impressive to the laymen.

The last kind of abuse defined by the physicists is the manipulation of meaningless phrases and words without regard to their prescribed meaning given by the scientific community. So, this kind of abuse asserts that for a proposition using a scientific term to be meaningful, it must match up with the given meaning. Sokal and Bricmont believe it is up to science to decide what counts as a legitimate use of a scientific term.

In order to distinguish between the motives of authors using concepts from mathematics or physics—how one determines if there is a legitimate point to be made by the concept or the concept is being used to promote the legitimacy of the author--Sokal and Bricmont claim that the concept in use should come without mistakes, explain all technicalities, which the intended reader needs to understand, apply mathematic parts of the concept to precise quantities, and should not apply esoteric and "abstruse" mathematic concepts (especially those that are rarely extrapolated outside of science) to the social sciences.[26] By providing the quotations of those who commit said abuses, Sokal and Bricmont intend to reveal the mistakes made about scientific concepts.

3. Criticism (i) The Fallacy of Composition in *Fashionable Nonsense*

Sokal and Bricmont commit the fallacy of composition and make an illicit transference of the attribute of nonsense when they categorize the intellectuals who deal with science into a homogenous group. The fallacy of composition is when "the conclusion of an argument depends on the erroneous transference of an attribute from the parts of something onto the whole. In other words, the fallacy occurs when it is argued that because the parts have a certain attribute, it follows that the whole has that attribute too…"[27] So, when Sokal and Bricmont claim that those within social studies of science all propagate nonsense, they are falsely attributing nonsense to the entirety of a group who has a wide range of different attitudes and beliefs towards science. I object to their methodology because the way they accuse cultural studies, postmodernism, and science and technology studies of all committing the same relativistic and anti-science crimes is false. In Stephen Hilgartner's *The Sokal Affair in Context,* he puts this well when he explains that those in science studies and humanistic studies of the history of science are not considered as participators within cultural studies, and they are certainly not all postmodernists. He says,

> people engaged in social and humanistic studies of science often do not think of themselves as doing cultural studies, and many may not have anticipated that the hoax would ultimately be used to tar an extremely heterogeneous population of scholars with the same broad brush[28]

This means that the lumping together, does not work because the disciplines are more nuanced because they have a mixture of ideologies ranging from relativism to objectivism.

The technique of criticizing a part of a group for being relativistic and making it stand in for the whole of contemporary social sciences is what theoretical physicist Felicity Mellor argues is called synechdochic rhetoric and is the tactic Sokal and Bricmont use to condemn several different disciplines without realizing those discipline's nuance. Mellor quotes Bruce Robbins in her essay review titled, *Scientists' rhetoric in the science wars* who says that this ability to rhetorically generalize is called ""synechdochic rhetoric"—SB are, he points out, trying "to make the part stand for, and condemn, the whole."[29] Mellor shows that this tactic is directly related to their tactic of saying that they do not wish to condemn all of postmodernism or the social sciences, but that their thesis is actually that, a condemnation of a larger group of intellectuals without an understanding of the views these intellectuals actually hold. Mellor says, "By embedding their quotes, albeit complete with disclaimers, within a broader discussion of "postmodernism," SB direct readers to one particular reading of their book without having to explicitly claim it, or defend it, as their own."[30] Mellor means that Sokal and Bricmont claim that they are not condemning a whole group, but then they still generalize to a whole group with their accusations that several misuses of a concept deems a whole discipline as nonsense. Mellor cites Sokal and Bricmont's critique of Bruno Latour's usage of special relativity as an example of misused scientific concept which is supposed to show that this would somehow invalidate the rest of his body of work. Mellor claims that Latour had a minor misunderstanding about special relativity but that this would not mean that any other parts of his work should be discredited,

> Their critique of his work is focused on his misunderstanding that special relativity is concerned with observers at different *positions* rather than with observers moving at different *speeds.* This is certainly a shameful mistake, but the paper in which it occurs is a minor part of Latour's corpus and it in no way invalidates the conclusions he draws from the rest of his work.[31]

Sokal and Bricmont use this technique to condemn a range of scholars in a field that should be able to use scientific concepts, and which still agrees to accurately represent those scientific concepts.[32]

One conflation Sokal and Bricmont make is with feminism, feminist critiques of science, and in general science studies, with epistemic relativism. There are feminists who study science, there are feminists' critiques of science, and there is also a whole field of history for studying science. These sub-disciplines and genres have many unique ideological dispositions towards scientific objectivity, contrary to Sokal and Bricmont's assertion. In Gita Chada's article *Sokal's Hoax and Tensions in Scientific Left* she claims Sokal and Bricmont's critique wrongfully poses large questions within science studies, such as the value ladenness of theory and standpoint theory, which they wrongfully believe produce epistemically relative beliefs in those researchers. Chada claims that they wrongfully polarize the conversation between the science and the humanities by splitting up the postmodern camp, pairing it with all radical and subjective ideologies, which all happen to have no nuance when it comes to the value scientific inquiry has according to so called subjectivists. She says,

> I argue that these critiques of science can neither simply be pushed into the political left or right nor can they simply be interpreted to mean pro- or anti-science, which is what Sokal's position eventually amounts to. Moreover the debates surrounding subjectivity and objectivity in the methodology of science cannot be categorized as 'sense' or 'nonsense'.[33]

Sokal does not mean that there are some strands of subjectivism or ideas which come from a cultural constructivist view of reality are ideas with the authority to use scientific concepts. Chada quotes Sokal, saying, "Sokal's aim of putting a check on the proliferations "not just of nonsense and sloppy thinking *per se* but of a particular kind of nonsense and sloppy thinking: one that denies the existence of objective realities."[34] One can see how Sokal does not offer up any room for nuance in interpreting the ideologies of those who study science and that are out of mainstream modern science. They are either a subjectivist for epistemic relativism and do not understand science correctly or they are an objectivist on Sokal and Bricmont's side. Chada cites Evelyn Fox Keller, a biologist and feminist as a counterexample to this claim. Keller, says Chada, tries to reach a middle ground. Keller says theories about gender and for solving political problems in the real world, which involves the practice of science, and from a standpoint or from a type of "self-reflexive reason"[35], all of which are ideas that come from feminist critiques of science "do not

thereby debunk the entire project of science."[36] and that these feminists still want to utilize science but they want to acknowledge the androcentric bias in scientific research as well as for us to cultivate the process of critical self-reflection as a means to refine and help the rational processes of modern science.[37] So, by conflating feminism within the subjectivist and objectivist dichotomy they critique with, Sokal and Bricmont fail to see the nuance and benefit science studies can have. Sokal and Bricmont's criticisms are weaker especially if we hold that their research is contradictory and that they use wrongfully criticize a whole group without realizing the complexity and nuance within that group's orientation to studying science.

4. Criticism (ii) The Intelligibility of the Term Chaos as used by Arkady Plotnitsky in *What is Philosophy?*

In this section I use Arkady Plotnitsky's *Chaosmologies: Quantum Field Theory, Chaos and Thought in Deleuze and Guattari's What is Philosophy?* to show both that Sokal and Bricmont do not understand the full equivocal use of chaos put forth by Deleuze and Guattari in *What is Philosophy?* and that the classification of Deleuze and Guattari's concept of chaos as nonsense by Sokal and Bricmont is built on weak argumentative points. Sokal and Bricmont's interpretation of the postmodern intellectuals' use of the term chaos is that the problems with the critiqued authors are that chaos theory in no way demonstrates the limitations of science[38], it does not prove relativism[39], it frequently misuses the terms linear and non-linear[40], it cannot be used by people who disagree with their definition of its implications in science (which they claim are limited to only mathematics), and that it cannot be used to promote the idea of non-linear thought sometimes promoted in postmodern writers works because chaos theory does not undermine Newtonian determinism or scientific objectivity. I show how these problems are given by Sokal and Bricmont and explain how the equivocal use of the term chaos does render it intelligible contrary to their critique that it is being abused. The equivocal use of the term chaos is allowed because I argue chaos is not used consistently nor only used in correspondence with its already contentious scientific definition.

Sokal and Bricmont's major problems with chaos that were given in *Fashionable Nonsense's* chapter, *Intermezzo: Chaos Theory and "Postmodern Science"* were the false philosophical extrapolations, or lack of them, the misusage of the mathematic terms linear and nonlinear, as well as the hasty generalizations stemming from the postmodern proclivity to epistemic relativism. So, this section first demonstrates that Deleuze and Guattari do not satisfy some condition of the grievances put forth by Sokal and Bricmont's charges, and is then is followed with my argument for why Deleuze and Guattari use the term chaos intelligibly. I say that one can pass off their concept of chaos as intelligible because Sokal and Bricmont generally misunderstand the term chaos as it is used by Deleuze and Guattari in *What is Philosophy?*, at least according to Plotnitsky, the term chaos is being misunderstood within Sokal and Bricmont's *Fashionable Nonsense* and that this specific critique cannot be used to call out Deleuze and Guattari for propagating non-sense in *What is Philosophy?* because it is used equivocally as chaos the virtual, incomprehensible, and as disorder.

Plotnitsky's article addresses the philosophical "underpinnings"[41] of quantum field theory and Deleuze's concept of the virtual in relation to chaos theory. Deleuze's concept of the virtual, says Plotnitsky, is the way in which thought confronts the ever-re-forming context of producing coherent knowledge (i.e. thought). Deleuze and Guattari link the conceptualization of the virtual with the conceptualization of quantum field theory, as well as quantum mechanics, and classical mechanics. Plotnitsky quotes Deleuze and Guattari when explaining *What is Philosophy?'s* project:

> The book approaches chaos by means of a particular and, in philosophy, rarely, if ever, used concept. According to Deleuze and Guattari: 'Chaos is defined not so much by its disorder as by the infinite speed with which every form taking shape in it vanishes. It is a void that is not a nothingness but a *virtual*, containing all possible *particles* and drawing out all possible forms, which spring up only to disappear immediately, without consistency or reference, without consequence. Chaos is an infinite speed of birth and disappearance.[42]

So, Plotnitsky is approaching Deleuze and Guattari's concept of the virtual so he can explain why it is that they use the "chaos" in accordance with their concept of the virtual; the virtual being the phenomenon where one confronts chaos and makes some sort of sense out of the ordering of those particles. He does this by linking the concept of the virtual to classical physics, quantum mechanics, and then quantum-field theory, which he then links to two other concepts from *What is Philosophy?*, the incomprehensible, and disorder. The concepts of the virtual, the incomprehensible, and disorder are all related to quantum field theory, argues Plotnitsky, which makes them all linked

to the overarching concept of chaos, which makes them, chaos as the virtual, chaos as the incomprehensible, and chaos as disorder, respectively.

The connection between chaos and science for Deleuze and Guattari when thinking about chaos as the virtual, disorder, and as the incomprehensible, is that science supposedly confronts chaos by slowing it down on a plane of reference, which says that science confronts disorder "that which is beyond all comprehension"[43] by slowing down chaos with numeric quantities that translate into physical constants or laws. This is done through thought and measurements, which allow us to conceptually relate chaos as the virtual to idea of slowing down science through measurements, and forms what Deleuze and Guattari call the plane of immanence. The plane of immanence then allows one to confront disorder (chaos as chance) and allows us to think of science as being in relation to the incomprehensible (chaos as the incomprehensible) which is opinion, and is according to Plotnitsky, claimed by Deleuze and Guattari to be thought's greatest enemy. Deleuze and Guattari's thesis of *What is Philosophy?*is related to the three types of chaos because it explains how thinking through the disciplines of art, science, and philosophy all confront chaos which is itself the act of confronting and struggling against "opinion".[44] They assert that science and philosophy both struggle against opinion, philosophy's slows down thought through creating concepts, and science freeze-frames thought through measurements.

Quantum-field theory's applicability to chaos also allows Plotnitsky to equivocally relate the idea of disorder to chaos. Plotnitsky says, while defining chaos through Deleuze and Guattari, "while 'chaos may be defined *not so much* by its disorder, it may partially be defined by disorder, at least, by chance."[45]Disorder is defined through chance, which comes directly from quantum mechanics and quantum field theory's ability to measure the probabilities of a particle's position but without any real empirical knowledge. Because physical concepts can then be complete concepts, not all boiled down to their definition from a textbook and Deleuze and Guattari's concept of chaos does not match up to a conventional definition, Sokal and Bricmont see it as being abused. Plotnitsky says, however, that this hinders Sokal and Bricmont because they cannot "be in a position adequately to discriminate between what is and is not an appropriate use of science in the texts they consider"[46].

One example of Sokal and Bricmont misunderstanding where they incorrectly critique Deleuze and Guattari is when they say that the speed of light equation used by them is simply too difficult for a layperson to understand, and that therefore it is still an abused scientific concept. Plotnitsky points out that they do use the concept of the speed of light correctly, it is just that Sokal and Bricmont find nonsense in the postmodernist/cultural studies folks usage of scientific concepts regardless of their supposed correct usage. Plotnitsky says "under these circumstances, an intellectually and ethically appropriate claim on Sokal and Bricmont's part could have been that *they cannot make sense of* this or other passages in question but not that *these passages themselves make no sense,* as they contend."[47] This response from Plotnitsky points out how Sokal and Bricmont color their critique with unwarranted conclusions. The whole point of Deleuze and Guattari's usage of the speed of light reference was to explain how science proceeds through functions, i.e. numerical quantities, such as 299,796 kilometers per second, which is the correct scientific definition and it is used by Deleuze and Guattari in a way that does not satisfy any sort of abuse, because it is justified and has a real purpose in their prose.

In Felicity Mellor's article *Scientists' rhetoric in the science wars* she says Sokal and Bricmont criticize with the "pejorative adverb"[48] which attempts "to make the claims of the critics of science appear disparaging."[49] This phenomenon is related to Sokal and Bricmont's negativity towards and failure to see the nuance within social constructivist thought. Sokal and Bricmont think that claims within the study of science involving social constructionism are automatically those who espouse the false beliefs of epistemic relativism. This is where the authors of *Fashionable Nonsense* failed to see the nuance in Deleuze and Guattari's *What is Philosophy?*, particularly their usages of the term chaos. There is no claim by Deleuze and Guattari which claims that science is not a viable way to gain helpful information about reality, but that it proceeds with methods different than philosophy and art.

Sokal and Bricmont's failure to recognize the interpretation of chaos in *What is Philosophy?* stems from their belief that scientific terminology can only have one correct meaning. Mellor says that they think using a term in any way other than corresponding to the definition given by the scientific community is useless besides as a being useful for pedagogy and only causes more confusion on a topic. She says,

> For Sokal and Bricmont, meaning is unique. Terminology that has a specific meaning within science or mathematics can have only that one true meaning. They acknowledge the usage of metaphor, but to them…metaphor is an explanatory device, a pedagogic tool, beyond which lies either confused ideas (hence the lapse into metaphor) or a more "pure" form of language use (where metaphor is needed only for those too ill-equipped to partake of that pure language)[50]

Therefore, one can understand why it is that Sokal and Bricmont cannot understand Deleuze and Guattari's equivocal use of chaos, because for them physical concepts tapping into reality are only being used acceptably when they are as "terms were they present in a maths or physics paper".[51]

Two more problems that Plotnitsky points out, is Sokal and Bricmont's false authority given about imaginary numbers, which Plotnitsky says are in fact irrational, contrary to their assertions and that *Fashionable Nonsense* being bolstered by scientists who abused their authority and raise objections which were unsupported by arguments gives way to worry of false authority. Furthermore, like with the blip about imaginary numbers, that we are doing something along the lines of Sokal and Bricmont's accusations against French intellectuals, that is, we believe what they say simply because they are presumed experts who can throw around scientific jargon. Plotnitsky says "So much in Sokal and Bricmont's book, and by so many, was accepted merely on the strength of their authority as scientists and their declarations concerning science and its uses and abuses, declarations unsupported by arguments"[52] We see that this is the case, and it is why Sokal and Bricmont cannot claim they have the authority they do on science, because they are not as thorough in using scientific concepts by themselves, and they do not recognize the possibility of a plurality of beliefs pertaining to physical concepts, which we know today there exists many interpretations physicists' interpretations on cosmology[53].

In their chapter titled *Intermezzo: Chaos Theory and "Postmodern Science"*[54] Sokal and Bricmont make three points on the alleged improper use of chaos theory. The first regards its philosophical implications and whether it has any implications; the second concerns the way chaotic systems' imprecision is measured in chaos theory. According to Sokal and Bricmont both are problems "arising from the metaphorical use of the words "linear" and "non-linear""[55]. The third concern is to rebuke the "hasty applications and extrapolations."[56]of chaos theory into other disciplines.

Sokal and Bricmont define chaos theory as actually two nearly identical systems which have the same initial physical conditions for which a single action in one system can end up, with enough time, as an extremely different developed system than the other. They figuratively explain this through the illustration that a butterfly's flight in Madagascar today, could end up causing a hurricane several weeks ahead in one system, but not in the other system. [57] Thus, they define chaos theory as a system where predictability of an event is limited to the set of initial conditions and the amount of time where predictions about such an event remain valid. This, they claim, is why weather reports are only valid up to several weeks in the future. [58]

Chaos theory, as explained by Sokal and Bricmont, describes how one minute variable in one system can have drastically different consequences on how that system develops over time. Chaos is then the measurement of the imprecision of each system and how that imprecision increases. The two types of increase that Sokal and Bricmont say people use to measure the amount of imprecision in the development of a system can be either linear or exponential. The amount of imprecision measured in chaos theory, as given by Sokal and Bricmont shows how chaos as chance or disorder (which is related equivocally to the virtual and the incomprehensible) is used intelligibly and in accord with Sokal and Bricmont's definition of chaos, that is, the measure of system's imprecision over time.

The disdain in the chapter for the philosophical implications of chaos are conceptually reinforced as a naïve belief for someone to have, however there is no actual argument given as to why such philosophical implications are faulty. One example of the possible applicability of chaos theory comes from Felicity Mellor's article, *Scientists' rhetoric in the science wars,* where her claim about Sokal and Bricmont's claim made against Lacan when he uses topology show that it the term chaos could be understood as useful in a similar way. She states,

> SB show that Lacan's use of topology has no meaning for the mathematician and they conclude that it therefore has no meaning whatsoever. They do not allow that thinking about the psyche as closed or bounded, by drawing on the topological notions, may call forth a whole host of connotations which may prove fruitful and come to have concrete analytical value within psychoanalysis. They do not allow that all language including that of science, is in some sense metaphorical; that metaphor creates meaning.[59]

Similarly, Sokal and Bricmont eschew that there is a legitimate way to use chaos, they believe it has no such implications for philosophy, but under Plotnitsky's conceptualization of Deleuze and Guattari's concept of chaos and how philosophy confronts chaos, we see that there are indeed philosophical implications from that concept and that its equivocal usages are intelligible, and not nonsense.

One instance where Sokal and Bricmont claim the philosophical implications of chaos theory are nonsense, but where they do not give an argument to why this is so, is when they criticize chaos theories implications (or any mathematic theory's implications for concrete reality) is because they think that mathematical theories must be understood completely by those using them and because they simply say that "Some purported "applications" of chaos theory—for example, to business management or literary analysis—border on the absurd "[60] The only argument given as to why these applications are absurd is Sokal and Bricmont's follow up comment, "to make things worse, chaos

theory—which is well-developed mathematically—is often confused with the still emerging theories of complexity and self-organization."[61]

The third confusion with the terms linear and non-linear brought up in the physicists' chapter refers to linear regarding thought as linear. Sokal and Bricmont state, "Now, postmodernist authors (principally in the English-speaking world) have added a third meaning to the word--vaguely related to the second [linear order], but often confused with them by the first [linear function] in speaking of *linear thought.*"[62]. The physicists claim that these academics in the English-speaking world advocate a new and non-linear thought opposed to the linear thought they think stems from the enlightenment. Sokal and Bricmont define linear thought as a general attitude from postmodern studies of science, they state,

> but the general meaning is clear enough: it is the logical and rationalist thought of the Enlightenment and of so-called "classical" science (often accused of an extreme reductionism and numericism). In opposition to this old-fashioned way of thinking, they advocate a postmodern "nonlinear thought". The precise content of the latter is not clearly explained either, but it is, apparently, a methodology that goes beyond reason by insisting on intuition and subjective perception. And it is frequently claimed that so-called postmodern science—and particularly chaos theory—justifies and supports this new "nonlinear thought. [63]

So, Sokal and Bricmont are against the misusage of the terms linear, nonlinear, and chaos, specifically when nonlinear equations are solvable. Whether this refutes relativism from the theories put forth by postmodern intellectuals and the ways they use the terms linear and nonlinear is unclear because some intellectuals may be using nonlinear in another way (i.e. non-ordered, or non-sequential) and they may also see direct uses for chaos theory in the social world or even the usage of chaos as meaning pandemonium, etc. [64] The point Sokal and Bricmont want us to take away is that the relationship between linearity, chaos, and an equation's solvability is often exaggerated to prove a version of thought that mistakenly promotes epistemic relativism and uneccessary criticism on the limits of scientific inquiry. One such historically correct usage of chaos, could even be the Greek mythological interpretation of chaos or khaos which was the void from which Greek cosmology started.[65] This version of chaos as a void from which the world was made sense of is a legitimate usage of the term and even has analogous ties to Deleuze and Guattari's conceptualization of the virtual and incomprehensible as they too confront voids.

In conclusion, Sokal and Bricmont's critique fails in criticizing a whole group because their synechdochic tactic is the fallacy of illicit composition. This fallacy was attributing nonsense to and categorizing all the beliefs of those who study science and have studied science in the late 20th century. The fallacious reasoning extends into Sokal and Bricmont's false conflation of several of these sub-disciplines, such as postmodernism and feminist critiques of science. We also see that the term chaos was used intelligibly via Arkady Plotnitsky and that the equivocal usage of the term in respect to chaos as the virtual, incomprehensible, and disorder, furthers the point that the term is used intelligibly.

5. Acknowledgements

Thanks to Dr. Melissa Burchard, Professor Grace Campbell, and the UNCA Philosophy department for their support.

6. Endnotes:

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2 Deleuze, Gilles, and Felix Guattari. *What is philosophy?* New York: Columbia University Press,1994

3 Plotnitsky, Arkady. "Chaosmologies: Quantum Field Theory, Chaos and Thought in Deleuze and Guattari's What Is Philosophy?" *Paragraph* 29, no. 2 (2006): 40-56. http://www.jstor.org.proxy177.nclive.org/stable/43151941.

4 Plotnitsky, *Chaosmologies,* 41.

5 Sokal and Bricmont, *Fashionable Nonsense,* xiii.

6 Hilgartner, Stephen. "The Sokal Affair in Context." *Science, Technology, & Human Values* 22, no. 4 (1997): 506-22. http://www.jstor.org.proxy177.nclive.org/stable/689833.

7 Sokal and Bricmont, *Fashionable Nonsense,* ix.
8 Ibid., ix.
9 Ibid., 1.
10 Fuller, Steve. *The British Journal for the History of Science* 42, no. 3 (2009): 442-44. http://www.jstor.org.proxy177.nclive.org/stable/25592282., 442.
11 Sokal and Bricmont, *Fashionable Nonsense,* ix.
12 Ibid., 2.
13 Gita Chadha. "Sokal's Hoax and Tensions in Scientific Left." *Economic and Political Weekly* 32, no. 35 (1997): 2194-196. http://www.jstor.org.proxy177.nclive.org/stable/4405784. 2194.
14 Scott, Janny. "Postmodern Gravity Deconstructed, Slyly." The New York Times. May 17, 1996. Accessed August 19, 2017. http://www.nytimes.com/1996/05/18/nyregion/postmodern-gravity-deconstructed-slyly.html.
15 Fuller, *The British Journal for the History of Science* 42, 443.
16 Sokal and Bricmont, *Fashionable Nonsense,* x.
17 Ibid., x.
18 Ibid., xiii.
19 Ibid., x.
20 Ibid., 1.
21 Ibid., 4.
22 Ibid., 4.
23 Ibid., 4.
24 Ibid., 4.
25 Ibid., 5.
26 Ibid., 10.
27 Patrick J. Hurley, *A Concise Introduction to Logic, Twelfth Edition*, 12th ed. (San Diego: University of San Diego), 171.
28 Hilgartner, *The Sokal Affair in Context,* 517.
29 Felicity Mellor, "Scientists' rhetoric in the science wars," Scientists' rhetoric in the science wars, by Felicity Mellor, 52, accessed April 17, 2017, http://www.physics.nyu.edu/sokal/pu9104.pdf.
30 Ibid, 52. When Sokal and Bricmont say that the problem with this group of intellectuals is that they propagate ideas about ""cognitive and cultural relativism"" and because they use these terms, "SB conflate postmodernism with science studies and both with certain trends within contemporary French thought"
31 Ibid, 52.
32 Ibid, 52. "SB themselves repeatedly claim that the factual mistakes they highlight are not the main point of their argument; it is the irrelevant usage of science that concerns them. This, however, cannot apply to Latour unless they are claiming that scholars studying the nature of science must never refer to the content of science."
33 Gita Chadha, *Sokal's Hoax and Tensions in Scientific Left*, 2194.
34 Ibid., 2194.
35 Ibid., 2195.
36 Ibid., 2195.
37 Ibid., 2195-6.
38 Sokal and Bricmont, *Fashionable Nonsense,* 140.
39 Ibid., 140.
40 Ibid.,143. The three types of linearity that Sokal and Bricmont claim exist are of a "linear function or equation", which is where "where the effect is proportional to the cause" in an equation, "linear order" where parts of a set are ordered in arrangement linearly, and "linear thought" which they say is mistaken and the way postmodern intellectuals of science classify all scientific, and therefore, logical thinking.
41 Plotnitsky, *Chaosmologies,* 41.
42 Ibid., 41.
43 Ibid., 41.
44 Ibid., 41.
45 Ibid., 41.
46 Ibid., 43.
47 Ibid., 43.

48 Mellor, *Scientists' rhetoric in the science wars,* 54.

49 Ibid., 53.
50 Ibid., 55.
51 Ibid., 56.
52 Plotnitsky, *Chaosmologies*, 44.
53 Smith, Quentin. "Did the Big Bang Have a Cause?" *The British Journal for the Philosophy of Science* 45, no. 2 (1994): 649-68. http://www.jstor.org/stable/687688. For example whether or not the universe was caused by the big bang or whether or not the big bang had a cause.
54 Sokal and Bricmont, *Fashionable Nonsense*, 143.
55 Ibid., 138.
56 Ibid., 138.
57 Ibid., 138.
58 Ibid., 138.
59 Mellor, *Scientist's rhetoric in the science wars,* 55.
60 Sokal and Bricmont, *Fashionable Nonsense*, 145.
61 Ibid., 145.
62 Ibid., 145.
63 Ibid., 144.
64 Harvey, D. L. (2001) 'Chaos and complexity: Their bearing on social policy research' Social Issues (http://www.whb.co.uk/socialissues/) Shows a practical application of chaos and politics.
65 Hesiodus, and Richard Hamilton. *Hesiods Theogony*. Bryn Mawr, PA: Thomas Library, Bryn Mawr College, 1990. II. 116-138.

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1. Deleuze, Gilles, and Felix Guattari. *What is philosophy?* New York: Columbia University Press,1994
2. Felicity Mellor, "Scientists' rhetoric in the science wars," Scientists' rhetoric in the science wars, by Felicity Mellor, 52, accessed April 17, 2017, http://www.physics.nyu.edu/sokal/pu9104.pdf.
3. Fuller, Steve. *The British Journal for the History of Science* 42, no. 3 (2009): 442-44. http://www.jstor.org.proxy177.nclive.org/stable/25592282., 442.
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9. Plotnitsky, Arkady. "Chaosmologies: Quantum Field Theory, Chaos and Thought in Deleuze and Guattari's What Is Philosophy?" *Paragraph* 29, no. 2 (2006): 40-56. http://www.jstor.org.proxy177.nclive.org/stable/43151941.
10. Scott, Janny. "Postmodern Gravity Deconstructed, Slyly." The New York Times. May 17, 1996. Accessed August 19, 2017. http://www.nytimes.com/1996/05/18/nyregion/postmodern-gravity-deconstructed-slyly.html.
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