

Complexity and Chaos Theories as Metaphoric Lenses: An Alternative in Exploring the Voices of Marginalized Populations

Dannielle Joy Davis

University of Texas at Arlington

Abstract

Through the metaphoric lenses of complexity and chaos theories, the Committee on Institutional Cooperation's (CIC) Summer Research Opportunity Program (SROP) is evaluated in terms of its breadth of influence within and without institutional walls, as well as social dogma that pervades this program and its various host institutions. Application of these theories as metaphoric lenses, unveil patterns of influence and dogma at both programmatic and individual levels. Such an application promises to assist in understanding the effectiveness of the SROP program. For decades, minority enrichment programs have sought to promote equity within education through programs such as SROP. By examining the voices of facilitators and former student participants, we may better understand the degree of effectiveness and ultimately the continued need for such initiatives.

Introduction

Contemporary educational stratification between historically marginalized groups and the dominant majority is developed and reinforced by policy and social values that underlie it. Inequitable distribution of educational opportunities grounded in merit-based ideology ostracize the disadvantaged and prompts cumulative deficits in wealth and cultural means for social mobility. Reoccurring attacks on affirmative action include the questioned legitimate need of programs geared toward the retention and educational attainment of racial minority students in higher education. Institutions have altered their minority enrichment programs to include White participants due to fear of potential affirmative action lawsuits. Proponents have been forced to provide evidence of the effectiveness and genuine need for these programs in both state and federal courts. Defense has relied upon qualitative (ex. expert testimonies on the history of educational exclusion of targeted groups) and quantitative data (ex. statistical summaries of admission, attrition, and graduation rates by race). Administrators who support minority programs are considering alternative ways of targeting minorities via focusing upon first generation students and students from high schools with few college bound graduates. However, the effectiveness of these measures in achieving racial parity within American universities remains questionable.

Amid accusations of being unconstitutional, programs such as the federal TRIO McNair Program, continue to work at evening the social playing field through enriched educational opportunities for underrepresented minorities. This article examines a similar initiative, the Committee on Institutional Cooperation's (CIC) Summer Research

Opportunity Program (SROP) through employing metaphor from complexity and chaos theories, in terms of its breadth of influence within and without institutional walls, as well as dogma that influences meeting program goals. Utilizing these lenses promises to assist in understanding the effectiveness of the SROP program.

The intent of this article is not to replace the featured theoretical frames as tools of qualitative analysis, but to use them as metaphors in understanding participant experiences. This intellectual exercise uniquely adds to the literature by applying aspects of chaos and complexity to postsecondary education policy and practice.

The Committee on Institutional Cooperation (CIC) Summer Research Opportunity Program (SROP)

The Committee on Institutional Cooperation is a consortium of “Big Ten,” major research universities that established the Summer Research Opportunity Program (SROP) in 1986. The program centers upon providing 8-10 week mentoring and undergraduate research experiences for groups traditionally underrepresented in academia, such as African Americans, Hispanic, and Native Americans. In its ultimate goal of increasing the numbers and completion rates of minority doctoral candidates, the program engages underrepresented racial minority students in research experiences with faculty mentors with the purpose of accelerating the students’ socialization into the professorate and fostering academic collegiality amongst participants (Eatman, 2001). Examination of the program’s effectiveness promises to provide further insight into postsecondary issues regarding minorities, particularly academic engagement, retention, and achievement.

Employing Complexity and Chaos in Qualitative Inquiry

This article seeks to understand the effectiveness of the featured minority enrichment program. This will be achieved through examining the voices of former participants and facilitators of the CIC’s SROP. The purpose of the study is to determine the effectiveness of the Summer Research Opportunity Program for the targeted student population by both analyzing interview data of former participants and program facilitators, as well as comparing this data with institutional site documents. I use complexity and chaos theories as metaphors to unveil and understand patterns of influence and dogma at both programmatic and individual levels. Data is viewed via the lenses of these theoretical constructs. In relation to the problem stated above, this research seeks to understand ways complexity and chaos theories help us understand the breadth of influence of the SROP program and the role of dogma in program outcomes.

Complexity Theory, Self Organization, and Dogma

According to complexity theory, institutions and social systems are made up of complex adaptive systems (CAS). The smallest unit of analysis of the CAS as applied to the social system is an individual human being. These individuals, or human agents, are shaped by their relationships to other human agents and external CASs. Complex adaptive systems (CAS) refer to “a world in which many players are all adapting to each other” (Axelrod & Cohen, 1999, p.xi). Human agents are also effected by the system’s Common Body of Metaphor (CBM), or the dogma, frame of reference and memory that orders the parts of the CAS. Peroff defines Common Body of Metaphor as follows:

A common body of metaphor (CBM) distinguishes human systems from complex adaptive systems at lower levels of organizational complexity. A CBM is the “organizational DNA,” glue, or equivalent human mechanism that distributes the control of internal, interactive relationships ... Through metaphor, our individual understanding of new things is acquired, defined, and organized in terms of our knowledge of things already retained in our minds as remembered images, ideas, symbols, and stereotypes. (Peroff, 1999)

Policy and dogma within a social system emerge from linear (predictable) and nonlinear (unpredictable) interactions between parts. CBM “forms a particular vision of reality that is the basis of the way the community organizes itself” (Peroff, 1999). CAS memory is distributed amongst the parts of the system and is influenced by the environment, other CASs, and individual perception or experience with the memory itself yielding a given CBM. Such memories often predict the future of CASs.

Complexity theory suggests that complex adaptive systems or societies, are comprised of “agents of a variety of types (who) use their strategies in patterned interactions” to promote social selection based upon environmental context and pursuit of personal and group goals (Axelrod & Cohen, 1999). Influx is balanced by a CAS’s tendency towards self organization, recreation despite turbulence experienced by an actor within or without.

Complex adaptive systems organize themselves via the transfer of energy (Marion, 1999). This capability to self order stems from the ability to process the environment (1999). Specifically, “. . .the system possesses mechanisms for imprinting environmental stimuli within itself and for referring to those imprints at future times. . . Because of this ability to map the environment for future reference, persistent relationships can evolve or self organize” (p. 71, 1999).

In likening this to the social system, human agents respond to the energy of a given system and mirror the social dogma which pervades it through the values and beliefs imparted through development, implementation, and adherence to policy. This work looks at Common Body of Metaphor, or dogma, as it pertains to participants and facilitators of the SROP program and how it reflects or detracts from both program and institutional goals and climate.

Chaos and the Butterfly Effect

The butterfly effect refers to the idea that the mere flap of a butterfly’s wings in Asia, theoretically, may affect the course of a Texas tornado. In terms of utility, the butterfly effect serves in the understanding of the breadth of influence of an individual experience and how it meshes with the experience of surrounding and future actors. Observing the breadth of influence points researchers to a number of additional factors regarding the perceived effectiveness of a program such as SROP, including but not limited to related individual factors, such as a sense of belonging, ownership, and validation. The butterfly effect is used to assist in identifying patterns of influence as it relates to the effectiveness of SROP at micro, individual levels.

Review of Literature: Distinguishing Between Chaos and Complexity

Chaos and complexity theories have been used as frameworks for the understanding of a variety of organizations, including higher education and the corporate sectors. The terms chaos and complexity are often haphazardly used interchangeably. Debate surrounding the definitions of the terms center upon whether complexity derives from chaos, whether they are one in the same, or whether chaos and complexity are separate and distinct. Specifically, some hold that complexity is a branch of chaos theory which focuses upon nonlinear dynamics (Marion, 1999). The Commission on the University of the 21st Century summarized chaos theory in the following way:

A mathematical concept called, somewhat misleadingly, “chaos,” holds that at certain points small changes within systems will produce great and unpredictable results... The mathematics created to conceive ... chaotic situations is nonlinear: the future does not follow trends established in the past. What [chaos theory] represents to us is the probability that the future will not be simply a linear extrapolation of the past, that small *events happening today will cause new patterns to emerge downstream*. (cited in Cutright, 2001, p. 4, Italics added.).

The major characteristic that the two theories share is that of nonlinearity, where effect is loosely related to cause (Marion, 1999). In nonlinear systems “a change (of) a causal agent does not necessarily elicit a proportional change in some variable it effects, rather, it may elicit no response, dramatic response, or response only at certain levels of cause” (1999).

Chaos and complexity theorists believe that the nonlinear dynamics of multifaceted systems render their behaviors or outcomes improbable to predict (1999). The influence of the research process on a participant in terms of personal and social reflection too is unpredictable, yet like the featured theories, yield patterns illustrating the effectiveness of a given treatment.

Nonlinear systems and/or its actors perform repeated, complex patterns of behavior (which includes non-action) not given to the linearity of cause and effect. A given behavior yields change within an environment and acts as “noise” (Warren, Franklin, and Streckler, 1998). This noise feeds into the original structure and prompts disarray and/or constant, rapid change (Cutright, 2001), altering the underlying makeup, or in a social system, dogma at the institutional and collective levels. The following application of theory examines noise as it relates to programmatic effectiveness.

Methodology

The Theories as They Relate to Qualitative Inquiry: Why Complexity & Chaos?

The use of a metaphor implies a way of thinking and a way of seeing that pervade how we understand our world generally. Metaphor exerts a formative influence on science, on our language and on how we think, as well as ... how we express ourselves on a day-to-day basis. (Morgan, 1986, pp.12-13)

Growth is found in chaos, not order (Cutright, 2001). It is my hope that complexity and chaos assist in ordering and understanding the featured data. Chaos often refers to irregularity in time, while complexity refers to irregularity in space. This distinction might render complexity more suitable than chaos in the analysis of the dynamics of space within human social systems, in which the irregularity of fair, equitable treatment throughout space, or poor distribution of space, may refer to lack of representation in varied arenas or inequitable allocation of social resources. The degree of social change or stagnancy of the system might prompt one to further reflect upon the historical factors of poor representation and inequitable distribution, an irregularity of time characteristic of chaos theory.

Time and space do not exist in vacuums. Where there is time, there resides space: the space between now and then ... the period between today and tomorrow. The two are inseparable. Because of this, I use a combination of both chaos and complexity as metaphors in understanding qualitative data. These lenses may provide a view of how reflection upon the SROP experience from former student participants and administrators of the program may point to the breadth of influence throughout time (chaos theory's butterfly effect) and the role both social and programmatic dogma (complexity theory's "common body of metaphor") play in an initiative's outcomes in a given space. Review of these responses may assist in the understanding of the effectiveness of the SROP program for underrepresented students.

Research Design

Semi-structured interviews were conducted at two CIC affiliated institutions during the summer of 2002. The people interviewed at these universities included the SROP Coordinator, Dean of the Graduate School, Provost, SROP staff, SROP team leaders, former SROP participants, and faculty mentors. Administrators at both sites were provided with interview questions prior to the interview, which lasted for approximately one hour each. Participants were given questions specific to their roles in the SROP and were informed that responses would be held in confidence. Interviews and analysis of this article's data were conducted solely by the author. Pseudonyms are used to protect the identities of individuals and institutions throughout this work.

Data Analysis

Focus group and individual interview responses were grouped based on their applicability to the featured theoretical tenets. Credibility was established by offering member checks to participants to ensure that interviews fully reflected their personal experiences. Approximately half of the individuals responded. The following provides an in-depth look at the interview data with former student participants and facilitators of the initiative via metaphor.

The Butterfly Effect & Common Body of Metaphor as Lenses

The Butterfly Effect: The Breadth of Programmatic Influence

The butterfly effect refers to how obscure actions may affect an outcome and serves as a metaphor in understanding the breadth of influence, and thus effectiveness, of a given program. The following former participant of the SROP notes the influence of peer

networking in his/her recruitment into the program. Here his/ her peers serve in advisory mentorship roles.

Former Participant: [I was influence by] recommendations of those orientation leaders, who I stayed friends with and I knew were going on to medical school or graduate school. [They] were serious students. So I don't know if it was consciously or sub-consciously, but...they were role models. You learn to take advantage of programs. I'm a first-generation college student, so I didn't know a lot about what to expect from undergrad and I really didn't know what to expect from graduate school.

These interactions with agents via mentorship functioned beyond that of recruitment. The mentoring provided to students, by students, offered a multitude of accumulating influences, including receipt of advisory and coach mentoring. Participants note the role of peer influence, while mentors and administrators acknowledge its value in students' acculturation into the professorate. The program's breadth of influence flutters about, facilitating the students' understanding of the academy through networking. Contacts with those familiar with the academy infuse students with knowledge required to make sophisticated decisions about their futures and shape their previous perceptions about possibilities available to them.

Faculty Mentor: I think the students get to see themselves in these graduate students who are mentoring them, and these graduate students have themselves been mentored. So they can see the next generation. It helps them, I think [to]...imagin[e] themselves doing the same thing.

The positive climate of the program is mentioned as an influence in choosing to matriculate at a given SROP affiliated university. These culminating factors: The positive campus climate and peer influence might be likened to that of the butterfly effect, influencing the ultimate trajectory and aspirations of the individual.

Former Participant: I wouldn't be pursuing a Ph.D. if it wasn't for SROP, because it wasn't ever an option that people ever talked about ... And maybe because of the field that I was in. I was a teacher, and most people when they graduate they became teachers. No one really talked about going to graduate school. But I do know that just from that one summer alone and keeping in contact with the people who were in my cohort was a big influence for me to say, "Let me look into what they're doing ...let me look into this"...that peer pressure.

Former Participant: [SROP] encouraged us to apply to graduate school and [made] sure that we did stay in contact with each other and look out for each other. [We] kind of ... accepted responsibility for each other. Once I began teaching and they were in graduate school and all...[I thought], wow, maybe I ought to apply.

As suggested in these quotes, the climate of the SROP program not only influenced this participant's interest in graduate study, but fostered a sense of responsibility or interest in his/her colleagues as well. The breadth of influence, like the butterfly, gently promotes networking and collegiality: attributes invaluable within the professorate.

One faculty mentor recognizes the connection between the students' SROP experience and his/her impressions regarding pursuit of an academic career. Again, the mentor's comment suggests a butterfly effect between two generations: that of the faculty member and his/her protégé in terms of mentorship and interest in research.

Faculty Mentor: If you find a good mentor, you're gonna' get good guidance and advice on what to do and what not to do. Preparing [students] for interviews, help[ing] them write papers ... if they need to, they can also...feel they can come back to you and ask for help. If they like you as a mentor, they're also going to like grad school. But if they don't like the mentor, then they're not gonna' like the project here and that's gonna' turn them off.

The faculty mentor's comments suggest that the fit between a mentor and participant may play a key role in a protégée's interest in academic research. This "fit" may occur due to one or a combination of factors, including demographic characteristics such as gender and race, or include personal characteristics such as similar values, communication styles, or ways of understanding the world.

Another faculty mentor moves beyond acknowledging current day effects of mentorship upon participants, suggesting that effects may take place in the future at both personal and social levels. The prospect of continuous mentorship extends the program's breadth of influence today to tomorrow's academy.

Faculty Mentor: I think it's absolutely essential that students of color begin to constitute a critical mass in higher education, being in the various disciplines, so they can begin to mentor other students in forthcoming generations. I believe that higher education is a fundamental path of confronting issues of racism.

The SROP program not only simulates the graduate school process, but serves as a model from which students may draw upon once enrolled in a doctoral program. Students gain a firm idea of aspects of effective mentorship and components of a fulfilling academic experience. Hence, the SROP influences their ideas, as well as expectations of themselves and others well beyond the summer experience.

Understanding the responsibilities and expectations of teacher-scholars stands as one of the most noted attributes of the program. This, coupled with the benefits of mentorship, is repeatedly acknowledged by former participants of the program. The breadth of influence of SROP's mentorship and research components are echoed by former participants of the program. The role of the mentor in promoting or demoting one's interest in research suggests the influence upon future career trajectories.

Common Body of Metaphor & Dogma

Complexity theory's common body of metaphor points to the dogma or underlying belief systems of a society or institution. This social dogma stems from individual dogma held by members of a given group. Introducing underrepresented minorities to the professorate likewise introduces academe to promising potential applicants. While graduate school is "demystified" for the participant, faculty members and departments are awakened to the reality of strong minority talent. The following data demonstrate the SROP program's effect on dogma at the micro, meso, and macro levels. The micro level is influenced via challenging faculty perceptions of minority ability. The meso level is changed through increased minority student recruitment by departments, while the macro level is influenced via the subsequent affect that a more diverse professoriate has upon institutional practice, pedagogy, and learning.

Coordinator: Well, I would hope that the immediate impact is that faculty realize there are students of color who have quality packages, who could come to this school and do well. I hope that's the immediate [result]. We have a number of departments who say that they have difficulty in recruiting students of color...they don't know where any are...which fascinates me. So we bring them to them and say, "Here they are. They're here."

Asst. Dean: I think that [faculty] get to broaden their perspective of what students of color can do. The kind of added benefit [the students] can provide, the kind of added insight that they can [offer] to their department ... it makes the applicant pool richer for graduate school.

The combined efforts of SROP staff, faculty, and university administration, reflects and promotes a welcoming campus climate for minorities. Facilitating a positive campus climate for underrepresented populations counters traditional negative social dogma regarding the intellectual and academic capacities of people of color. Instilling trust by creating a warm, receptive environment and the institution's interest in acclimating participants to the host SROP site are key in validating students and increasing their sense of belongingness. This serves to combat the pernicious effects of negative social dogma that students themselves may have internalized. Such internalized dogma may manifest as self doubt, diminished self efficacy, or depression.

SROP staff and faculty mentors play a key role in reconstructing overall perceptions of minority ability, ultimately influencing dogma pertaining to the benefits of diversity at the personal, departmental, and institutional levels. The belief that changing institutional climate and dogma "is everybody's job" was reflected in the comments of numerous affiliates of the program. Evidence of countering negative dogma is evident in the following.

Coordinator: Without the faculty who sit on these admissions committees ... and say, "I've worked with this student, I think he's capable. I want him here and I'd like to work with him," I don't think I can successfully do my job and I don't think that SROP has successfully accomplished its goals.

In addition to countering negative social dogma, faculty mentorship serves to deconstruct dogma that may blind a student from his/her highest potential. Internalization of negative social dogma lifts when subject to positive interpersonal, social, and campus climates. A faculty mentor reflects upon this deconstruction process and its effect upon performance, self perception, and future decision making.

Faculty Mentor: At the end of the sophomore or junior year...all students, including those students who are extremely talented, have a lot of questions and...a lot of doubts. And the one thing you learn from being a mentor for so many years is it is not at all a foregone conclusion that the students who are the most talented would also be the most confident. Sometimes you get students who really may have a lot of confidence, and they may not be as good academically as students who are very talented and lack confidence...So I think part of the mentoring process is to really help them to answer questions and deal with issues of doubt and insecurity ... a sense of whether they belong ...

The idea of deconstructing negative personal dogma or belief systems through mentorship resonates in another faculty mentor's description of a good mentoring relationship. Like that of the metaphoric butterfly, such an experience holds the likelihood of influencing a protégée's future interests and aspirations.

Faculty Mentor: The relationship has to be...supportive. It has to be mutually empowering, but you have to be able to help kindle a desire or spark for this kind of scholarly work on the part of the student and help them see that they can do this...help them get the confidence to take risks and to do things they might not otherwise do.

Similar to this faculty mentor, a dean acknowledges both class and racial dynamics in understanding lack of parity in educational access. The faculty and administrative interests in promoting a positive climate for minorities mirror earlier staff assertions of the need for campus-wide programmatic support.

Dean: I came to this enterprise from a working class family where no one has gone to college, so this kind of thing would've helped me a lot. But I didn't have the additional sort of demographic that anyone who's growing up Black or Hispanic and American. So I think it is really important to put this opportunity in front of people, many of whom will have come from situations where the idea of going to graduate school is no more a part of the everyday dynamic than the idea of going to the moon.

The dean demonstrates his familiarity with issues surrounding lack of graduate enrollment for targeted underrepresented groups. Participants are encircled by a host of supportive faculty, graduate students, and staff. These varied levels of support facilitate a broad degree of influence within the program. The effect of the butterfly shifts the common body of metaphor to a dogma mirroring that of the program's goals and ideals of excellence and equity in higher education.

Conclusion

The butterfly effect of chaos theory serves as a metaphor in observing the breadth of influence of the featured program, specifically participant and facilitator perspectives on how the program influenced their thinking and experiences. Like the butterfly effect, participant responses indicate how obscure actions may affect retention and interest in graduate study of participants, as well as the likelihood that interest in graduate study has a generational effect, with students developing mentorship relationships with less advanced peers. As indicated throughout the data, the SROP has a positive influence on the personal and academic growth of participating students and faculty mentors. It also promotes improved campus climate for persons of color via invested involvement of administration and staff. These in turn work to transform social institutional dogma pertaining to persons of color and counter negative campus community belief systems surrounding traditional notions of minority underachievement. Amelioration of campus climate and programmatic influence at personal and institutional levels promise an increased likelihood of subsequent minority inclusion within the academy.

Through the use of metaphor, specifically that of the butterfly effect from chaos theory and common body of metaphor, this work reveals the strong nexus between the individual and the institution, the personal and the communal, as well as the private and the public. Just as complex adaptive systems are comprised of “agents of a variety of types (who) use their strategies in patterned interactions” to promote social selection based upon environmental context and pursuit of personal and group goals (Axelrod & Cohen, 1999), this study suggests effectiveness of the SROP program via influence at the personal, departmental, and campus levels.

In light of the attack upon affirmative action and race-based enrichment programs, these findings point towards the continued need for SROP and similar programs. Future research in this area may incorporate the voices of current participants of the program through individual interviews or participant journaling. Further analyses may be made in determining variations in mentoring experiences based on gender and race.

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