Advising Undecided Students: Lessons From Chaos Theory

Amy Beck, Southwest Texas State University

Chaos theory can be used as a metaphor for advising undecided students. Concepts from chaos theory viewed in this context include dependence on initial conditions, strange attractors, emergent behavior in complex systems, and fractals. Looking at advising in a new light often gives advisors new ways of responding to traditional problems. The lessons advisors can take from chaos theory may simply be "get back to the basics," or they may open advisor and student minds to avenues for change.

Using concepts from one of the most exciting areas of science, chaos theory, advisors can examine comfort zones of uncertainty and create imaginative ways to address undecided students. Because one's first impulse is to think of chaos as disorder or confusion, the term can cause misunderstandings about the nature of the theory. Used scientifically, however, chaos refers to an approach, a set of methods, used by scientists and mathematicians to study complicated and seemingly unpredictable behavior in systems (Kellert, 1993). Chaos theory, despite the implication of its name, is used to study dynamic systems that generate an order of their own.

The idea that metaphors from hard science may be employed in psychological theory has been explored by researchers, a number of whose works were collected by Robertson and Combs in *Chaos Theory in Psychology and the Life Sciences* (1995). They believe, "one of the promises of chaos theory is the application of its mathematical ideas to the analysis of behavior" (p. 49). Whether the metaphors are always a true application of the theory or not, they are valuable because they allow one to look at a field of interest in new ways. Therefore, academic advisors may be interested to know how the basic concepts of chaos theory correlate with the research on advising undecided students.

The Evolution of Chaos Theory

What is now considered to be the seminal article on chaos theory was published by meteorologist Edward Lorenz in 1963. The discovery that Lorenz made while analyzing weather data is now considered to be a revelation that changed scientific thinking. According to Gleick (1987), who retold Lorenz's story, as the meteorologist was watching weather patterns unfold on his computer printout, he decided to take a shortcut. He typed in numbers from the earlier printout to provide initial run parameters, but because he expected the new run to exactly duplicate the previous one, he analyzed the output midway through the simulation. He found that the pattern deviated rapidly from the original. He realized that the numbers he had entered had been rounded off to three decimal places rather than the original six places. One could reasonably assume that the results would unfold in a slightly different way, but the two patterns grew more divergent until all resemblance disappeared. Lorenz had identified the ordered unpredictability of a system.

James Yorke first used the term "chaos" to describe Lorenz's work on weather patterns. He curiously entitled an article, written with his student Tien-Yien Li, *Period Three Implies Chaos* (Li & Yorke, 1975). The term chaos has been used increasingly in science and mathematics ever since.

The advent of the computer was crucial to the development of chaos theory. Computers allowed researchers to calculate the long-time histories necessary to observe and measure chaotic behavior (Kellert, 1993). Computer graphics played a key role in the process of discovery by allowing researchers to see patterns that would otherwise have remained hidden in the numbers (Gleick, 1987).

James Gleick's *Chaos: Making a New Science*, published in 1987, was a major catalyst in the development of popular interest in the theory. It presented the basic concepts in terms that everyone could comprehend, and it became a national bestseller.

The graphics associated with the theory evoked aesthetic responses and increased the popularity of the theory among nonscientists. For example, the fractal known as the Mandelbrot set now adorns posters, music videos, and t-shirts. These colorful iterations have linked mathematics with art and nature in a fascinating way (Hall, 1991).

Enthusiasm for chaos theory may be measured by the breadth of its applications. It has been used in every scientific discipline: astronomers have applied it to the motion of stars, planets, satellites, and comets (Murray, 1991); meteorologists have

Downloaded from https://prime-pdf-watermark.prime-prod.pubfactory.com/ at 2025-10-20 via free access

employed it to explore the weather (Palmer, 1991); biologists have used it to study populations of insects and birds, spreading of epidemics, metabolism of cells, and impulses along nerves (May, 1991); physicists have applied it to the motion of electrons and atoms (Berry, 1991); and mathematicians have used it to solve problems that would not have been attempted before the days of computers (Vivaldi, 1991). In addition to scientific problems, chaos theory has been applied to psychological systems (Barton, 1994), to family systems (Ward, 1995), to financial markets (Savit, 1991), to management (Wheatley, 1992), to teaching (Iannone, 1995), and even to football (O'Hare, 1996).

Four of the concepts from chaos theory are particularly relevant to metaphor development for advising undecided students. In addition to dependence on initial conditions as described by Lorenz in his study of weather patterns, the concepts of strange attractors, emergent behavior in complex systems, and fractals, frequently represented as graphics, can apply to academic advising.

Dependence on Initial Conditions

A basic tenet of chaos theory, originally described by Poincaré in 1952, is sensitive dependence on initial conditions. A slight variation in initial conditions in a nonchaotic system leads to a prediction error that grows linearly with time. However, in chaotic systems, the error grows exponentially over time, so that the state of the system is essentially unknown after a very brief period. When Lorenz (1963) analyzed weather patterns, he noticed that the slightest variation could cause huge effects over time. His observation that the fluttering of a butterfly's wings in Sydney today might change the weather in Peking tomorrow became a popular example of chaos theory, and sensitive dependence on initial conditions is now commonly known as "the butterfly effect."

For advisors, the butterfly effect involves the level of trust built with advisees. As a crucial initial condition affecting undecided students, established trust levels with advisors will have profound implications on future relationships. In a recent study of undecided students, Hagstrom, Skovholt, and Rivers (1997) found that feelings of isolation, shame, lack of motivation and direction, frustration, hopelessness, and concern about the perceptions of others were common among the undecided. Other problems, such as family issues and unspoken fears, may be relevant in the search for a major. The researchers suggest that establishing trust with an advisor is of paramount importance for helping the undecided student.

Also, as Bogenschutz (1994) pointed out, many students become undecided when their initial choice is unavailable to them. When students prepare to study in one area and then are not admitted into that program, their self-esteem can suffer greatly. Beatty (1994) described the loss of a first-career choice as a kind of grief; one with which students surely will need assistance. Beatty also identified trust as a crucial factor in advising special groups of undecided students. Advisors must pay particular attention to trust building with minority students and advisees with disabilities.

Stephen Covey (1989), author of *The 7 Habits of Highly Effective People*, stated, "compelling trust is the highest form of human motivation" (p. 178). His workshops may be available to advisors. Covey presents a profile that assists the participant in assessing trust-building behaviors. He includes discussions on honoring commitments, taking responsibility for errors, showing respect, sharing information, discussing important decisions, and supporting appropriate risk-taking behavior (Franklin Covey Company, 1997).

By establishing trust with advisees, advisors may alleviate some of the initial conditions, such as the fears and frustrations identified by Hagstrom, Skovholt, and Rivers (1997), that may cause undecided majors to lack motivation or drop out of college. Advisors know that selecting a major does not send students down an unchangeable career path; however, students may think that it does. Trusted advisors can encourage advisees to take the necessary risks to choose a fulfilling major. In particular, advisors can help advisees see that peripheral issues, such as gender stereotypes, parental pressures, or overemphasis on marketability, are not appropriate initial conditions of choosing a major.

Strange Attractors

Watching chaos emerge on a computer screen is a fascinating experience. Computer software called *James Gleick's Chaos: The Software 1990* (Autodesk, 1991) is available for exploring and demonstrating chaos theory. The software tracks the evolution of a system. A simple yet surprising example can be seen in the case of a pendulum swinging above magnets. Through computer simulation, movement is tracked, back and forth and looping around, but the lines weave into a pattern—order emerges. The shape is a strange attractor; it is the geometrical description of the behavior of a system. The attractor is the totality

Downloaded from https://prime-pdf-watermark.prime-prod.pubfactory.com/ at 2025-10-20 via free access

of points that appear by iteration; it is termed "strange" simply because it is unexpected (Field & Golubitsky, 1992). The apparent function of the attractor is to provide boundaries for behavior in a system (Chamberlain, 1995). The most chaotic systems never extend beyond certain boundaries; they stay contained within a shape that can be recognized as the strange attractor (Wheatley, 1992). People also display ordered unpredictability. They retain an identity; they exhibit behavior that falls within bounds shaped by a lifetime of experiences (Marks-Tarlow, 1995).

Advisors can learn to allow individuals their sometimes unpredictable meanderings. The student's character, aspirations, and values will serve as strange attractors. Advisors can be assured that chaos, when it occurs, will never exceed the bounds of its strange attractor. If a student is in an early developmental stage, he or she will perceive the teacher or advisor as an authority; the student may be looking for a definitive test that will indicate which major or career to pursue. Advisors need to recognize the courage needed to assume the risks of moving to the next developmental stage—in which students begin to take responsibility for their own learning—and provide support (Gordon, 1981). Advisors must encourage the student to develop a sense of identity based on values, traditions, aspirations, competencies, and culture because they will serve as the strange attractors during student exploration. Advisors and students can confidently allow for fluctuations and changes in major and career choice if they understand that the system boundaries are set in place.

Bütz (1992), who argued that metaphors from hard science may be employed in psychological theory, suggested that movement from simple to more complex emotional and intellectual tasks naturally involves chaotic behavior. The individual is the system which is destabilized when confronted with new material that the psyche is unable to integrate. In comparison to the global stability of the individual's life, however, these chaotic points are only transitory. Bütz reminded us that for Jung, the ultimate goal in development was the attainment of the self. When establishing a defining personality, an individual incorporates unique traits that make the person into a distinctively cohesive whole. According to Bütz (p. 1058), "The restructuring of the psychic system necessitates a chaotic period. . . ."

Wheatley (1992, p. 21) also noted, "there is a way to see this ballet of chaos and order, of change and stability, as two complementary aspects in the process of growth." If these theorists are right, then advisors should advocate exploration, questioning, flexibility, and change to undecided students. Advisors should see their role as helping move students from the state at which they feel powerless and controlled, merely following rules, to a state in which they feel free and can welcome change.

Emergent Behavior in Complex Systems

The idea of order arising out of a complex dynamic system is referred to as "emergence." Through the interaction of individual components of a system, a global property emanates which could not have been predicted from its separate parts. This emergent system behavior influences the actions of the component parts (Lewin, 1992). Career decision making is such a system. It involves bifurcation points, critical times when distinct possibilities are available to a system.

Every student experience related to career choice—excitement generated in a class, dialogue with a teacher, communication with parents, engagement through experiential learning—provides feedback loops for the exploring student. As in nonlinear systems, feedback triggers more change in the emerging global system. Advisors need to be mindful of helping students process experiential information, whether positive or negative. As Lewin (1992, p. 13) stated, ". . . the aggregate of a kaleidoscope of developmental processes is a mature individual." Wheatley (1992) agreed, noting that scientists for years failed to notice the role positive feedback and disequilibrium played in moving a system forward. Educators tend to appreciate stability, failing to note the internal processes that people need to grow and adapt.

Whenever advisors engage in activities aimed at bringing order to the complex system of academic advising, they are practicing emergent behavior. For example, Beatty (1994) produced a flowchart showing decision points in the process of developing an academic and personal plan for success. He suggested that developing such a chart would be a stimulating exercise for a high-ability undecided student. The process would also allow for collaboration between advisor and advisee.

Fractals

Fractals were introduced through the research of Benoit Mandelbrot of IBM who coined the word from the Latin *fractus*, a broken stone. Fractals are the geometry of deterministic chaos.

Downloaded from https://prime-pdf-watermark.prime-prod.pubfactory.com/ at 2025-10-20 via free access

They are shapes that reveal self-similarity. That is, if a small section of a fractal is isolated and enlarged, the product often looks strikingly like the original. Fractals are produced using simple, recursive equations where each result becomes the input for the next iteration. Fractals known as Mandelbrot sets result from repeating relatively simple equations to produce extraordinary graphics (Mandelbrot, 1991). These beautiful images have introduced chaos theory to many people. Examples of fractals in the natural world include ferns, cauliflower, and broccoli which are characterized by having small-scale features that translate into large-scale patterns (Mandelbrot, 1991).

Fractals are lessons of wholeness; their self-similarity property is characteristic of whole systems (Wheatley, 1992). A key lesson for advisors of undecided students is to look to the whole system within which they work and the whole student whom they advise. Habley (1994, p. 18) reminded advisors, "advising for undecided students should be an integrated effort." Advisors need to be cognizant of the whole range of student services and consider the links among themselves, academic departments, and campus resources.

When thinking about the whole student, advisors should consider associating developmental theory with advising. To get a complete description of today's college student, advisors need to draw a composite developmental picture and consider identity formation and the psycho-social, cognitive, and moral-reasoning development of the individual. Issues of ethnicity, age, and gender can also raise important developmental issues (Laff, 1994). Advisors need to keep in mind all the internal and external forces that affect students. For example, self-doubt or loneliness may inhibit enjoyment of learning and academic achievement. Likewise, external forces, such as encouragement of teachers or parents, may overcome the negative effects of roommate problems or discrimination.

The concept of wholeness can benefit advisors and students. Advisors need to encourage undecided advisees to look for themes and patterns—to consider their whole lives in making decisions regarding majors.

Conclusion

The chaos theory paradigm reminds advisors of several basics of advising undecided students. It reaffirms the following tenets: being an undecided student is acceptable; establishing trust with advisees is important to establishment of successful relationships; encouraging risk-taking behavior can help students make healthy changes; looking at the whole person (advisee) allows advisors to apply developmental advising principles; and maintaining a positive attitude to change can reassure apprehensive students.

The title of a chapter in Wheatley's (1992) book provides the summary for the overall message generated by using the chaos theory metaphor: "Being Comfortable with Uncertainty." Advisors, as well as undecided advisees, should find comfort in the lessons of chaos theory. Just looking at the beauty of the orderliness apparent in a fractal should remind educators that the dynamics of change may be bounded by a broader pattern—sometimes the beautiful pattern of an individual's life.

References

Autodesk, Inc. (1991). *James Gleick's CHAOS: The software.* [Computer software]. Sausalito, CA: Author.

Barton, S. (1994). Chaos, self-organization, and psychology. *American Psychologist, 49*(1), 5–14.

Beatty, J. D. (1994). Advising special groups within the undecided student population. In V. N. Gordon (Ed.), *Issues in advising the undecided college student* (pp. 67–83). Columbia: South Carolina Press.

Berry, M. (1991). Quantum physics on the edge of chaos. In N. Hall (Ed.), *Exploring chaos: A guide to the new science of disorder* (pp. 184–95). New York: W. W. Norton & Company.

Bogenschutz, M. (1994). Career advising for the undecided student. In V. N. Gordon (Ed.), *Issues in advising the undecided college student* (pp. 49–58). Columbia: South Carolina Press.

Bütz, M. R. (1992). The fractal nature of the development of the self. *Psychological Reports, 71*, 1043–63.

Chamberlain, L. (1995). Strange attractors in patterns of family interaction. In R. Robertson & A. Combs (Eds.), *Chaos theory in psychology and the life sciences* (pp. 275–83). Mahway, NJ: Lawrence Erlbaum Associates.

Covey, S. R. (1989). *The 7 habits of highly effective people: Restoring the character ethic.* New York: Simon & Schuster.

Field, M., & Golubitsky, M. (1992). *Symmetry in chaos: A search for pattern in mathematics, art and nature.* New York: Oxford University Press.

Downloaded from https://prime-pdf-watermark.prime-prod.pubfactory.com/ at 2025-10-20 via free access

Franklin Covey Company. (1997). *Building trust profile.* [workshop materials]. Provo, UT: Author.

Gleick, J. (1987). *Chaos: Making a new science.* New York: Viking.

Gordon, V. (1981). The undecided student: A developmental perspective. *Personnel and Guidance Journal, 59*, 433–39.

Habley, W. R. (1994). Administrative approaches to advising undecided students. In V. N. Gordon (Ed.), *Issues in advising the undecided college student* (pp. 17–23). Columbia: University of South Carolina.

Hagstrom, S. J., Skovholt, T. M., & Rivers, D. A. (1997). The advanced undecided college student: A qualitative study. *NACADA Journal, 17*(2), 23–30.

Hall, N. (Ed.). (1991). *Exploring chaos: A guide to the new science of disorder.* New York: W. W. Norton & Company.

Iannone, R. (1995). Chaos theory and its implications for curriculum and teaching. *Education, 115*(4), 541–47.

Kellert, S. H. (1993). *In the wake of chaos.* Chicago: The University of Chicago Press.

Laff, N. P. (1994). Developmental advising for undecided students: Rethinking the relationships. In V. N. Gordon (Ed.), *Issues in advising the undecided college student* (pp. 25–35). Columbia: University of South Carolina.

Lewin, R. (1992). *Complexity: Life at the edge of chaos.* New York: Macmillan Publishing Company.

Li, T., & Yorke, J. (1975). Period three implies chaos. *American Mathematical Monthly, 82*, 985–92.

Lorenz, E. N. (1963). Deterministic nonperiodic flow. *Journal of the Atmospheric Sciences, 20*, 130–41.

Mandelbrot, B. (1991). Fractals—a geometry of nature. In N. Hall (Ed.), *Exploring chaos: A guide to the new science of disorder* (pp. 122–35). New York: W. W. Norton & Company.

Marks-Tarlow, T. (1995). The fractal geometry of human nature. In R. Robertson & A. Combs (Eds.), *Chaos theory in psychology and the life sciences* (pp. 275–83). Mahway, NJ: Lawrence Erlbaum Associates.

May, R. (1991). The chaotic rhythms of life. In N. Hall (Ed.), *Exploring chaos: A guide to the new science of disorder* (pp. 82–95). New York: W. W. Norton & Company.

Murray, C. (1991). Is the solar system stable? In N. Hall (Ed.), *Exploring chaos: A guide to the new science of disorder* (pp. 96–107). New York: W. W. Norton & Company.

O'Hare, M. (1996). Chaos pitch: Application of chaos theory to football matches. *New Scientist, 150*(2033), 24–28.

Palmer, T. (1991). A weather eye on unpredictability. In N. Hall (Ed.), *Exploring chaos: A guide to the new science of disorder* (pp. 69–81). New York: W. W. Norton & Company.

Poincaré, H. (1952). *Science and method.* New York: Dover.

Robertson, R., & Combs, A. (Eds.). (1995). *Chaos theory in psychology and the life sciences.* Mahwah, NJ: Lawrence Erlbaum Associates.

Savit, R. (1991). Chaos on the trading floor. In N. Hall (Ed.), *Exploring chaos: A guide to the new science of disorder* (pp. 174–83). New York: W. W. Norton & Company.

Vivaldi, F. (1991). An experiment with mathematics. In N. Hall (Ed.), *Exploring chaos: A guide to the new science of disorder* (pp. 33–43). New York: W. W. Norton & Company.

Ward, M. (1995). Butterflies and bifurcations: Can chaos theory contribute to our understanding of family systems? *Journal of Marriage and the Family, 57*(3), 629-38.

Wheatley, M. J. (1992). *Leadership and the new science: Learning about organization from an orderly universe.* San Francisco: Berrett-Koehler Publishers, Inc.

Author's Note

Amy Beck, M.A., is an academic advisor in the University College at Southwest Texas State University. Her interests include advising undeclared students, retention, and use of technology in advising. To discuss the article, interested readers may contact Ms. Beck at AB20@swt.edu.

Downloaded from https://prime-pdf-watermark.prime-prod.pubfactory.com/ at 2025-10-20 via free access