The paradox of stability and change in relationships: What does chaos theory offer for the study of romantic relationships?

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ABSTRACT

This article explores the potential relevance of chaos theory in understanding development and change in romantic relationships. Chaos theory implies that relationship development may not be linear, that relationships may quickly and spontaneously shift to different states and relational patterns, and that predicting their future state may be problematic. Furthermore, chaos theory generates several methodological and statistical issues for relationship studies. The application of chaos theory may increase the understanding of relationships as it stimulates a renewed emphasis on relationships as process, a moving from concern with predictability to emerging patterns, seeing variability as normal, and the recognition of the need for multiple perspectives and methods in studying relational development.

KEY WORDS: chaos • nonlinear • relationship development

For years, researchers of romantic relationships have struggled to find the patterns of stability in the jumbled river of relational change. The hope has been that if researchers could only find the true underlying cause and effects in relationship development, they could predict relationship trajectories. Relationship development would be completely predictable given the right parameters. Consequently, linear stage models that included a beginning, middle, and end to a relationship largely influenced early models of relationship development. For example, Duck (1982), Wood (1982), and Knapp (1984) proposed various stage models involving coming together and coming apart in generally sequential phases.

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More recently, however, these researchers and others have suggested that relationships do not always follow patterns of linear change. Some relationships end only to be reborn in a new form. Others begin and end so often that it is difficult to even identify any stable sequence. More recent conceptions of relationships tend to minimize their linear stage nature. Baxter and Montgomery (1997), for example, contend that relationships are continually being driven by internal tensions that must be managed moment by moment. Management of these tensions does not occur in a linear manner. In fact, Baxter and Montgomery see relationship change as 'an indeterminate process with no clear end states and no necessary paths of change' (p. 341). Likewise, Duck and Wood (1995) argue for an approach that focuses on the daily management of conflicting stresses rather than linear stages.

In addition to questions of linearity, in the studies of relationship development there are always the outliers — the renegade couples who do not fit neatly into the expected patterns. These renegades often are explained away as measurement error and ignored. However, it is often from studying these nonconformists that important implications for the fuller understanding of behavior emerge (Duke, 1994). Attempts to explain both the conformist and nonconformist couples, as well as the linear and nonlinear changes, are where chaos theory may be useful.

Although chaos theory has its origins in the physical and biological sciences, in recent years it has gained popularity in the social sciences as an approach for studying social systems. Chaos theory has been popularized through its exotic terminology — butterfly effects, cascading events, bifurcations, and attractor states. Yet the concepts are finding their way into the social sciences to explain processes such as social change (Nowak & Vallacher, 1998), neuropsychology (Barton, 1994), family development (Ward, 1995), psychotherapy and assessment (Heiby, 1995), and marital stability (Gottman, Swanson, & Murray, 1999). Chaos theory touches on many key issues of interest to relational and marital studies scholars: How do relationships change? Why do they change? What things influence the changes? How do we predict the outcomes of change? The focus on attempting to understand change is at the heart of chaos theory.

The application of chaos theory is sometimes difficult because much of the argument of the theory has been developed through complex mathematical formulae that may initially overwhelm some social scientists who do not have a grounding in advanced mathematics. But the concepts of chaos theory may be useful to the study of relationships (Ward, 1995). Therefore, the key question becomes: Does chaos theory offer fresh insights into the study of relationships? This article assesses the relevance of chaos theory in understanding development and change in romantic relationships. First, several key elements of chaos theory are described in light of relationship development. Methodological approaches and issues are then explored. Finally, several implications of chaos theory for understanding relationships are discussed.

Before launching into a description of chaos theory, we first need to understand three broad types of change — deterministic, random, and stochastic. Deterministic change occurs when one can accurately predict the long-term outcomes of change given the initial conditions of the system and the fact that specific changes in the initial conditions cause specific results (Kincanon & Powel, 1995). For example, one can accurately predict the trajectory and final outcome of a pool ball given the initial force of striking, the angle of roll, friction of the pool table, air resistance, and so forth. Deterministic change is completely predictable. Kincanon and Powel (1995) see a reliance on deterministic change as the basis for all scientific study before the 20th century.

In contrast, random change lacks all predictability and gives completely different results, no matter how much we know about the initial conditions. Random change is completely unpredictable. Kincanon and Powel (1995) give the example of how the lottery system is random in that knowing the numbers that were picked in last week's lottery is of no help in predicting this week's numbers.

Finally, stochastic change falls somewhere in-between deterministic and random change. While it may be possible to make some predictions about stochastic change in the short-term, long-term prediction becomes more difficult. Unlike linear systems, small changes in the initial conditions of chaotic systems can give completely different long-term results (Kincanon & Powel, 1995). Stochastic change can appear in systems that are recursive (i.e., where output from one point in time becomes input in the next), thus allowing the system to react to sudden or unexpected change.

At times, chaotic systems, more commonly called nonlinear dynamic systems, may have elements of all three types of change. They may be deterministic (even though nonlinear), with a well-defined order of transitions, or stochastic, such that the transitions between states are probabilistic (Nowak & Vallacher, 1998). Even elements of randomness may enter the system on occasion. Because relationships are recursive systems, there is a dynamic imbalance, not between individuals but between the order and disorder within the system. To try to better understand nonlinear dynamic systems, we explore some key concepts of chaos theory in the next section and apply the concepts to romantic relationships.

Chaos theory and romantic relationships

Nonlinear dynamic systems

A key focus of chaos theory is understanding linear systems and nonlinear dynamic systems. Some systems are linear, where specific changes in one variable can be expressed as a direct proportion of changes in the other variable. Take, for example, a thermostat and the temperature of a room. By raising the thermostat 1° from 70° to 71°, the temperature in the room will average 1° warmer. Raise the temperature 5° to 75° and the room will average 5° warmer. In other words, specific causes lead to predictable results. Much of the research on relationships is designed to identify key variables and elements that will allow us to predict linear changes and states in relationships. If we know the conditions of a relationship at point A, we can predict its condition 1 month later at point B, and another month later at point C, and so on. Conceivably, we would be able to predict the relationship's condition months and years later. Viewing relational growth in a linear fashion is to think of relationships as moving 'in a unidirectional manner from states of less to more on several key dimensions' (Baxter & Montgomery, 1997, p. 341).

Many systems, however, are anything but linear. A nonlinear dynamic system is one that evolves over time. The state of the system at one point in time determines the state of the system at the next moment (Nowak & Vallacher, 1998). Furthermore, a nonlinear dynamic system has the ability to change from one pattern to another in a seemingly sudden manner. The weather is a good example of a nonlinear dynamic system. When viewed over a long span, the weather shows a pattern of regularity coinciding with the seasons. However, specific weather changes are essentially unpredictable beyond the scale of a day or two (Lorenz, 1979). Weather patterns never quite repeat themselves, and even the most complete information is not enough to specify the subsequent behavior of the weather system. In nonlinear dynamic systems, small causes may produce disproportionately large effects, or none at all. Even the smallest perturbation, such as the rise in water temperature in the ocean, can be amplified into dramatic differences in global weather, 'rendering it virtually unpredictable beyond a few days' (Thelen & Ulrich, 1991, p. 25). Prediction of future states of nonlinear dynamic systems based on current states is extremely difficult.

A key question, therefore, is: Are romantic relationships linear systems or nonlinear dynamic systems? If relationships were simple, linear systems, they would develop along an orderly trajectory. Partners would meet, spend time together, fall progressively deeper in love, marry, and 'live happily ever after.' Such a linear pattern in relationships is far from the rule, however. The majority of budding romantic relationships do not even make it to engagement and marriage (Lloyd, Cate, & Henton, 1984) and those that do follow anything but a smooth path. In a recent study, Surra and Hughes (1997) found that more than half (54%) of the couples in their study exhibited unpredictable and nonlinear relational trajectories involving a large number of turning points. Partners identified events such as new rivals, unresolved differences, meeting the partner's family, and job changes as turning points that greatly changed the nature and progress of the relationship. Similar findings by Baxter and Bullis (1986) indicated that college students reported a mean of 9.2 relationship turning points during courtship. Non-student couples reported a mean of 8.6 turning points in their premarital relationships (Bullis, Clark, & Stine, 1993). Therefore, it appears that, for many couples, relationship development is not easily described by a simple, predictable linear progression.

Nonlinear dynamic systems can produce quite unpredictable changes, where small initial differences result in disproportionately large consequences (Ward, 1995). The nonlinearity of nonlinear dynamic systems is reflected in what is called 'sensitivity to initial conditions.' This means that, depending on the initial conditions of the system, the outcomes can diverge dramatically over the long-term (Barton, 1994). Kincanon and Powel (1995) provide an example of the importance of initial conditions by looking at two water molecules in a river. The two molecules may start out next to each other with velocities that are close and they will stay together in the river for some time. Eventually, however, the molecules will be far apart in the river and their futures will look completely different. The small difference in the initial conditions for the two molecules leads to futures that are substantially different.

A study by Heaton and Call (1995) on the survival rates of marriages helps illustrate the importance of initial conditions in relationships. By examining age at marriage in over 10,000 couples, the likelihood of a marriage surviving 5 years for those people marrying between 27 and 29 years of age was 87.4%. For those couples marrying just a few years younger (23–26 years old), the chances of the marriages surviving to 5 years were almost identical at 87.1%. By 10 years the survival rates of the two groups were beginning to diverge, with a rate of 80.4% for the 27–29-year-olds and 77.5% for the 23–26-years-olds. The divergence continued at 15 years where the survival rate for the 27–29-year-olds was 76.7%, while the survival rate for 23–26-year-olds was 70.1%. Finally, at 20 years, the marital survival rate of 27–29-year-olds was 74.3% and 67.2% for 23–26-year-olds. The seemingly inconsequential initial difference of a few years of age at marriage between the two groups resulted in a cumulative difference over the course of the marriage. The two groups were virtually identical at 5 years, but followed different trajectories as their survival rates grew further apart. If the marriages were linear, the initial minor differences would have created similar minor differences after 20 years. However, in nonlinear dynamic systems, even small differences in initial conditions can cause the systems to assume divergent paths.

An additional reason that the behavior of a nonlinear dynamic system cannot be predicted in long time spans is that we never know the initial data with infinite accuracy. As Nowak and Lewenstein (1994) point out, our knowledge always contains some rounding, errors, or uncertainty. Given a nonlinear dynamic system, and given that all estimates of initial conditions contain at least small errors, even small errors in estimating and measuring initial values might be amplified into large errors of prediction later on. For example, assuming we could develop an agreed upon measure of relationship quality, our measurement of the quality of a specific romantic relationship would still contain some errors in measurement and uncertainty. These errors will become magnified over time so that the gap between the relationship's actual trajectory in quality and where we would have predicted grows as time passes. Therefore, precise long-term prediction of nonlinear dynamic systems will be impossible, even though the actual system and laws governing its evolution may be understood (Baker & Gollub, 1990).

Based on the concept of initial conditions, seemingly insignificant changes that occur at one point in time can result in significant differences in behavior patterns later. This is sometimes referred to as the 'butterfly effect,' in which a butterfly flapping its wings over the Amazon might produce a storm next month in Texas (Kauffman, 1991). Because of the nonlinearity of global weather, even the smallest perturbation — metaphorically, the beating of the wings of a single butterfly — can be amplified into dramatic differences in global weather. The concept of a butterfly effect might explain how seemingly insignificant events, such as a careless comment during an argument or the chance meeting with an old boyfriend, may become devastating for a couple. The careless comment or chance meeting may cause a ripple of other events that can drastically alter the course of the relationship.

The opposite also may be true. In a stable nonlinear dynamic system, a disturbance can be absorbed into the details of the system without disturbing the overall stability, while in a linear system it creates irreversible change (Nowak & Vallacher, 1998). What would seem to be major causes entered into the system may create only minor changes. Roloff and Colvin (1994) illustrate how in some relationships seemingly serious relational transgressions can be dealt with and absorbed without causing the relationship to end. Transgressions can include behaviors like severe conflict, abuse and violence, sexual infidelity, and criminal behavior. In a linear system, such transgressions would create significant change and likely destroy the relationship. Some relationships, however, persist and absorb such transgressions by using behaviors such as the reformulation of relational understandings and rules, minimization of the transgression, justification, prevention of further transgressions, and the use of retribution (Roloff & Colvin, 1994).

The ability of nonlinear dynamic systems to resist change in spite of mounting or decreasing pressure is called hysteresis. Tesser and Achee (1994) provide an example of hysteresis centered on perceptions of love and overt displays of love. If perceptions and behavioral displays of love start out low in a relationship, there is a tendency for the behavioral displays to remain low even though perceptions of love may have increased substantially. Only when a threshold is passed does the display of love increase dramatically. The opposite also occurs. When perceptions and behavioral displays of love both start out high, then displays tend to remain high even when perceptions of love have decreased substantially. When a threshold is fallen below, displays of love will decrease suddenly. Hysteresis helps explain why, in nonlinear dynamic systems, a perturbation can create either significant change or no change at all. This is what makes predicting the outcomes of change in nonlinear dynamic systems difficult under the rules of traditional science.

The occurrence of hysteresis points out the importance of thresholds, called control parameters, in understanding nonlinear dynamic systems. All systems, even those in a steady state, exhibit some degree of variability in behavior. When the amount of variability increases in a system, it becomes less stable. Thelen and Ulrich (1991) state that at a critical value of the 'control parameter', the variability in the system becomes amplified and the system is free to explore other patterns and seek new stable states. Control parameters act as catalysts for system change; the parameters do not control the system in the sense of a command or a prescription, but operate more as thresholds. When a certain level of the control parameter is crossed, the system can be thrown into nonlinear change. In this way, Gottman's ratio of 5 to 1 in terms of negativity/positivity in marital communication serves as a control parameter. For example, in a series of studies, Gottman (1994) found that what creates potentially fatal problems in some marriages is the level of negativity and positivity in couples' communication. Whenever the amount of negative communication in a marriage exceeds the positive at a ratio greater than 5 to 1, the couple is at risk for potentially destructive communication and marital difficulties. Whenever the threshold ratio of negativity to positivity is crossed, it can propel the relationships down a negative cascade.

Phase shifts

As Duck (1994) points out, most relationships have periods of calm and stability. Studies that capture couples in such a steady state would likely find representative linear characteristics. However, all relationships experience periods of instability and change (Duck, 1994). Dynamic systems undergoing extreme instability tend to break apart and lose much of their order and pattern (Young, 1991), and can lead to what are called phase shifts (Gleick, 1987). A phase shift is the process through which the system changes from one state to another qualitatively different state in a seemingly sudden or discontinuous manner (Thelen & Ulrich, 1991). For example, a simple pot of water progresses through several phases as it changes from room temperature to boiling. At room temperature, the molecules in the pot bump around randomly, and, as long as the temperature does not change, the overall behavior of the molecules stays the same. When the pot is placed on the stove with the burner on, the bottom layer of water gets warmer and less dense and tries to rise, but the cooler temperature of the top layer prevents the warm water from rising. As the bottom layer becomes hotter, however, a critical point is reached at which the warmer water begins to rise through the cooler upper layer and suddenly forms itself into a new stable and ordered pattern of rolls. With further warming, this pattern also becomes unstable and the pot boils with another, seemingly chaotic, pattern that eventually produces steam. In a nonlinear dynamic system, phase shifts occur when the system experiences internal or external pressure and the current steady state is unable to assimilate the pressure.

In relationships, phase shifts frequently occur at times of transition in which relationships often take on new meanings and functions (Trickett & Buchanan, 1997). With each transition, a nonlinear dynamic system is faced with bifurcation. One transitional point that may initiate a phase shift in the marital relationship is the transition to parenting. The transition to parenting involves the appropriation of the parenting role and the negotiation of a new marital reality after the birth of the first child (Stamp, 1994). Roles, responsibilities, power, time, and space in the marital relationship all have to be renegotiated and redefined (Veroff, Young, & Coon, 1997). Johnson and Huston (1998) found that spouses realign their role preferences and expectations after the birth of the first child. For some couples, this is a task that creates only minimal discomfort; for others, it is a change that creates tremendous turmoil and crisis. The trajectory the relationship takes following the transition can take any number of directions. For example, Belsky and Kelly (1994) report that nearly half of married couples experience a change in the marital relationship during the transition to parenting. Some couples experience accelerated decline in marital quality, others experience minor declines, while still others even experience some improvement in their marital relationship. Clearly, a number of marriages experience a shift in the marital system following the transition to parenting.

The point at which the previously stable phase becomes unstable and the system shifts to another phase is called a bifurcation point. A bifurcation point marks changes in a pattern of behavior (Nowak & Lewenstein, 1994). Thus, when a dynamic system is pushed further and further from its steady state by internal and external pressures, it may reach a threshold beyond which it cannot recover. At this point, two or more new steady states become available and the system moves to one of those states. Ward (1995) likens the process of bifurcation to a decision tree. The initial condition begins with the trunk. With each bifurcation, the tree branches out. Under stable conditions, the system may follow one branch over another, and change will appear smooth. If, however, there is sufficient pressure upon the system, it may shift suddenly to another branch, producing disjointed change. 'Although the route a system has taken to reach its present state is evident, this position cannot be predicted from a knowledge of its starting point' (Ward, 1995, p. 631). An impending phase shift is sometimes evident as the system will exhibit increased fluctuations as it approaches the bifurcation point (Baron, Amazeen, & Beek, 1994).

Baron et al. (1994) used Levinger's (1980) ABCDE model of relationship development to model a bifurcation point. The ABCDE model purports that one trajectory that relationships can take is from attraction to building a relationship to continuance to divergence to exit. Levinger treated continuance as a bifurcation point, which can lead to one of three qualitatively different states: growing satisfying continuation, placid static continuation, or unstable conflictual continuation. Both placid and unstable continuation will lead to relationship deterioration. In Baron et al.'s modeling of this potential bifurcation point, the route a given couple takes depends upon the dynamic interaction of the mutuality of emotional investment, level of intimacy, frequency of interaction, and affect intensity. By generalizing this approach, it becomes easier to see relationship development as a series of bifurcations and phase shifts.

Once a phase shift occurs, the system can not go back to the previous state. As indicated earlier, nonlinear dynamic relationships are marked by significant turning points. Turning points trigger a reinterpretation of what the relationship means to the participants (Graham, 1997). Turning points are often dramatic episodes in the couple's life that either move the relationship forward or cause it to drift backward (Yerby, Buerkel-Rothfuss, & Bochner, 1995). For example, when a person first says 'I love you', the relationship is changed drastically. The relationship cannot be turned back. The system is faced with the choice of bifurcations. The couple can escalate the relationship or run away as fast as is humanly possible. Baxter and Bullis (1986) identified a number of relationship turning points, such as first becoming sexually intimate, providing assistance in times of crisis, or surviving a major fight. As stated by Yerby et al. (1995), 'turning points are experienced either as breakthroughs, after which the relationship soars to higher levels of commitment, or as breakdowns, after which the relationship falls apart' (p. 101). Turning points illustrate relationship growth as phase shifts that are accompanied by 'positive or negative explosions of relational commitment' (Baxter & Bullis, 1986, p. 486).

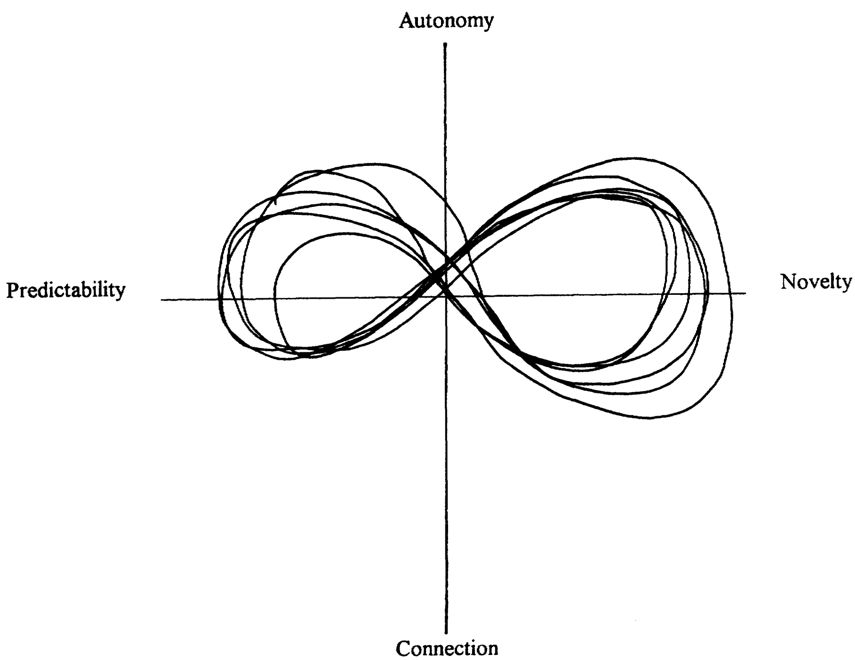
Attractors

Relationships require a certain degree of stability to survive. If couples were experiencing continual phase shifts, there would be little energy left for doing anything else but renegotiating the relationship. Stability does not mean a lack of movement, tension, or dynamics; rather, stability can be seen as a regular pattern of behavior. In chaos theory terms, patterns of stability are called attractors. Gleick (1987) defines an attractor as a point or pattern around which, or toward which, phenomena seem to be drawn. For instance, the attractor for a bowl of water sitting peacefully on a table is one of calmness. We could create a perturbance in the water by dropping a small stone into the bowl. Ripples would immediately rush to the sides of the bowl and back to the middle. Gradually, the ripples would calm and the bowl of water would be drawn back to its attractor state of calmness. Just as the ripples of a pool will return to calm after being perturbed by the rock, a relationship will return to its preferred pattern, or attractor, following a disturbance.

An attractor is often displayed mathematically and graphically in the chaos literature. For example, if one were to graph the movement of a pendulum, it would be a gradual spiral into a point as the pendulum comes to rest. In his attempts to predict weather, Lorenz (1979) mathematically plotted a pattern that loosely resembles a figure of eight. A similar plotting of dialectic tensions in relationships may provide an intriguing scheme for studying attractors in relationships. In her conceptualization of relational dialectics, Baxter (1994) proposes three primary dialectic contradictions underlying relationships: autonomy–connection, predictability–novelty, and openness–closedness. At any given time in each dialectic, one pole is dominant over another. For example, at one period the relationship may move toward autonomy, but it would eventually come back to connection. Relationship development is a continual pull between the two poles of the dialectic. Each of the three dialectics operates concurrently. Thus, the relationship is being continually pulled between autonomy–connection, predictability–novelty, and openness–closedness.

By taking just two of the dialectics, autonomy–connection and predictability–novelty, and assuming that we could measure the relationship regularly over time on these two dialectics, we could plot a pattern of where the couple is in balancing the two dialectics at a particular time (Figure 1). With our first measurement, we might find that the couple was high on autonomy and high on prediction. With the second measurement, we might notice that the couple had moved to high on connectedness, while remaining high on predictability. At the third time, we might discover that the couple has changed back to high on autonomy, but is now high on novelty. By this point, we might have a strong suspicion that this relationship is unstable. With the fourth measurement, we could discover that the couple was now balancing high on both connectedness and novelty. At the fifth time, we might find that the couple is again high on autonomy and predictability. At this point, we would probably throw up our hands in frustration. However, if we had plotted the progression of the measurements, we would see that the couple's struggles with dialectic contradictions had corresponded roughly to a figure of eight pattern, similar to the one Lorenz found by plotting changes in weather (Figure 1). If we could get past our exasperation and continue sampling the couple for dozens more times, we might find that the figure of eight pattern regularly repeats itself. What we would discover is the pattern, the attractor, which is underlying the present

FIGURE 1.
A hypothetical plotting of relationship dialects.



couple's relationship. Of course, other patterns might be possible, an oval or even a star, for example. Whatever the pattern, the main point is that the relationship will follow that pattern as it manages the dialectics. The pattern it displays illustrates the attractor guiding the relationship. If Baxter's third dialectical contradiction were added, we could then plot a three-dimensional representation of the attractor.

Duke (1994) identifies a key characteristic of attractors in that they represent a pattern of behavior that is never exactly regular or predictable, but falls into an identifiable configuration over time. In the case of the dialectic tensions, if we only sampled our relationship at a few points in time it may seem substantially different each time, but, in fact, may not be; or it may appear stable because we only measured at T1 and T5. Rather, measurement may merely represent varying points within the overall pattern of the same attractor. We might find that the figure of eight pattern repeats itself regularly, even though the exact location of the score in each quadrant of the graph would change slightly. Attractors do not specify exactly how behavior will occur, but in what range we should expect to find it.

An attractor in relationships can be conceived of as the behavioral pattern that underlies the period of stability. Perhaps nothing can create as much turmoil in a marital relationship as a separation and divorce. Divorce implies relationship dissolution and most would see it as the official termination of the relationship. But Masheter (1997) has studied patterns of post-divorce relationships and found that the divorce was not the actual end of most relationships. In most cases, the relationship continues on after the divorce, particularly those divorces involving children. In fact, Masheter (1997) contends that many divorced couples have a relatively healthy relationship. Post-divorce relationships involve renegotiating a new reality (attractor) following the chaos of the divorce. Graham (1997) found five patterns in post-divorce relationships: (i) gradual relational progress, characterized by slow and steady progress toward a fully functioning post-divorce relationship; (ii) disrupted progress, referring to a pattern of initially high hopes for the relationship, interrupted by a significant emotionally charged event(s), and then a steady recovery; (iii) sustained adjustment, described as a relatively high-quality relationship that was maintained since the time of divorce; (iv) disjointed erratic cycle, characterized by considerable change and fluctuation, highs, and lows; and (v) eventual deterioration, starting with high hopes, but a rather immediate and continued decline in the relationship. Out of the disorder of the divorce, these patterns of strange attractors emerged, some linear and some nonlinear. Graham captures the essence of phase shifts and new attractors when she says that we need to recognize that 'relationships sometimes dissolve in one form only to be reborn in another, which is an important step in the way we conceptualize and think about relationships' (p. 351).

Attractors not only provide patterns to which systems are drawn following a phase shift, but also provide boundaries or limits to the behavior of the system. Applying this idea of attractors as setting boundaries to relationships, behaviors will fluctuate, but within limits. One case in which attractors may define and limit behavior in the system is the relationship rules couples develop. As stated by Shimonoff (1980), rules 'may function to regulate, interpret, evaluate, justify, correct, predict, and explain behavior' (p. 83). Rules do not govern behavior, directly; rather, they serve as guidelines for how individuals should or ought to behave in certain circumstances (Honeycutt, Woods, & Fontenot, 1993). Following a phase shift or transition, couples will need to adapt previous rules, discard ones that are no longer useful, and establish new rules for which behavior is now accepted and which is not. Couples may even have rules to govern the shift to new strange attractors. Rules may not only provide a pattern of stability to the relationship, but also define the limits of behavior.

Self-organization

Complex nonlinear dynamic systems are comprised of many heterogeneous subelements that change over time (Nowak & Vallacher, 1998). A developing organism, for example, contains subelements such as cells, enzymes, chemicals, neural systems and reproductive systems. A developing relationship also contains numerous subelements, such as interaction patterns, rituals, rules, expectations, tensions, individual competence, and so forth. These subelements change over time and are free to act either as individual elements or to combine in an almost infinite number of ways (Nowak & Vallacher, 1998). Under certain conditions, these elements show coherence and the elements cooperate to produce form and flow that has pattern and complexity. The form into which the components assemble can be thought of as a preferred state of the system — the attractor. The relational system settles into that pattern and returns to it when perturbed. Under other conditions, the relational system components may reassemble into other stable attractors.

The interesting thing about nonlinear dynamic systems is that their structure emerges out of an interaction within the system's parts, and between the system and its environment (Ward, 1995). In chaos theory terms, this occurrence is called self-organization, or the ability of the system to continuously reorganize itself. For instance, Thelen and Ulrich (1991) point out that, during development, what begins as a single cell is prompted by both internal and environmental stimuli to form organs and eventually to develop the cognitive abilities of a human being, who in turn relates to other individuals to form social networks. Self-organization is neither hardwired in terms of predetermined characteristics and developmental trajectories, nor at the total mercy of environmental forces. The new state is neither completely determined by internal relational dynamics nor driven by external environmental context forces (Thelen & Ulrich, 1991). In terms of romantic relationships, the couple does not willfully direct what the relationship will become (though some may try); rather, the relationship emerges from the interaction among basic internal elements, such as attitudes, desires, exceptions, histories, and communication patterns, and is further shaped by the environment. Therefore, following the principle of self-organization, the essence of relationship development is not predetermined, but emerges from the ongoing dynamics of the system itself.

It may be possible to see the concept of self-organization in the process of how couples adapt to a major crisis, such as infidelity, disabling illness, or loss of a job (McCubbin, McCubbin, & Thompson, 1993). In attempting to adapt to the crisis, the couple will draw upon internal and external resources, coping strategies, and perceptions. When the crisis occurs, it can throw the relational system into disequilibrium, and, if strong enough, can initiate a phase shift. Gradually, by drawing upon these internal and external resources, the relational system either returns to a state of equilibrium or self-organizes a new relational state (i.e., new attractor). McCubbin et al. (1993) believe that the new state may be either stronger and more resilient than the previous state (bonadaptation) or weaker and less resilient (maladaptation). The key to understanding the self-organization principle is that the relational system re-organized itself out of apparent disorder.

Following a phase shift, couples need to develop or adapt new rules, rituals, and routines to reinforce the new relationship organization. Many of the old patterns that were useful may no longer be useful. Communication is the process through which self-organization may occur in relational systems (Ward, 1995). During periods of stability, Duck (1994) believes that couples use routine communication to maintain the status quo. When thrown into a phase shift, couples use more strategic communication to self-organize a new steady state. Wynne (1984) proposes a hierarchy of interaction skills necessary to respond to changing needs in the system. When experiencing change, couples need to reconfirm attachments and caring for one another, create shared meaning and a sense of mutual understanding, engage in joint problem solving, establish new mutual relationship patterns, and reinforce emotional sharing and intimacy. As relationships change, new behavior prompts accommodation by the partners. For example, new communication patterns may be established when a spouse suffers an accident or debilitating illness (Wood, 1995). Following the phase shift created by the serious illness, the couple self-organizes a new communication pattern and steady state. What may have been an egalitarian communication pattern will likely become more established as the ill spouse becomes less independent.

The existence of chaotic relationships and scale of observation

At this point in the examination of chaos theory, an odd question arises. Given the amount of nonlinear, unpredictable change in relationships, why is it that, over the course of 2, 10 or 20 years, many relationships appear stable? One reason for this has to do with the scale of observation. Duke (1994) believes that there can be rapid changes over short periods, but over long periods there will tend to be trends that do not change. Depending on the scale from which one observes phenomena, 'the very same object or event may appear at the very same moment in time as being anywhere from unchanging to unstable' (Duke, 1994, p. 278). Coming to understand the giant Red Spot on Jupiter is an example of the importance of scale. From a far distance the Red Spot looks stable and orderly on the face of Jupiter. Yet, the fly-by of Voyager in 1978 revealed that the Red Spot was a huge system of turbulent gaseous flow. Similar conclusions can be drawn about the development of organisms. Thelen (1990) demonstrates that over the life span, the ontogenetic trajectories of all members of a species are globally similar. Yet the individual pathways are highly variant; no two individual life spans are the same.

If one examines the minute-by-minute, day-to-day interactions of couples, behavior might appear almost random. But over the course of a few weeks, regular patterns would begin to emerge. Over the course of a year or two, these patterns would appear almost intractable. Even substantial phase shifts might be masked from the broader scale of a year. For example, if we gathered data on instances of negative and positive affect toward one's partner over several days, we might see patterns of high variability as couples experience arguments, intimacy, violated expectations, and reminiscences. These patterns of affectivity might be so variable as to appear almost random. However, during the same time frame, if we were to measure a more global dimension, such as relationship satisfaction, we might see only minor swings in satisfaction. Stepping back still another step, if we were to measure a spouse's commitment to remaining in the relationship, we might find no variance whatsoever. Hence, nonlinear dynamic systems like romantic relationships exhibit both linear and nonlinear characteristics depending on the scale of observation and the status of their present steady states.

The time frame of observation can also influence the appearance of stability and chaos. Erwin (1996) contends that if social systems are studied over time, a number of nonlinear patterns emerge: systems in which things flow smoothly at most times, with occasional periods of rapid fluctuation and divergence; systems in which things are usually not smooth and multiple interfering cycles frequently interrupt the system; and nondescript systems in which patterns can not be discerned. Furthermore, Gragnani, Rinaldi, and Feichtinger (1997) studied the cyclical dynamics in relationships and found that unstable relationships seemed to follow two patterns: (i) ones in which the intensity of the chaotic periods declined over time, and (ii) ones in which the period of time between chaotic episodes increased over time so that they appeared to be stable relationships.

Long-term relationships, such as those described by Robinson and Blanton (1993), may appear stable over the life-span of the relationship, yet, looking back, during a given day or week of those relationships, we might have seen nonlinear, chaotic, and unpredictable behavior. Thelen (1990) sees this possibility of chaos theory conceptually accounting for the occurrence of both differences in individual relationships and global similarities across relationships as one of the strengths of the chaos perspective. The localized variability illustrates the differences in individual relationships; the broad stable patterns illustrate the global similarities across relationships.

Herein lies the paradox of nonlinear dynamic systems. They can appear highly stable or highly variable, depending on the scale and time frame of observation. From one viewpoint a given relationship may look smooth and stable, yet from another perspective the same relationship may appear dangerously volatile.

Methods for examining nonlinear dynamics in relational research

Up to this point, it appears that chaos theory may provide a useful metaphor for understanding relationship development, but its utility needs to carry over into research. In this section, we consider the question of how one might explore possible chaos theory processes in relationships. This overview is admittedly brief, but our purpose here is to introduce some research strategies used to investigate nonlinear dynamical systems. Readers will want to refer to Cambel (1993), Levine and Fitzgerald (1992), Nowak and Vallacher (1998), or Watt and VanLear (1996) for more information about the technical aspects of chaos theory and nonlinear dynamic systems in the social sciences.

Research approaches

Nowak and Vallacher (1998) assert that the goal of studying nonlinear dynamic systems is not to isolate momentary changes, but to discover the patterns of change over some time scale. Consequently, research into relationship processes from a chaos theory perspective involves close observation and analysis of interaction over time. Once patterns have been identified, it is possible to formulate and test hypotheses about chaotic principles. Thelen (1990) contends that the analysis of group outcomes, so common in the social sciences, often obscures the dynamics of change, and she believes that there needs to be a greater reliance on individual, in-depth studies. By studying individual systems, one can map the developmental trajectories of behaviors of interest to identify where the stability of one state is disrupted and the system seeks a new stable attractor. Once individual developmental paths are identified, it may be possible to cluster systems, not on the basis of outcome, but on the basis of trajectories. This means that detailed longitudinal studies are necessary to capture times of stability and change (Thelen, 1990). Alternatively, it may be possible to conduct intensive observations over a relatively short, but rapidly changing, period.

Studies collecting continuous time data are ideal for examining chaotic processes in relationships. The best examples of continuous time data in relationship studies may come from video-tape and audio-tape studies. Gottman et al. (1999), for instance, used video-tapes of conflict resolution interactions of newlyweds to examine nonlinear dynamics in marital interaction and the prediction of divorce. Such data provide a continuous stream of information with a tremendous number of data points. The availability of continuous time data provides the opportunity for interested researchers to go back and reanalyze their video- and audio-tapes using analysis techniques designed to identify nonlinear and chaotic dynamics.

Another promising research strategy is the use of continuous response measures. Continuous response measures allow respondents to continuously signal changes in some mental or emotional state. Gottman and Levenson (1985) video-taped marital interactions and then had each partner continuously rate his or her own affect while watching the replay of the video-tape. While watching the video, each person used a dial to rate variations in affect — positive affect was indicated by turning the dial to the right, negative by turning the dial to the left. Likewise, the communication box technique also provides a continuous response measure. Burleson and Denton (1997) employed the communication box technique, which consists of a plastic box with five buttons ranging from very negative to very positive, to study marital communication. During a conversation, each partner makes ratings by pressing one of the buttons, which creates an inaudible tone that is recorded on the video-tape for future analysis.

While not employing continuous data, other methods can sometimes provide enough data points to examine nonlinear processes. For example, Almeida, Wethington, and Chandler (1999) used a daily diary approach to study the transfer of tensions within families over a 42-day span. Another strategy might be to use pager-type devices to collect data (LeMay, Dauwalder, Pomini, & Bersier, 1996). For example, people could be asked to carry a pager and when beeped, they would enter the level of a state, cognition, or emotion into a portable data collection device or call a researcher to enter data. Data collection could take place several times a day for a number of days. Also, retrospective techniques similar to those used by Surra and Hughes (1997) hold promise. In their study, Surra and Hughes had participants indicate changes in levels of commitment along a time line of their courtship period. Of course, retrospective techniques have other difficulties.

Examining dynamic processes

While researchers have applied a number of different strategies for analyzing nonlinear dynamic systems in the physical and biological sciences, many of the techniques have only recently been applied to the social sciences. Graphical techniques involving both visual and mathematical approaches are often the first step in examining dynamic processes. One of the simplest approaches is to create a graphical time series by plotting values of variables as a function of time. Nowak and Vallacher (1998) state that such an approach may reveal phenomena such as 'periodicity, regions of stability versus change, smooth versus catastrophic changes, rapid versus slow time scales for the system's evolution, and tendencies toward stabilization versus increasing variance' (p. 68). VanLear (1996) used graphical techniques to illustrate dynamic patterns in communication processes. Furthermore, Buder (1996) shows how the amplitude and frequency of communication behaviors can be plotted in a series of observations using Fourier transformations and spectral analysis. These techniques allow for the mathematical and visual display of behavioral peaks and cycles in communication interactions. Buder (1996) used this approach to illustrate patterns of synchrony in conversations.

Similarly, LeMay et al. (1996) illustrate how the plotting of sequences of stages using simple Boolean algebra can be used to create maps and visual models of relationship change. The Boolean binary method allows one to consider many variables simultaneously, plot the structure of the configuration of these variables overall, and plot the evolution of the configuration (Kupper & Hoffmann, 1996). Researchers, for example, might be interested in studying the fluidity of emotions in romantic relationships. They might collect data on four basic emotions (e.g., happiness, sadness, anger, and disgust) over time (say four times a day over 3 months). At each point in time, each emotion would be recoded as a dichotomy with 1 = *high* and 0 = *low*. Participants would also report each time on an event in the relationship that triggered a positive or negative mood, or a life event that was significantly intense. The successive interactions between the four emotions would then be plotted; analyses would be carried out along the lines of a single subject design, with maps created for each relationship. The Boolean approach allows one to examine attractors, as well as positive and negative feedback loops and chronic cyclic patterns. Its appeal is that it allows complex dynamic processes, either found in theory or clinical observations, to be visualized as simple models that show both the dynamic patterns and attractors. In addition, it allows one to compare predictions with observations to date.

Other, more mathematical, approaches also have been used to test for chaos dynamics. For example, the use of differential equations has been advocated to allow for explanation of stationary as well as cyclic or chaotic processes (Nowak & Vallacher, 1998). Gottman et al. (1999) used coupled ordinary and nonlinear differential equations to model cyclic dynamics of marital interaction and found that subsequent divorce could be predicted by examining conflict interactions of newlyweds. Likewise, Gragnani et al. (1997) used nonlinear differential equations to model relationship trajectories along dimensions of love and attraction.

Several other quantitative techniques have frequently been used to test for potentially chaotic dynamics in data, including the correlation dimension, the Lyapunov technique, and nonlinear time series analysis. Unfortunately, few of these have techniques have been applied to the study of romantic relationships. In trying to understand the trajectory of a relationship, Cambel (1993) suggested that one calculate a correlation dimension, which is the slope of the linear portion of the log–log plot. The Lyapunov exponent is a nonlinear technique that offers the possibility of detecting deterministic components that may previously have been explained away as random error in an empirical time series analysis (Cambel, 1993). This measure examines the rate of divergence of two points (e.g., characteristics of the relationship) that began close to each other and follow independent trajectories over time. Another approach, nonlinear time series analysis (e.g., nonlinear forecasting and the method of surrogate data), can be used to deal with short and noisy time series data

(Scheier & Tschacher, 1996). It is particularly helpful in distinguishing chaos from random processes. Because many of these techniques have only recently been applied to social processes, it is unclear which methods will prove most useful. As one might expect, each method has strengths and limitations and scholars disagree as to the usefulness of any one approach.

At this point, one of the most promising approaches to exploring chaos theory processes is the use of computer simulation to develop models of relationship dynamics. Nowak and Vallacher (1998) comment that one of the strengths of computer simulation is that it allows researchers to investigate a large number of interacting elements over many iterations. Furthermore, they believe that computer simulations can be helpful in generating hypotheses that can then be tested with empirical study. Fortunately, to aid in the analyses of nonlinear dynamic systems, a range of computer programs exists for those who wish to conduct analyses of relationships over time, looking for chaos and stability. Among these programs are user-friendly bifurcation programs, such as CONTENT, in which one could examine bifurcation trees, rather than the standard decision-making trees. There also are manageable programs for creating models or examining data sets (e.g., Model Maker, Stella, and CDA — Chaos Data Analyzer). Hopefully, such programs will make the analysis of nonlinear systems like relationships much easier and much more common in the future.

The search for chaotic dynamics is not relegated to the quantitative realm. Goldstein (1996) supports the use of qualitative methods and suggests that qualitative methods bring together information regarding the randomness in the causal linkages and the emergence of patterns. The use of explanatory narratives may better allow the meaning that flows through the sequence of events in a relationship to emerge, representing the system in a more holistic manner. Jones (1995) conducted an interesting study of 21 years of love poetry by Petrarch to his platonic mistress Laura. From his qualitative study of the poetry, Jones concluded that the poet's emotions follow a regular, 4-year cyclical pattern, ranging from the extremes of ecstasy to despair. Rinaldi (1998) used differential equations to analyze those same poems and confirmed Jones' more qualitative, linguistic, and stylistic analysis. Qualitative approaches may hold promise for the study of chaotic dynamics using relationship narratives such as autobiographies and long-term diaries.

Implications for relationship studies

The basic question asked at the beginning of this article was: Does chaos theory offer fresh insights into the study of relationships? The answer to this question is not a simple yes or no. It appears that chaos theory holds both promise and problems. In this section, we present four implications of chaos theory for the study of romantic relationships. These implications are by no means original, but can help inform the application of chaos theory to relationship development.

Relationships as nonlinear process

The promise of chaos theory can be seen in the way in which it helps describe several processes within relationships and relationship development. The concept of nonlinear dynamic systems seems to make sense when looking at relationship trajectories. Duck (1994) argues that relational development is not always smooth and steady. Rather, it is jerky, marked by times of discontinuous activity and inactivity, characterized by steps and plateaus of growth. That relationships might be nonlinear is nothing new to relationship scholars, but chaos theory provides a framework for understanding the nonlinearity. The idea of the butterfly effect and sensitivity to initial conditions underscores why even the seemingly smallest events can create such turmoil for couples. Similarly, chaos theory may explain why relationship transitions can be difficult for some couples and not others. Even the concept of self-organization seems relevant to how couples reconfigure their relationship following transitions and changes. As such, chaos theory highlights relationships as a process rather than as a state, and may provide explanations for some of the noise that often plagues the study of relational development.

Moving from predictability to patterns

Chaos theory also impacts on the way we look at predictability. In linear systems, it is possible to predict certain outcomes given certain causes. In nonlinear dynamic systems, the same cause might have a whole range of possible outcomes. Predictability is possible during periods of stability, but decreased predictability occurs during periods of instability and phase shifts (Gottman, 1991). Doherty (1986) describes how, in the early part of the 20th century, physicists struggled with trying to predict the exact location of an electron in an atom. Using deterministic linear approaches, they were frustrated by the fact that the electrons were never accurately found where they were predicted to be. This frustration led to the rise of quantum physics. In quantum physics, one can never predict exactly where an electron will be at any given time, but it is possible to identify a general pattern around the nucleus in which the electron can be found.

The need to re-examine views of predictability echoes Berscheid's (1986) concerns about the state and future of relationship studies. Berscheid argued that we have been hindered by the conception of causal pinpoint prediction borrowed from the natural sciences, particularly classical physics. For example, using pinpoint prediction, one might be asked to predict exactly when a specific pot of soup will boil. This view follows the traditional Newtonian-based mechanistic approach to causality based on amount, substance, and control (e.g., How much of the variable is present? How much and in what direction does it change over time? How can I control that change?). Pinpoint prediction requires stable variables, precise measurement, and control over variables. Berscheid feels that individual pinpoint prediction may not be appropriate for the study of relationships, because first, pinpoint prediction calls for the precise measurement of a manageable and measurable number of variables, which in relationships studies is nearly impossible, and second, the control of those variables, which is not feasible either ethically or technically for relationship scholars. In fact, a classical physicist is not asked to predict the fall of a single snowflake, yet social scientists are expected to predict not only if a specific couple will divorce, but when. Ironically, given the revolution of quantum physics, most physicists have given up on the notion of causal pinpoint prediction.

Berscheid (1986) calls for a return to science as the 'process of making systematic observations of events that are interpersonally replicable and verifiable and to the original aim of trying to make sense of those events, whether or not that sense can be converted to mathematical formulae and precision and whether it leads to changing nature or to simply appreciating it' (p. 285). Such a view calls to mind the Pythagorean approach to prediction and causality that focuses on patterns and emergent phenomena (e.g., Over time, how are patterns transformed? How do new patterns in the emergent phenomena relate to earlier patterns of the system? What in a new pattern is unique and what is similar to that from earlier states of the system?). If romantic relationships are nonlinear dynamic systems, we may never be able to fully predict future outcomes and trajectories. It may be that there will always be those outlier couples, couples undergoing phase shifts, which do not fit the linear expectations. Yet, we may be able to identify a general pattern in which the relationship might regularly be found. Chaos theory, through its focus on emergence, allows for the joining of determinism and indeterminism, causal and stochastic methods, and the interweaving of causality and randomness (Goldstein, 1996).

Variability as normal

Likewise, by viewing relationships as dynamic systems, variability within and among relationships becomes the norm, rather than the deviant. Classical approaches assume that there is one set of universal and eternal laws that govern all relationships all of the time. The belief is that, in principle, we can accurately test those laws given better measuring techniques, better research designs, more truthful participants, or less biased researchers. Nowak and Vallacher (1998) argue that human behavior is far too unstable to be studied with traditional scientific assumptions regarding the stability of observations. Human beings and their social relationships are highly sensitive to fluctuations. Variability in findings can mean that one has accurately assessed the behavior of the same system, but that it is now in a different state and therefore a different place. It has varied and the findings still may accurately reflect its current state.

Chaos theory, however, informs us that variability in relationship development is normal rather than abnormal (Nowak & Vallacher, 1998). The variability found using linear and causal approaches might not be due solely to measurement error, but to the possibility that relational variability is truer than relational constants. Thus, rather than being consumed with cause and effect, the role of relationship scholars may better be served to create theories that make social dynamics and relationship patterns intelligible to scientists and the public. As Young (1991) states, 'there are no iron laws of nature and society, only the infinite richness of variation and change' (p. 330).

Chaos as beneficial

For scholars, nonlinear dynamic processes can often be seen as problematic, whereby the variability and unpredictability doom our research efforts. The opposite may be true. Chaos theory, and specifically the concepts of stability and change, may open up a number of new ways to explore developmental processes (Thelen, 1990). Instead of considering variability as a problem plaguing our linear models, we may be able to exploit the 'inherent noisiness of relationships in a principled way to open doors on the dynamics of change and to explore the limits of predictability' (Thelen, 1990: 37). Likewise, from an applied perspective, Parry (1996) believes that clinicians can benefit from an understanding of chaos theory principles. Clinicians may want to resist the urge to always help couples return to a previous state of order; rather, they can help couples see phase shifts and new relationship attractors as healthy instead of deleterious.

Thelen (1990) believes that chaos principles change our fundamental views of the nature of variability. When we consider individual differences as noise, residual error or the refusals of our participants to cooperate, we design and interpret experiments that maximize global similarities and emphasize conventional statistical tests for the generalizability of results. If, however, we view variability as not only the inevitable consequence of relationship development but the very substance from which change is sculpted, we begin to look at the local vacillations as well as the the global patterns. Furthermore, Thelen speculates that there is a relation between variability and flexibility. 'It is possible that adaptive functioning is not so much a product of any specific style of response, but of the ability to reorganize quickly and smoothly as task demands change' (Thelen, 1990, p. 40). Individuals and couples may well differ in their ability to keep the relationship's integrity despite the inevitable disturbances of life.

Conclusions

We need to acknowledge, however, that despite the promise of chaos theory, there are problems in applying it to romantic relationships. For instance, mathematical techniques used to examine chaos theory are not familiar to the majority of social scientists. Also, for researchers to adequately conduct quantitative analyses of nonlinear dynamic systems, they may need sets of hundreds to tens of thousands of data points (Kincanon & Powel, 1995). With areas such as relationship development, it may be difficult to obtain the number of data points needed to learn about the chaotic structure of a system. Hence, it may be almost impossible to obtain precise enough data to test perfectly good theories about relationships. In addition, a body of scholarship applying chaos theory to relationship issues does exist. However, many social scientists are not familiar with it largely because scholars in countries outside North America conduct much of it and it usually appears in journals with mathematical orientations not read by a broad base of social scientists.

Also, in their analysis of studies that have attempted to apply chaos theory to the social sciences, Kincanon and Powel (1995) found a number of examples of misapplication and misuse. Terms that refer to specific and limited ideas in mathematics and physics can easily be confused with the broader characteristics of nonlinear dynamic psychological systems. Chaos theory definitions developed in the physical sciences may bear little resemblance to the definition of chaos in the social sciences. Such is the case of other theories, such as systems theory, which have been applied from the physical sciences. Ardent chaos theorists themselves do not always agree on definitions. Using chaos theory terms as metaphors may be heuristically acceptable, but the two are not the same (Barton, 1994). Although useful at times, all metaphors eventually break down or lose their validity when more and more exacting parallels are drawn between them and reality.

Kincanon and Powel (1995) also point out that even though it may be necessary that a chaotic system be nonlinear, nonlinearity is not sufficient proof that a system is chaotic. Many nonlinear systems are not chaotic. Throughout this article, we have tried to be careful not to conclusively state that romantic relationships are chaotic systems. We realize that at times they are nonlinear, but there needs to be much more data before we can reliably call them chaotic. Researchers still need to be cautious in declaring relationships chaotic until the data are in.

Studying relationships brings to mind the well-known analogy of trying to describe an elephant while blindfolded (Acitelli & Duck, 1987). A traditional linear approach would try to describe the elephant using only one person touching only one part of the elephant. From this experience, a generalization about the elephant would be made. A better approach would be to use multiple people to explore the various parts of the elephant. Acitelli (1995) suggests that to fully understand and describe romantic relationships and their development multiple perspectives and methods are needed. (Unfortunately, if our elephant were truly following chaos theory, by the time we described it using multiple perspectives, it might have changed to a rhinoceros.)

Despite the difficulties, chaos theory does provide enough new ways of thinking about relationships to warrant consideration. Barton (1994) affirms that researchers need the latitude to be speculative at first. Creative ideas and strategies need to be developed, expanded and tolerated. While new and exciting, chaos theory does not replace the continuing need for strong research and theory building in the study of relationships. Chaos theory needs to be rigorously and thoroughly tested in application to relationships. Ultimately, its value to relationship studies will come from its ability to solve problems and explain behaviors. Only then will we be able to ascertain whether relationships are systems best understood through the window of chaos theory.

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