# Studying the human–environment phenomenon using the science of complexity

The principal argument of the present article is that a new theoretical paradigm capable of facilitating the understanding of complex phenomena is necessary to study nursing's claim to its science as the science of unitary human beings, or the integrality between humans and the environment. A research study of the complex human–environment phenomenon illuminating a four-phase methodology is presented. It is argued that much can be learned by the use of the science of complexity to integrate data gleaned from different approaches to knowledge generation into a comprehensive understanding of the human being in the environment as a unified whole.

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THE USE OF RESEARCH METHODS from different paradigms can contribute to greater understanding of complex nursing phenomena. Nurses care for human beings with health needs that become increasingly complex through life in a continuously changing environment. The way the human–environment phenomenon is studied continues to be a dilemma for nurse scientists.

In 1988, Moccia[1] challenged nurse researchers engaged in the development of nursing science to go beyond the technical and to make choices that affirm both nurses and those for whom they care. The debate between quantitative and qualitative methods and the possibility of their combination has raged with claims of their incommensurability,[2] or the uncomparability of views of reality, to a view of the combination as a stimulus to insight into the whole.[3,4] Coward[5] considered that critical multiplism, the thoughtful choice of multiple methods relevant to the problem, was particularly appropriate for the contextual nature of nursing

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science. The dialectic model of inquiry was identified as particularly useful for generating new knowledge of human–environment interactions for nursing science.

The phenomena that nursing scientists study are complex. As Moccia[1] noted, holistic human phenomena cannot be controlled or predicted; they are experienced and open to possibilities. But human behavior has also been shown to include both qualities. Control of some parts of the human–environment relationship may give greater assuredness of the outcome, but not absolute certainty. Furthermore, the role of the researcher in the interpretation of data cannot be negated. The choices therefore that Moccia[1] recommended to affirm both nurses and clients must be guided by a reexamination of philosophies of science and theories of complex systems as they apply to the phenomenon of investigation. Nursing's research methods should be appropriate to the patterning of our phenomena of study.

## THE PHENOMENA OF STUDY

Human beings in the environment are a central focus of nursing research. Rogers[6] theorized that human beings and the environment are in continuous, mutual process. Change in one is related to change in the other. These changes are irreversible, and the human being becomes increasingly complex through life, manifesting patterns that are not predictable. At times, the patterns occurring in the human being living in the environment may appear radically different from previous patterns. As Newman[7] suggested, disharmony in the human energy field may be seen clinically as dis-ease. Nurses caring for human beings frequently feel their knowledgebase is inadequate, given the complexity of unique human beings who are continuously changing in a diverse, changing environment. The art of creative nursing uses knowledge for human service. This knowledge constitutes the science of nursing and is generated through research. Nurse scientists study phenomena that display patterns that are deterministic or stable (eg, chemical structure, family structure) or that change dramatically (eg, cancer cell metastasis, response to aging, caring), as well as certain critical points at which the patterning of the phenomenon changes unpredictably and with no apparent relationship to previous patterning (eg, extreme grief or depression). Yet, within this chaos, a new and greater order may be found in which new ways of looking at the parts and the whole are utilized. A new way of being may evolve that still encompasses the unique patterning of the individual human beings but in more complex patterns. Mapping of these changing patterns reveals the continuously dynamic nature of a system of human change and the self-organizing ability of the integral human–environment process.

The way that human beings come to understand their environment begins with an awareness of the whole, moves to a focus on parts, and then returns to focus on the whole with increasing understanding. Davidson[8] found in 1988 that environment is first perceived and described by subjects as a whole. Awareness of specific manifestations of the environment occurs as more specific information is needed to understand and respond in the environment. The unique pattern of the individual filters and dialectically reflects upon the information to gain understanding not only of the environment but of the self. Merleau-Ponty[9] considered that environment is the only place that people truly

know themselves. By uniquely living in the environment, human beings learn about the patterning of themselves and others.

Dialectical patterns, or movement between the opposing extremes about the midpoint of a phenomenon, are fundamental to an understanding of the environment and to life. Oscillating cells, chemical reactions, financial markets, and the human–environment relationship[8] all manifest swings above and below a midpoint. Seldom actually in equilibrium, they are dynamic. Dialectical movement has also been used in philosophy and science to further understanding. Wilson and Fitzpatrick[10] and Moccia[11] encouraged the use of the dialectic to study complex, relational, and dynamic worlds, such as the human–environment relationship. From the research perspective, the boundaries of the dialectical excursion, or the moving back and forth among multiple sources of data, enhance the researcher's intuitive knowing and sense of the problem under study. Through literature review, the researcher broadens his or her existing understanding of the phenomenon. Reflection upon the data, the literature, and previous research further challenges the intuitions of the researcher and strengthens the evolving strands of sense-making in preparation for the conversion to language. Through reconciliation of dialectically opposed data comes a new understanding of a new possibility through a transformative spiraling.[12,13]

## STUDYING THE PHENOMENA

In nursing science and practice, the need for factual, quantitative, or objective knowledge that provides a high degree of predictability of outcome cannot be overlooked. Such information serves to guide interventions and communicate to others—students, clients and family—the how, what, and why of the nursing process in giving care. Yet much of the dynamic reality of living resides in context and is best described and understood through comparing and contrasting varied data, examining critical points, and searching for a higher order of the whole, which is not easily seen but evolves from the self-organizing power of the phenomenon itself.

## THE SCIENCE OF COMPLEXITY

From the current research into the physical sciences of physics, chemistry, and mathematics have come new ways of describing and understanding systems of such complexity that they seem to exhibit no rational, predictable behavior. The science of complexity applies to a broad range of physical systems that are characterized by deterministic development with chaotic outcomes.[14] The current state of the system depends on the previous state in a rigidly determined way. And even though the system evolves in a deterministic way, measurements made on the system do not allow the prediction of its state even moderately far into the future. The system is characterized by nonlinearity, but the measured values of the properties of a system in a later state depend in a complicated way on the measured values in an earlier state.[14] In this instance, "complicated" means something other than proportional to or differing by a constant, or some combination of these two. It does not mean that the system cannot be modeled by linear relations. In response to a stimulus from the environment, systems close to instability

develop fluctuations at a critical point, which are amplified in a nonlinear manner to give rise to a macroscopic order.

The science of complexity models a pattern of evolving order that is relevant to nursing science. A deterministic history does not bring about a predictable future, but rather a possible future. By taking quantitative and qualitative data, reflecting on them through a dialectical process, and bringing in the self-organizing filter of the researcher's understanding in the hermeneutic process, the researcher can make critical choices that facilitate leaps to greater understanding of the order within the whole of the phenomenon. The process outlined here and used in the study of the human–environment relationship depicted in Fig 1 elucidates a method for studying complex nursing problems within this paradigm. This method for the study of complex phenomena of human–environment integrality involves

- apprehension of the whole to determine data needed,
- examination of the manifestations of the whole collected as data,
- analysis of data according to the appropriate traditional paradigm,
- dialectical movement among the findings,

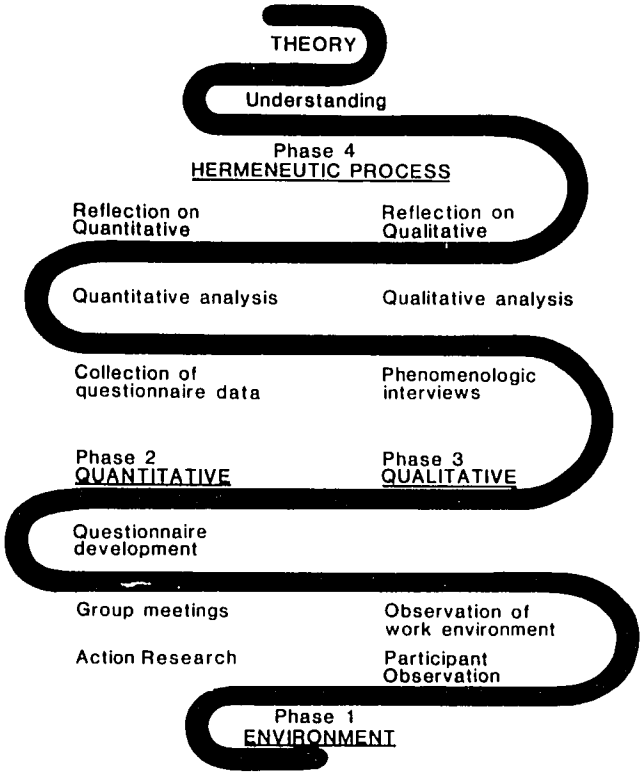


**Fig 1.** Methodological process for the study of the human–environment relationship.

- pattern identification among the data across paradigms,
- application of boundaries of existing understandings from data, literature review, and so on,
- boundary crossing by reversing and questioning,
- disengagement and enabling ideas to be transformed into new patterns or creative insights of meaning-making,
- intuiting an understanding of the phenomenon (unity of meaning), and
- communicating meaning through language and practice to others.

## CHOICE PATTERNS: A THEORY OF THE HUMAN–ENVIRONMENT RELATIONSHIP

The following is a research study of the human–environment relationship that evolved from the process as described with supporting philosophical frameworks already common to nursing science. A metaphor of choice as the conductor of the symphony was used to describe the insight, following hermeneutical reflection, into the importance of choice for human beings in selecting patterns from the environment that promote their unique well-being. The theory incorporated the metaphor to explain the integral human–environment phenomenon, viewing human beings as energy fields whose life patterns sometimes looked like chaos but actually contained great order within, which was brought about through the filter of their unique self-pattern. Through an integral process with the environment, human beings increased the intensity of their patterning, becoming more like themselves through life.

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The research[8] reported here used a four-phase methodology incorporating both quantitative and qualitative methods to study the complex human–environment relationship (Fig 1). The research question was, "How does the integral human–environment relationship facilitate the well-being of human beings as manifest in productivity and creativity?" For most people, the understanding of a global phenomenon such as the human–environment relationship is a vague intuition. To guide nursing practice, greater understanding of the complex human–environment relationship was sought through the study of the manifestations of the whole of the phenomenon—particularly, of productivity and creativity. Productivity was viewed as a variable that was more amenable to quantitative analysis because it is more outcome-oriented. In contrast, creativity is a more abstract concept that possesses qualities of elusiveness and wholeness and was viewed as more accessible through qualitative methodology. The researcher's previous studies[15,16] revealed nagging inadequacies with either the quantitative or the qualitative method alone. On the one hand, from a quantitative standpoint, the relationships between variables were not statistically significant. Trying to identify cause-and-effect relationships was difficult because of the confounding influences of other elements of the environment. On the other hand, qualitative methods provided insights but lacked specificity that could pro-

vide recommendations for practice. Thus, it seemed advisable to study the question using both the quantitative and the qualitative methods, but also with a philosophical vehicle to facilitate movement from the parts to understanding the whole.

## DESIGN OF THE STUDY

The research began with methods to gather data about the whole of the work environment and the general human–environment relationship, and then it moved to the actual collection of data about explicate manifestations of environment as they related to human manifestations. The process of data collection is outlined here in a seemingly linear fashion for purposes of clarity, although it was actually integrated with more than one type of data collection occurring simultaneously. The phases of data generation included

Phase 1. Participant observation of the environment and action research,
Phase 2. Quantitative method: Causal modeling,
Phase 3. Qualitative method: Phenomenology, and
Phase 4. Hermeneutical analysis of totality of data.

### Phase 1. Participant observation of the environment and action research

In the first phase of the study, the researcher observed 350 workers of an organization involved in designing and manufacturing computers. The occupational environment was selected to fulfill the researcher's desire to study the environment as it related to greater human well-being. Frequently, at least in nursing, environment has been studied only for its hazardous effects. Ways to use environment to facilitate well-being have remained largely unexplored. An essentially well population was selected for the research to evaluate their use of environment to increase their productivity and creativity, traits that are considered to be manifestations of well-being in the human energy field.

A perspective of the whole of the environment with the human beings functioning within it was needed. Participant observation, as described by McCall and Simmons,[17] allowed the researcher to step back and observe the whole human–environment relationship of the setting and to focus on particular factors within the organization (eg, measuring noise or checking lighting levels). The researcher shifted several times between active participation and observation. Action research[18] provided the view of the environment held by those living in it for the purposes of creating practical change. Six employee volunteers who wanted to create a better work environment helped design the questionnaire used in the quantitative portion of the study and provided overall guidance toward the aims they saw as important.

### Phase 2. Quantitative method: Causal modeling

Quantitative research methods were used in this phase of the study to gain an objective perspective on the existence and strength of relationships and interrelationships among key variables of the human–environment relationship. Questions relating to the primary

areas of interest in the literature and theory were incorporated into a 57-item questionnaire and given to the entire research and development population of 104 engineers and computer scientists. Data from the 90 returned questionnaires were then factor-analyzed and weighted[6] to determine the optimal weights for questionnaire items in creating four composite variables: Human–Environment Interference, Choice, Well-being, and Productivity. The hypothesized relationships among the variables in the model (Fig 2) were based on research and theory from numerous disciplines that examine the relationships between human beings and the environment.

Analysis of the causal model of this study was accomplished by the repeated application of multiple regression analysis. The level of significance for all the paths was set at 0.05. Beta weights were calculated for each direct path of the model using the SPSS advanced statistics guide[19] with direct and indirect effects calculated. In this manner, the complex interrelatedness among variables could be examined.

## Phase 3. Qualitative method: Phenomenology

Phenomenology, or the study of the meaning of the experience of the life-world (or lived world) of experience as reported by participants, guided the generation of qualitative data. Two questions were asked of 12 respondents in the phenomenological interviews: "What is the meaning of the human–environment relationship for people?" And, "What are human–environment relationships like for people?" Participants directed the interviews in the sense that the researcher, after the initial phenomenological question, took her cues for subsequent interview questions from the participants, while holding preconceived knowledge of the phenomenon in abeyance during the interview process.

The taped interviews were transcribed as text by the researcher to provide the foundation for the reflective analysis of the data. Thematic patterns or structures of experience emerged from the textual account of participants who described themselves and

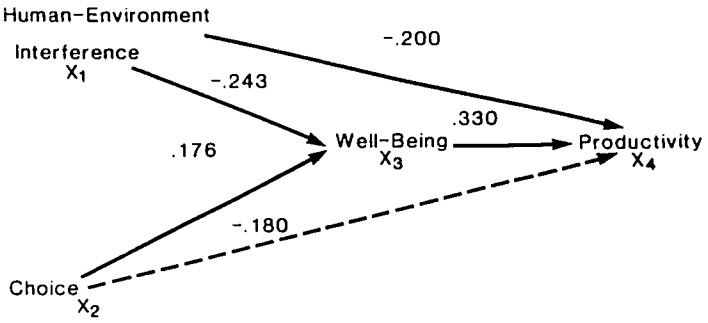


**Fig 2.** Cumulative causal model.

their relationships to the environment. Through repeated reading and reflection, the meaning of the experiences emerged, and the researcher gained a deeper understanding or a unified meaning of the whole of the described experiences.

### Phase 4. Hermeneutical analysis of totality of data

The findings from the three phases of data collection were then reflected upon by a hermeneutical method (the theory and practice of interpretation). The quantitative data were compared with the qualitative data so that a more global understanding of the unitary phenomenon became visible and could be communicated as patterns of the whole, here termed metathemes.[17] Hermeneutics transcends different texts, such as quantitative and qualitative research data, so that understanding through interpretation becomes possible.

The format used in the hermeneutic reflection is shown in the appendix. Quantitative findings were separated from qualitative in condensed sections to allow appreciation of the findings from each traditional paradigm on the hypothesized relationship among variables. Continued reflection upon the quantitative and qualitative findings evolved into five metathemes[20] to explicate linguistically the knowledge gained of the emergent whole. As did the hermeneutic process, the metathemes became more concise and clear toward the end of the detachment and engagement processes.

A synthesis of the theories of hermeneutics of Gadamer[21] and Ricoeur[22] was used to guide the reflective process. Although Ricoeur accepted the ideas of Gadamer[21] and Heidegger[23] about bringing one's previous understandings to the interpretation of a phenomenon, he advocated an objective distancing phase first. Following many naive readings of the textual transcriptions, the structural elements of the phenomenon were examined. In the process of objectification of language (distancing), judgment was suspended as words that appeared in respondents' descriptions of their experience were noted for strength (how often they appeared within and among transcriptions) and relationships (what other words were associated with frequently occurring words). For example, findings about the strength of the path from Choice to Productivity in the causal model stimulated careful examination of the qualitative data, including specific quotes that typified the common themes expressed by many in the interviews. Choice had been hypothesized to be negatively related to productivity. The Beta weight of this path was –0.180 ($p<0.09$). When the mediating effect of the positive relationship between Well-being and Productivity (beta=0.330) was added to yield the total effect of Choice on Productivity, the negative relationship decreased to –0.122. In the phenomenological interviews, the importance of choice in human–environment relationships became central to an understanding of the totality of the findings.

The strength of choice in the interviews prompted greater searching to achieve the best possible interpretation of the text (a statement used by Gadamer[21] in relation to the ultimate result of the hermeneutic process). People spoke of actively choosing environments outside work (eg, a natural outdoor environment or a highly ordered and individualized home) that gave them energy

rather than draining it. Thus replenished, they were able to be productive at work by ignoring the interferences in their environment (eg, noise, frequent interruptions, uncomfortable furniture). Those who accepted their lack of choice and their incapacity to change their environment were still able to be productive because they flowed easily with their environment, avoiding engagement with energy-draining human interruptions, noise, glare, disorder, and patterns perceived as nonaesthetic. Energized by their capacity to flow with patterns of their own choosing outside the work environment that facilitated their well-being, they could risk engagement with the complexities of the work environment, where choices may be limited.

In this study, it became increasingly clear that the manifestations of the human and environmental fields were so interrelated that it was difficult to talk about them separately. It was difficult to avoid repetition in presenting the findings. Material about one variable was also relevant to discussion of others. The human–environment relationship truly was an integral phenomenon.

A redescription of life as metaphor evolved from the hermeneutic reflection on Choice as the Conductor of the Symphony. The human being is aware of the environment as waves of varying frequency and amplitude. Choice is a felt capacity within the multidimensional human field that is manifested as a knowingness influencing environmental pattern selection. As manifested awareness of the multidimensional uniqueness of the human being, choice patterning evolves from the intersecting of multiple wave forms reflecting the "infinite now"[24] or being of the human field (life-patterning) and the potential future for becoming (self-pattern).

## USING COMPLEXITY TO BRING ORDER TO MULTIPLE MODES OF INQUIRY

The support for the use of several modes of inquiry comes from the philosophical foundations of science, and the model for implementation in research is the science of complexity. Both quantitative and qualitative methods are important for studying nursing problems, and the use of both in the same study adds a richness beyond their singular contributions.

In the study reported here the researcher used holographic theory,[25,26] quantum mechanics and physics, chaos theory,[14] fractal geometry,[27] and Rogerian science[6] as explicate knowledge that was interrelated in the researcher's mind as a pre-existent understanding[23] of the complex human–environment relationship. Through openness and weighing of counter ideas, a common statement revealed as language emerged, closing the gap between data (text) and the more abstract thematic patterns identified by the researcher. Through the combination of structural analysis of the text and interpretation, a deeper understanding of the meaning of the total research emerged as a metaphor to communicate the unity of meaning or essence of the human–environment relationship. This unity incorporated with the researcher's knowledge was developed subsequently into a theory of the human–environment relationship called "choice patterns."

By moving back and forth, employing the use of a dialectical reflective process, first

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between transcriptions and then between patterns among the data, the researchers considered various possibilities and sought the best possibility of interpretation or interpretive solution. The best possibility, as Ricoeur said, is "a solution which can never be more than a compromise."[22(p348)] Reeder[28] noted that the understanding is not static but moves in a spiral upward, using the dialectic to create ever-changing understanding (Fig 1). Experience changes our knowledge, and, like life or chaotic dynamics, it is irreversible, nonlinear, and complex. Experience is not new when it is seemingly repeated. In re-experiencing, the "experiencing consciousness has reversed its direction, that is, it has turned back on itself."[21(p317)] The experiencer is experienced. He or she never has the same experience again. In the study reported here, previous conclusions were negated when new experience (from reflection on the raw data) challenged the rationality of that position. Hegel[29] conceived of experience as skepticism in action. It is not possible to have the same experience twice. According to Hegel,[29] the "in-itselfness" of an object can be known only in the way it presents itself to the experiencing consciousness. When another object causes us to experience the falsehood of the first, the new object contains the truth concerning the old ones. This is the dialectical experience. Unlike Hegel, Gadamer[21] saw the dialectic of experience as resulting not in definitive knowledge, but in an openness to experience. In a re-experiencing, a deepening of understanding occurs. But Gadamer agreed that it is negativity that emerges in the relation between experience and insight. Insight involves an escape from something that has held us captive. Understanding is dynamic and emerges through interpretation that arises out of the movement from the question to the answer and back again, with negativity creating the critical points at which totally new paths with radically different futures may begin.

As do the complex systems studied through the science of complexity, many of the problems studied in nursing exhibit deterministic development, with an unpredictable outcome that, superficially, may seem to possess little order. The word "chaos" implies that some observation of a system varies unpredictably. There may appear to be no discernible regularity or order. In more technical terms, it could be said that the correlation in observations separated by space or time appears to be limited.[30] Complex systems exhibiting chaotic dynamics possess a kind of self-organization that emerges from the assembly of their different parts and from the contact with their external environment. Serra et al[14] listed certain fundamental conditions that seem to be needed for the coherent energy of self-organization. These four conditions are listed here and related to the research process as a model for the emergence of order from a multiple method design:

1. The interaction between active atoms (or the study of the parts),
2. An external energy source (the researcher) that excites the oscillators (or dialectical concepts),

3. Boundary conditions (literature, theory, preunderstandings) that suggest a certain organization, and
4. An incessant "exploratory" activity (dialectical or hermeneutical process) of the possible configurations due to fluctuations (eg, inconsistencies in the data, unexpected findings).

Caring is the coherent "radiation" of nursing and the energy of nursing research. In caring, nurses manifest the aesthetic values of nursing and the affirmation of nurses and clients. Caring provides the energy by which order evolves out of disorder. In the caring relationship, the goal is to enable the client to evolve his or her own well-being. The agent of change is the individual patient, but the nurse participates in the change through the human care process.[31] Ray[32] used philosophical analysis to gain deeper understanding of caring as the essential nature of nursing manifested through co-presence and love. The nurse in the caring relationship flows with the client to enhance the depth and complexity of the understanding of self—both the nurse's and client's selves. The self-pattern of the client functions as a filter in the selection from the environment of patterns that are harmonious with the unique individuality of the client and that promote the evolving self.[8] Nurse researchers demonstrate their caring through the problems they choose to investigate. In research, the scientist through caring brings the energy that may allow insight into the whole of the phenomenon by facilitating harmony, critique, and the possibility of a new order.

Whitehead wrote that "nature cannot be divorced from its aesthetic values; and that these values arise from the cumulation, in some sense, of the brooding presence of the whole onto its various parts."[33(pp87,88)] The brooding presence moving among the data, filtering through the intuition of the problem, and caring enough to keep going through the black moments of self-doubt and disillusionment with the method, theories, and philosophy of science promotes understanding. "One all-pervasive fact, inherent in the very character of what is real, is the transition of things, the passage from one to another."[33(p93)] Whitehead viewed this transition not as a linear procession of discrete entities, but rather as our first choice fading by transition beyond itself and finally emerging into the "actuality of something."

The movement horizontally between quantitative data pieces and qualitative data pieces related to the same concepts evolves a vertical spiraling movement toward greater understanding (Fig 1). The disorder or noise of the "exploratory" activity functions in creating organization and order. Prigogine and Stengers[34] observed that open systems are able to "dump" their disorder into the environment to develop a new order. In these dissipative structures, the new pattern is more complex and the change exhibits manifestations that are irreversible.

Van Foerster[35] observed that self-organizing systems could not exist unless they were in close contact with an environment that possessed available energy and order. In developing understanding of a problem through the collection of mounds of data, order must be brought to the task. Thus, the nurse researcher operates as a filter, using her apprehension of the phenomenon and her genuine caring about the topic to provide some boundaries for the evolution of understanding.

Understanding is communicated through language. Language is the ground, the beliefs that stand fast for all members of that culture.[36] Gadamer considered language the creative power that could "make this fluid whole."[21(p498)] In verbalizing the findings of nursing research, the goals are to convey a sense of the whole and to describe those manifestations and their relatedness that may enable another to understand and put our recommendations into practice.

What works in the nursing world will be used and kept. It will become part of the foundation upon which decisions are made.[36] There is no way of proving any right answer to all rational people. There is a shift from truth to adequacy as determined through practical reasoning and argumentation. Termed "assertoric knowledge" by Polkinghorne,[37] negotiation, reciprocity, and empowerment of the community can drive change in the practical arena. We can collaborate in practice without agreement. The goal may be debate of high quality through "reflective dialogical communities,"[38(p45)] as suggested by Ray, so that nurses are choosing the paradigms and research methods that will develop the science of the art of nursing.

Neither the quantitative nor the qualitative paradigm is absolute truth. It is necessary to question ideas from both of these artificially constructed realms. There is nothing sacred about the rules and categories that have been constructed, although they have been viewed as such. They are human creations and may have served well the historical period in which they emerged. As we move into an increasingly complex world, we must not be afraid of questioning accepted truths and of selecting ideas that, when combined with others, contribute to their rationality. The true test is how well they facilitate our understanding and practice. Kuhn[39] concluded, after studying the advancement of science, that the notable difference in a new paradigm is that it can solve the problems that led the old one to a crisis. It permits the prediction of phenomena that were unsuspected under the older one. In actuality, the decision to adopt a new paradigm is often based on faith. Those who embrace it must believe that it has the ability to succeed in dealing with many large problems ahead.

By comparing and contrasting data, searching for patterns and examining exceptions, we may gain new insights and previously unanticipated understandings. Immersed in the literature about a phenomenon with pre-existent understanding of its complexity developed through knowing and acting, the researcher can identify the research methods that are most likely to contribute new knowledge. By moving beyond a focus on the differences in methods, reflection on what is known and practiced about a phenomenon may emerge as the means to leap beyond the limitations of methods. In a spiraling process toward greater understanding, we may learn in the research process to tolerate paradox and ambiguity and to value complexity and chaos, which are authentic in human existence, as the unique phenomena of nursing. Guided by the science of complexity, multiple modes of inquiry can be used to make significant contributions to nursing science, to improve the problem-solving ability of theories, and to enable nurses to create caring environments that affirm both nurses and those for whom they care.

## REFERENCES


1. Moccia P. A critique of compromise: Beyond the methods debate. *ANS*. 1988;10(4):1–9.
2. Smith JK, Hesuvius L. Closing down the conversation: The end of the quantitative-qualitative debate among educational inquirers. *Ed Res*. 1986;14:4–12.
3. Schultz PR. Toward holistic inquiry in nursing: A proposal for synthesis of patterns and methods. *Sch Inq Nurs Pract*. 1987;1(2):135–146.
4. Benoliel JQ. Response to holistic inquiry in nursing: A proposal for synthesis of patterns and methods. *Sch Inq Nurs Pract*. 1987;1(2):147–152.
5. Coward D. Critical multiplism: A research strategy for nursing science. *Image*. 1990;22(3):163–167.
6. Rogers ME. *An Introduction to the Theoretical Basis of Nursing*. Philadelphia, Penn: F.A. Davis, 1970.
7. Newman M. *Health as Expanding Consciousness*. St. Louis, Mo: Mosby, 1986.
8. Davidson A. *Choice Patterns: A Theory of the Human–environment Relationship*. Boulder, Colorado: University of Colorado, 1988. Dissertation.
9. Merleau-Ponty M; Smith C, trans. *Phenomenology of Perception*. New York, NY: Routledge-Kegan-Paul, 1981.
10. Wilson LM, Fitzpatrick JJ. Dialectical thinking as a means of understanding systems-in-development: Relevance to Rogers' principles. *ANS*. 1984;6(2):24–41.
11. Moccia P. Theory development and nursing practice: A synopsis of a study of the theory-practice dialectic. In: Moccia P, ed. *New Approaches to Theory Development*. New York, NY: National League for Nursing, 1986.
12. Moccia P. *New Approaches to Theory Development*. New York, NY: National League for Nursing, 1986.
13. Ray M. The theory of bureaucratic caring for nursing practice in the organizational culture. *Nurs Adm Q*. 1989;13(2):31–42.
14. Serra R, Andretta M, Zanarini G, Compiani M. *Physics of Complex Systems*. New York, NY: Pergamon Press, 1986.
15. Davidson A. *Comparisons Among Older Persons Seen by Public Health Nurses*. Cleveland, Ohio: Case Western Reverse University, 1971. Thesis.
16. Davidson A, Young C. Repatterning of stroke rehabilitation clients following return to life in the community. *J Neurosurg Nurs*. 1985;17(2):123–128.
17. McCall GJ, Simmons JL. *Issues in Participant Observation: A Text and Reader*. Menlo Park, Calif: Addison-Wesley Publishing Co, 1969.
18. Susman G. Action research: A sociotechnical systems perspective. In: Morgan G, ed. *Beyond Method*. Beverly Hills, Calif: Sage, 1983.
19. Norusis M. *SPSS X Advanced Statistics Guide*. New York, NY: McGraw-Hill, 1985.
20. Tesch R. Emerging themes: The researcher's experience. *Phenomenol Pedagog*. 1987;5(3):230–241.
21. Gadamer HG; Barden G, Cumming J, trans-eds. *Truth and Method*. New York, NY: Seabury Press, 1975.
22. Ricoeur P; Thompson JB, trans-ed. *Hermeneutics and the Human Sciences*. New York, NY: Cambridge University Press, 1981.
23. Heidegger J. *Being and Time*. New York, NY: Harper Row, 1962.
24. Rogers ME. Science of unitary man: A paradigm for nursing. In: Laskar GE, ed. *Applied Systems of Cybernetics*, vol 4. Elmford, NY: Pergamon Press, 1981.
25. Pribram K. *Languages of the Brain*. Englewood Cliffs, NJ: Prentice Hall, 1971.
26. Bohn D. *Wholeness and the Implicate Order*. London, England: Routledge & Kegan Paul, 1980.
27. Mandelbrot B. *Fractals, Form, Chance and Dimension*. San Francisco, Calif: Freeman, 1977.
28. Reeder F. Hermeneutics. In: Sarter B, ed. *Paths to Knowledge: Innovative Research Methods for Nursing*. New York, NY: National League for Nursing, 1988.
29. Hegel GWF; Johnston WH, Struthers LG, trans. *Science of Logic*, vol 1. London, England: Unwin Brothers, 1961.
30. Rasband S. *Chaotic Dynamics of Nonlinear Systems*. New York, NY: John Wiley, 1990.
31. Watson J. *Nursing: Human Science and Human Care*. Boston, Mass: Little, Brown, 1985.
32. Ray M. A philosophical analysis of caring within nursing. In: Leininger M, ed. *Caring: An Essential Human Need*. Thorofare, NJ: Slack, 1981.
33. Whitehead A. *Science and the Modern World*. New York, NY: The Free Press, 1925.
34. Prigogine I, Stengers I. *Order Out of Chaos*. New York, NY: Bantam Books, 1984.
35. Van Foerster H. On self-organizing systems and their environments. In: Yovits MD, Cameron S, eds. *Self-organizing Systems*. New York, NY: Pergamon Press, 1960.
36. Wittgenstein L; Paul D, Anscombe GM, trans. Cited in: Anscombe GM, von Wright GH, eds. *On Certainty*. 2nd ed. New York, NY: Harper & Row, 1969.
37. Polkinghorne D. *Methodology for the Human Sciences: Systems of Inquiry*. Albany: State University of New York Press, 1983.
38. Ray M. Critical reflective analysis of Parse's and Newman's Research Methodologies. *Nurs Sci Q*. 1990;3(1):44–46.
39. Kuhn T. *The Structure of Scientific Revolutions*. Chicago: University of Chicago Press, 1970.