TESTING A DECISION MAKING MODEL FOR NURSING

By

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In memory of

Amanda Christine Coble

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The purpose of this study was to test a decision making model for nursing developed by the author in a previous qualitative study. Concepts in the decision making model were creativity, experience, leadership, education, risk taking, and informatics. The Chinese philosophy of Cosmogony and chaos theory provided the theoretical framework for the model.

Analysis of Decision Making in Nursing (ADMN), a tool developed for this study, incorporated a bipolar scale of 81 items. Pilot testing showed adequate reliability and validity of the ADMN.

The 5,000 subjects were randomly selected from a list of registered nurses licensed and residing in Florida. A total of 510 questionnaires was returned, with 491 providing usable information.

Correlation analysis, multiple regression, and path analysis were performed on an over-identified model. Four path coefficients had non-significant t values and were removed. The goodness of fit indices for the reduced model provided a mixed review of the effectiveness of the model. The significant chi-square test result ($\chi^2 = 35.47$, df = 7, p = 0.0001) suggested the model did not adequately represent the decision making framework. However, the Normed Fit Index (NFI) and Comparative Fit Index (CFI) values above 0.95 indicated a relatively high fit of the model to the data. In addition a Lagrange multiplier test did not suggest further improvements to the model that had not previously been considered or rejected.

The reduced model explained 86% of the variance in decision making. Leadership furnished the largest direct effect (0.33), indirect effect (0.19), and total effect (0.52) on decision making. Experience (0.32), creativity, (0.24) and education (0.24) followed in total effect. Risk taking (0.14) and informatics (0.16) had the smallest direct effects on decision making.

The study contributed to the body of knowledge in nursing about decision making in the four domains of nursing practice: clinical, administration, research, and education. Along with opportunities for additional research in model development, the results of this project may advance an informatics-based understanding of nursing.

CHAPTER 1
INTRODUCTION

Rationale, Significance, or Need for the Study

Nurses face many challenges in the early years of the 21st Century. Health care reform has produced dramatic changes in health care financing and delivery mechanisms (Spitzer, 1998) in an environment that is chaotic, with many threats to quality (Forrest, 1999). As nurses are poised to provide a unique role in the reformed system, a challenge is how to make effective decisions in the *unglued* environment (Flarey, 1993). In this new millennium, nurses serve as information brokers, using the Internet for obtaining and communicating information, and as information generators, accessing knowledge for decision support (Clark, 2000). Decisions made in the enactment of the professional nursing role combine complex human interactions, leadership skills, allocation of resources, and prioritization of needs within an overriding concern for quality outcomes (Boblin-Cummings, Baumann, & Deber, 1999). Decisions made during this time of chaos and turbulence will transform nursing, its leadership, and its practices to meet future challenges.

Decision making is the choosing of options directed toward the resolution of problems and the achievement of goals (Kerrigan, 1991). Decisions that nurses make influence patient care in all four domains of nursing: (a) health through mobilization of human and environmental resources to preserve health and to promote healing;

(b) human beings through a humanistic ethic to preserve dignity, uniqueness and freedom of choice; (c) environment through creation of a culture that promotes health, self respect and professional identity; and (d) nursing through professional practice models, research, networks, and partnerships (R. Anderson, 1993; Flarey, 1993; Kerrigan, 1991; M. Smith, 1993).

In a previous qualitative research study (Coble, 1995), a conceptual model for decision making in nursing was constructed. A sample of 30 registered nurses wrote stories on making a decision which affected patient care or patient outcomes. The stories were analyzed for themes and concepts; in depth interviews were conducted with 10 of these nurses to clarify the concepts and themes used in decision making. Six concepts related to decision making emerged from these analyses: creativity, experience, leadership, education, risk taking and communication. After a secondary review of literature, communication was changed to a more global term to reflect both communication and information management: informatics. The model required additional testing to determine relationships among the concepts. The purpose of this study was to test this decision making model using correlation and path analyses to determine the relationships among the concepts and with decision making in nursing.

Theoretical Framework for the Study

The theoretical framework for this study was chaos theory. Chaos theory was first developed in mathematics but has become increasingly popular in science to understand complex nonlinear systems (Abraham & Gilgen, 1995; Bassingthwaighte, Beard, Percival, & Raymond, 1995; Center for Nonlinear Science, 1999; Grebogi & Yorke,

1997; Murray, 1998; Phillips, 1991; Tvede, 1997; Zbilut & Staffileno, 1994). Poincare in 1890 disavowed the Newtonian explanations of the earth and the moon around the sun (N. K. Hayles, 1990). Hurst and Mandelbrot (Tvede, 1997) separately discovered self-similarity: nonlinear systems often repeat the same behavior in different scales. Mandelbrot further distinguished two dynamic properties of complex systems: the Noah effect, in which small movements are interrupted by violent, disruptive jumps; and the Joseph effect, in which movement is unidirectional and trendy.

The world view of chaos is that variation, change, and unpredictability are the centers of the knowledge process. Gleick (1987) proposed that chaos is a paradox: an apparent irregular, unpredictable behavior which is deterministic, nonlinear, and dynamic. For nursing, chaos theory allows the understanding of complex, variable events such as decision making. While the action of some variables can be predicted under controlled circumstances, the real world is complex, disorganized, interconnected, individualistic, and unique.

A nonlinear or chaotic system is any system that evolves over time (N. Hayles, 1999; Herbert, 1995). Nonlinear systems are rich and complex spectrums of recurrent behaviors (from equilibria, periodic to aperiodic) and modes of changes in behavior (bifurcations) which may be continuous, discontinuous or explosive. Chaos is characterized by short-term predictability and long-term unpredictability because of a sensitivity for initial conditions. Sensitive dependence on initial conditions is a phenomenon common to chaos theory in which a small change in the initial conditions can drastically change the long-term behavior in a system.

Chaotic systems are in continual fluctuation; patterns never repeat themselves yet stay within bounded parameters. Nurses expect change and variation in the environment and consider these positive processes or desirable outcomes of nursing intervention. While deviations may be judged exceptions or even errors, chaos theory allows the nurse an infinite variety of decision outcomes within a framework of holistic, humanistic care.

An attractor is the behavior of a system during equilibrium or disequilibrium (Herbert, 1995); this set of behaviors defines a system's steady state motion (Mark, 1994). An attractor can be single, closed curve or strange. A closed curve attractor fluctuates in a repetitive manner, while a strange attractor is characterized by non-repetitive fluctuations.

For this study, chaos theory described the behavior of the six concepts within the framework of the decision model. For a nurse making a decision, the process followed, or the steps initiated, or the sequencing of events is inconsequential. The nurses in the earlier study (Coble, 1995) reported that the best decisions were made when a number of the concepts converged from the chaotic environment. The nurse's decisions and behavior were a consequence of the alignment of the six concepts in some array. In the model, the six concepts are floating within the decision framework, with a process of decision making in a circular, open systems configuration. A more apt version may be that of a sphere containing the six concepts in a primordial soup. Some concepts are linked at times, while others are independent at times. Nurses in the study reported both conscious and unconscious awareness of the mix and alignment of the concepts at the time of decision making. In this study, the conceptual framework of chaos theory

allowed the model to be explored for patterns and relationships, while maintaining integrity with the nurses' description of behaviors leading to decision making.

The decision making model for nursing being tested in this study was composed of open, interactive, dynamic systems, based upon a world view of nursing, health, human beings, and environment. The Chinese philosophy of Cosmogony (Gleick, 1987; Mahdihassan, 1990a, 1990b; Rossbach, 1983; Spear, 1995; Wensel, 1980) was utilized to depict the decision making process in an open system and in an interactive environment. The Chinese believed that five essences of life each had its own basic energy, color, emotion, posture, and voice. Fire, Water, Earth, Wood, and Air (also known as Metal) are depicted by the author in Figure 1, along with their colors and voices. In addition, relationships between model components and across the model were utilized by Chinese acupuncturists as the philosophical base for their profession. Today, the Chinese art of placement (Feng Shui) is founded on this philosophy. Opposites in the model may be antagonistic or may be used for control of phases out of bounds.

In the model, the decision making process is the nursing or scientific process. These five steps are (a) problem identification; (b) assessment; (c) planning; (d) implementation; and (e) evaluation and are depicted as constructed by the author in Figure 2.

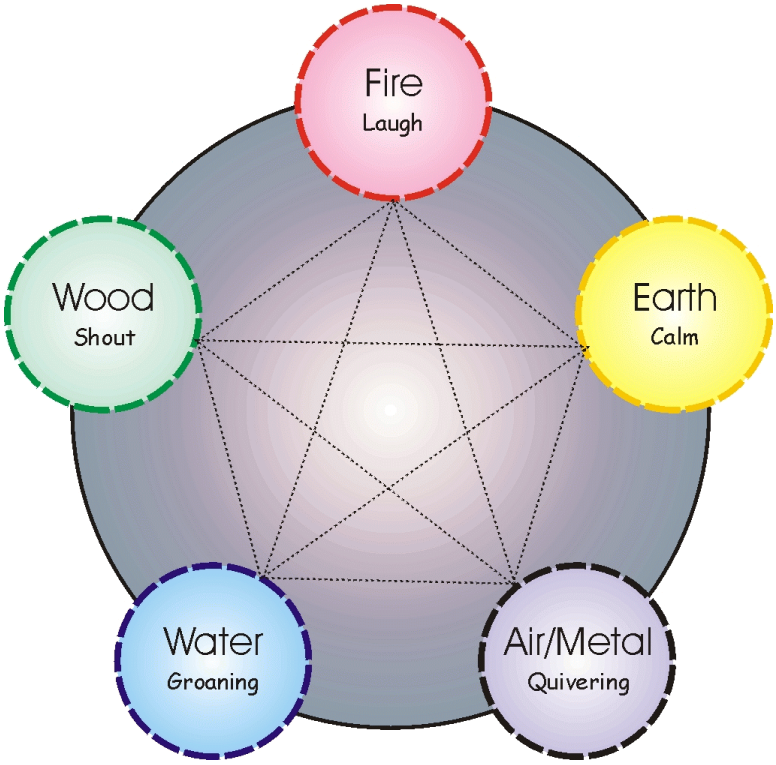

Figure 1 Chinese Cosmogony

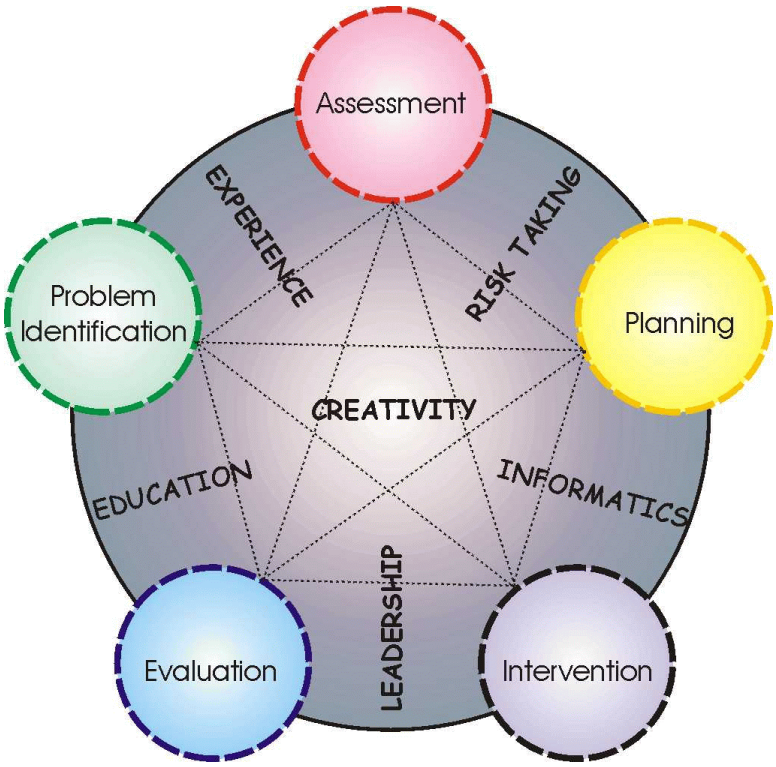

Figure 2 Decision Model for Nursing, with the Imbedded Nursing Process

Problem identification. In the model this step defines the purpose, motivation and boundaries of the problem or opportunity. Resources (people, methods, technology, materials) are identified for future consultation or utilization. When problem identification is out of bounds or control, the nurse becomes swamped with data, which in turn diminishes the success of the decision or hinders the ability to complete the process.

Assessment. This step alters information from the problem identification step to synthesize a structured approach to the problem. Specific data may be clarified or additional information requested. Potential conflicts in methods and outcomes are addressed. Controls are devised to guarantee that the focus of the decision making process remains correctly placed on the root problem or opportunity. When not managed in a planned methodology, conflict becomes subterranean and may surface as an unwelcomed outcome or as a challenge to the decision itself.

Planning. This step provides an opportunity to stimulate creativity through the generation of ideas. The role of each individual is valued and appreciated as an important contribution of the team. Building teamwork fosters an atmosphere of group effort and consensus. After ideas are generated, priorities are established based on factors such as goals and mission of the organization or individual; probability of success; resource intensity required; and probability of addressing the root cause of the problem. Too many ideas without reaching a consensus may be exhaustive and may cause communication problems in that the mission and goals of the organization or individual are not brought to bear on possible solutions, thus clouding the relationship between the activity and attention to the problem with the perceived outcome and benefit.

Intervention. The purposes of this step are to produce stability and to increase productivity of the organization if the problem has been corrected. Support for the solution may require contributions by a few or by many individuals, groups, or departments. The service delivery system may be affected by the proposed changes and alternative solutions being tested. When a number of solutions are implemented in a short time frame, the work may be exhausting, depleting the energy of individuals and the organization, resulting in sickness rather than health.

Evaluation. In this step a new paradigm or standards of practice may be established. Individual and organizational goals are evaluated based upon the achievement of problem resolution. Values of the organization or individual may change as the new methods become the accepted standards. Quality control measures are instituted to assure continued compliance with the new standards. Grieving may occur as the old ways are discarded. Individuals and organizations may be reluctant to terminate successful past practices, resulting in a rejection of the decision rather than acceptance.

Assumptions for the model include the following:

1. The design of the model allows for interactions and opposing forces among the five steps.
2. Behavior is a reflection of decisions that people make.
3. The decision making process normally starts with problem identification and proceeds clockwise through the model.
4. Nurses possess the power and authority to make decisions about patient care and within organizations.

5. Nurses adapt behavior to the demands of the situation.

Propositions for the model include the following:

1. Opposing forces can be used to balance. For example, planning may be related back to problem identification to assure a focus on the correct variables is maintained.

2. A return to a previous step is used to recapture the path. If evaluation steps languish for lack of commitment, a return to planning may provide a more acceptable solution.

3. A pattern of *Perpetual Start Up* is identified when problem identification alternates with assessment but no progress to other steps is detected.

4. A pattern of *Co-dependency* is established when the triangle of assessment-planning-intervention is detected. Without initial problem identification and proceeding through the model to evaluation, the pattern becomes a self-fulfilling prophecy.

Statement of the Problem

The purpose of this study was to determine the relationships among the concepts of a decision making model for nursing: creativity, experience, leadership, education, risk taking, and informatics. The population was registered nurses licensed in the State of Florida.

Research Questions

Is the hypothesized model adequate in explaining decision making in nursing? What are the relationships among the concepts in the decision making model?

Delimitations of the Study

Generalization of this study is limited by the non-experimental design, the size of the sample, and the return rate of the questionnaire. The registered nurses may not have valued research into a theoretical model; therefore, their responses may not have reflected true decision making in their practice. The use of a bipolar scale to measure the six concepts in the model may not have been the best approach to measure the effects in the model or the relationships among the model concepts.

Definition of Terms

Decision making is the choosing of options directed toward the resolution of problems and the achievement of goals (Kerrigan, 1991).

Creativity is the application of novel solutions which change the context in which the problem is embedded (Kirton, 1989).

Experience is the refinement of preconceived notions and acquired theory through encountering actual situations that add nuances or shades of difference to theory (Benner, 1991; Benner, Tanner, & Chesla, 1992, 1996).

Leadership is the process of influencing people to accomplish goals (McCloskey & Molen, 1987).

Education is investigational inquiry or learning by critiquing, proposing, doing, or doing in collaboration (Wheeler, Fasano, & Burr, 1995).

Risk taking is a behavior characterized by increased tolerance of possible error or mistake (R. Jones & Beck, 1996).

Informatics (American Nurses Association, 1994) includes the management and processing of data, information and knowledge (Graves & Corcoran, 1989); information seeking behaviors (Henry, 1995c); communication methods (verbal, nonverbal, messaging); analytical methods (identifying, standardizing, modeling)(Henry & Mead, 1997); engineering methods (design, evaluation, adapting, customizing, applications, tools); and managerial methods (strategic planning, change, collaboration, accessibility, project management) (Goossen, 1996; Goossen, Epping, & Abraham, 1996).

Summary of Chapter 1

Nurses face a challenging time of transition in the 21st Century. Decisions made in practice, education, and management will profoundly influence the profession for years. Decision making is a concept that has not been examined by nurse theorists or researchers in detail. The purpose of this study was to test the relationships among decision making concepts: creativity, experience, leadership, education, risk taking, and informatics. Using the framework of chaos theory, decision making was viewed as a random, unique pattern which is unlimited, yet deterministic. Operational definitions were presented for model concepts. The generalizability of this study may be limited by small sample size, rate of return of questionnaires, and ability of the bipolar scale to measure the model concepts.

CHAPTER 2
REVIEW OF THE LITERATURE

Theory and Model Concepts

Chaos Theory

The utilization of Chaos Theory in nursing has been both philosophical and empirical. Ray (1994) defined chaos as belonging to the universe and as knowledge-in-process. Since all phenomena in the universe are interconnected and dynamic, all knowledge is limited and approximate. Creativity takes place at the boundaries between chaos and order. Tension exists between chaos and order; this tension stimulates change and a creative reordering into self-organizing systems. The edge of chaos is a communication and information process which feeds back on itself and promotes systems behavior though continual, mutual interaction.

The laws of information patterns were developed using chaos theory (Sabelli, Carlson-Sabelli, & Messer, 1994). Symmetric flux is the state of information which is always mixed with uncertainty, ignorance, and error. Processes contain random, symmetric flux, which is unobservable except as an absence. Observable patterns of matter, information and energy are asymmetric within the symmetric flux. Action asymmetry exists as a flow of energy in time and is unidirectional. Union of opposites is the duality in nature; everything contains a difference and that difference implies information. Opposites alternate in predominance so they never coexist in the same

place, same time, and same respect. One process may have higher priority and supremacy, yet can coexist with the opposite state. Organizational diversification is the result of interaction of two opposites which produces processes of three or more dimensions. Although many aspects of the world appear random, the randomness is really a surface manifestation of deep, complex structures (Bolland & Atherton, 1999). A key feature of chaos is flexibility (Pediano, 1996). For nursing, chaos theory may bridge the gap between nursing theories (the scientific representation of reality) and research utilization in individuals and communities (reality with variety, diversity, irregularity, uncertainty–in other words, chaos) (Rambihar et al., 1999; Rambur, 1999).

Chaos theory has been utilized in nursing research to explain complex behaviors of individuals, groups, and organizations. Researchers in Texas (Hamilton, West, Cherri, Mackey, & Fisher, 1994) identified patterns of births in adolescent girls. Time series analysis revealed a data pattern that was noisy (chaotic) and superficially random. The complexity was marked by ragged fluctuations in the process over time and by the constantly changing background features of the population.

Mark (1994) examined chaotic events related to nursing vacancy rates. The impact of a small change in nursing vacancy rates at an institution created a far-from equilibrium state in the system. The organization may institute a change in salaries which would describe a bifurcation point; this change in salaries may return the organization to the previous steady state. With nursing vacancies, a cyclical pattern of highs and lows may be observable (a closed curve attractor). Symmetry-breaking occurs with the failure of tactics to regain equilibrium. Redesign, removal of service barriers, and new

technology may be creative energies which force the system to evolve into a new organization or a new steady state (a strange attractor).

Puskar and Lucke (1999) employed chaos theory to explain nursing care of stroke patients. Early stages of care focused on stable patterns of information processes and cognitive functioning. Progression to more complex activities and abilities followed gradually. Following stroke, neural impulses transmit at random intervals, overloading the patient's ability to focus on a single task. Small changes in environment or routines may have a negative effect by contributing confusion, agitation, or anxiety.

Other studies ascertained nonlinear relationships between spiritual disequilibrium and traumatic life events (Dombeck, 1996); between exercise capacity and heart rate variability (Cowan, Hathaway, & Kreider, 1999); with suicide in the elderly (Winreich, 1999); in public health and epidemiological patterns (Coppa, 1993); and among temperature, pulse and respiration (Vicenzi & Hamilton, 1999).

Decision Making

Decision making has been found to be the discovery and selection of alternatives (Loke, 1996); the intuitive judgments made by humans; and the relationship of priorities to goals in the decision process (Slade, 1994). Decisions may be well structured, routine, and require few resources (tactical decisions) or may be ill structured, unique, and require substantial resources (strategic decisions) (Kline, 1994). People are generally unaware of, or concerned with, the nature of decision making, or why one alternative is preferred to another, or the quality of the decision making process (Hogarth, 1987; Hogarth & Kunreuther, 1992). Judgment about choices is a persuasive activity, in which the

decision maker must be persuaded to choose a course of action from alternatives. Most decisions are based on the anticipations people make about the immediate and/or distant future.

Decision approaches can be classified as descriptive/behavioral or prescriptive/normative (Fox, 1994, 1997; Fox & Tversky, 1998; Koutsoukis, Mitra, & Lucas, 1999; Loke, 1996; Luce & von Winterfeldt, 1994; Raiffa, 1994; Vazsonyi, 1990). The descriptive mode delineates the actual decision process, the players and the rules of the game. Descriptive techniques include decision trees (stages of response across time) and regression analysis (identifying individual factors and their weights). The normative mode compares actual behavior with that predicted by laws of probabilities. The utilitarian normative mode takes the action with the largest sum of predicted subjective value and objective probability of the payoff. The dynamic normative mode accounts for risky behavior by choosing actions with the largest product of subjective value and subjective probability of the payoff. The prescriptive mode requires thinking reflectively about serious choices. Values and beliefs about uncertainties are elicited as well as confronting incoherence. The foundation of the prescriptive concept is the subjective expected utility theory, a doctrine of choice based on psychology (subjective), Bayesian probability theory (expected), and economics (utility). Through this art and science interaction, a comprehensive overview of the situation guides actions.

The decision process in the real world is complex, ill-defined, and disorderly; human behavior is at best quasi-rational, with deep iterative thinking a myth, or at least a rare occurrence (Quinn, Anderson, & Finkelstein, 1996). Values and interests of the

decision players (if players are even known) are not usually common knowledge. With limited information, individuals often choose the first alternative that gives a satisfactory solution.

The individual's perception of information may be selective rather than comprehensive (Hogarth, 1987). Memory works by association with past events; thus, through an active process of reconstruction, memory can change. Processing is mainly done sequentially and across time. However, an unstable environment leads to deficient judgmental strategies. Processing capacity and mental effort are reduced by using heuristics (subjective operational knowledge of the world). Several heuristics have been found to produce systematic errors in the decision process (Levin & Reicks, 1996; Loke, 1996): representativeness; availability; or adjustment and anchoring. Errors in representativeness arise when similarities between events and properties rather than the frequencies or base rates influence the subjective evaluation of important descriptive features. Other errors in representativeness occur when the decision process is insensitive to sample size; when the effect of chance is disregarded or underestimated; when the reliability of the description is not questioned; or when there is an illusion of validity based on the goodness of fit between the predicted outcome and the input information. Availability heuristic is the situation in which individuals judge the frequency of an event based on prior experiences or other related, known or imaginary experiences. Adjustment and anchoring bias occur when an individual fails to consider different individuals and different initial points; adjustment along a continuum of choices would improve sensitivity for underestimations and overestimations of the correct answer.

Utilizing a pyramid to represent various approaches to decision making, Schoemaker (1994) found that people tended to use the quickest and the easiest process. The base of the pyramid was formed by the concept of intuitive judgment. Intuition is a quick and easy approach, sometime brilliant. However, intuition is open to inconsistency and distortion, is difficult to articulate, and is difficult to apply consciously or unconsciously. The second level of heuristic procedures consists of rules, tailored and generic shortcuts. These rules sort out information and may be generic or specific to a situation. While quick and clever, these rules can be articulated and applied consciously. Importance weighting allows that some factors have more importance or weight than other factors in a decision. These weights can be articulated, tested and stored for future use. Bootstrapping is a variant of importance weighting in which the model is derived from an expert but then the model out performs the expert. Value analysis is the peak of the pyramid. Value analysis is a comprehensive assessment refining weighting by considering how factors affect broader objectives and values added to the decision. Key objectives and nonlinear values (an increase in some given factor does not always increase the value of the factor) are uncovered. Value analysis requires the use of experts and consideration of multiattribute utility. Value analysis, as the epitome of decision making, commands resources and time, resulting in increased costs.

Styles of decision making have been explored using the Myers Briggs Type Indicator (MBTI) (Nutt, 1993). An individual's preferences for types of data and ways to process that data have been incorporated into the MBTI. A sensing (S) individual prefers hard data, dealing with what is and with specifics. The intuitive (N) person considers

possibilities, qualitative values, and what might be. Thinking (T) stresses logic and formal modes of reasoning, while feeling (F) considers the decision in personal terms, or how people are affected. Combining the preference for one of the data acquisition types with one of the data processing approaches creates four styles: ST (sensation-thinking), NT (intuition-thinking), SF (sensation-feeling), and NF (intuition-feeling). The preferred modes of understanding (S, N, T, and F) suggest how people like to make judgments and choices. Therefore, the ST style applies to an analytic approach to decisions, while the NT implies a speculative approach. The SF style creates a consultative approach, such as a decision group; NF style suggests a charismatic approach, catering to the whims of powerful individuals. The ideal decision-maker would use all four modes of understanding (S, N, T, and F), resulting in an auxiliary style of SNTF or synthesizer. Synthesizers have high tolerance for ambiguity and uncertainty, were the most prone to adopt a solution, and saw the least risk in the decision. Linkers have access to three modes, producing SNT, SNF, STF, and NTF styles. Tolerance for ambiguity and uncertainty was less pronounced in linkers, who also identified more risk in decision. Pure types evoke one strong preference for data and one for processing (ST, NT, SF, and NF) and are called analyzers. ST and SF types had a low tolerance of ambiguity, while NT and NF tolerated a moderate amount of ambiguity. Observers have dual function (NS) with strong preference for perceptive action; data processors have dual function (TF) with strong preference for judgmental action. Observers tended to be action-oriented with a pessimistic view of the decision's risk. The observer had much more tolerance to ambiguity and uncertainty than data processors. Overall, conservative outlooks toward

adoption of a decision were profiled by ST, TF, and STF styles. Action-oriented postures were found in SN, SNT, and SNF styles.

Decision Making in Nursing

The review of literature for decision making in nursing revealed several areas of effort: decision process identification and refinement; theory utilization; decision maker characteristics; and decision application in practice. These areas will be discussed separately.

Decision process

The routine process for decision making in nursing has been identified by several authors (Corcoran, 1986; Grobe, Drew, & Fonteyn, 1991; Hannah, Reimer, Mills, & Letourneau, 1987; Harbison, 1991; R. Jones & Beck, 1996; Joseph, Matrone, & Osborne, 1988; Kerrigan, 1991; Laborde, Dando, & Hemmasi, 1989; Marriner-Tomey, 1992, 1993; Narayan & Corcoran-Perry, 1997; Nixon, 1995; Rowland & Rowland, 1997; Ruland, 1996; M. Smith, 1993; Steele & Maraviglia, 1981; Tappen, 1989; Tschikota, 1993; Turley, 1996a; Wangsness, 1991; Watkins, 1998) and follows the well-established nursing process: assessment (problem identification); planning (identifying alternatives); intervention (implementing decision); and evaluation (evaluating response or outcome). Variations to the decision making process have been devised to enhance creativity (Steele & Maraviglia, 1981) by inserting an incubation and illumination phase and to deal with emergency procedures (Marriner-Tomey, 1992) by increasing the pace, limiting alternatives, and immediate evaluation.

Theory utilization

Ruland (1996) delineated three main decision-making theories in the nursing literature: (a) information processing, (b) decision theory or decision

analysis; and (c) intuitive clinical judgment. First, information processing uses concepts of memory, processing, and problem solving and is the basis for most of nursing decision making studies. Decision making within the information processing framework involves interaction between the problem solver and the task in a complex environment. Humans have limited short-term memory but have access to infinite long-term memory, a key resource of knowledge gained from study and experience. The aim of information processing is to achieve diagnosis, assessment or classification. Hypotheses in diagnostic reasoning are made early in the search for further information. Information is confirmed; potential solutions are eliminated; possibilities are finely discriminated from one another; and specific hypotheses are explored for related or unrelated disorders or complications. Task complexity increases the demands on the information processing skills of the decision maker (M. Lewis, 1997). Individuals tend to simplify the decision-making requirements and this tendency increases as the complexity increases. Components of the decision-making task are defined in terms of content (signs, symptoms and behaviors) and context (physical and social environment). Diagnostic decision making incorporates critical thinking and data collection by clinicians to identify and classify phenomena in clinical situations (G. Davis, 1994; Hamers, Abu-Saad, & Halfens, 1994; Hannah et al., 1987; Koch & McGovern, 1993). This form of decision making incorporates the nursing process model with the medical diagnostic model.

Narayan and Corcoran-Perry (1997) developed a line of reasoning model for clinical decision making based upon information processing theory. A clinical situation was analyzed for its task demands. Three types of requisite knowledge were identified:

general factual knowledge about human conditions or situations; specific factual knowledge about differences in those with and without the characteristic under consideration; and procedural knowledge surrounding the specific requirements of the situation. Using a think-aloud method, the investigators found triggering cues (symptoms), domain concepts (specific disease profiles) which activated hypotheses, intermediate conclusions and actions, and a final line of reasoning conclusion. The transition from cues to hypotheses reflects adaptations to short-term memory limitations and the process of long-term memory retrieval.

The second theoretical perspective of decision theory focuses on the clinician making decisions of a probabilistic nature, which includes the majority of clinical decisions (Panniers & Walker, 1994; Anderson, Rungtusanatham, Schroeder, & Devaraj, 1995; Boblin-Cummings, 1996; Ash & Smith-Daniels, 1999; Ruland, 1999). The purpose of decision theory is to arrive at a correct decision in less than optimal environments. Decision analysis considers the preferences and values of the decision maker, conflicting objectives, and the ambiguous nature of information. The goals are to overcome uncertainty and to reduce risk by producing recommendations for decision making rather than modeling human behavior.

The development of an algorithm, protocol, or decision tree for clinical decisions is an example of decision theory. Decision analysis provides a structure for depicting relationships between actions and outcomes, as well as a procedure for combining information with values or preferences for outcomes (Corcoran, 1986). Corcoran identified four steps in the decision analysis process: (a) structuring a decision flow

diagram; (b) assigning values (worth or utility) to possible outcomes; (c) assigning probabilities to chance events; and (d) working backwards through the decision tree to reveal the best alternative action. This last step calculates the expected value of each alternative; the alternative with the highest expected value becomes the prescribed choice of the analysis.

In a study of oncology nurses, Akers (1991) found algorithms to be flexible, safe and effective, with feedback to reinforce behavior and references to standardize care. The process included expert development, critiques by users, and delineation of progressive, escalating decision making throughout the branches of the decision tree. Use of the algorithm led to a more thorough patient assessment and a more informed nursing response, ultimately resulting in better patient management.

Other researchers (Brennan, 1995; J. Clarke, 1999; Edwards & Barron, 1994; Garre, 1992; Kokol, Zorman, & Medoo, 1999) found a system of attributes and their corresponding weights or utility (worth, payoff, psychological value, or level of satisfaction) had usefulness. Users of the complex process identified a list of attributes potentially relevant to the decision and, by consensus, generated a relative weight for each attribute. Scoring rules for physical value-related measures, if available, were determined in advance. Rules of thumb were instituted when physical value-related measures were not available. In this additive model, the physical value-related measures were adjusted by the weights and then totaled. Analysis of the contribution of each individual value to the decision as well as the cumulative effect was assessed.

The third theoretical perspective on decision making in nursing is that of clinical judgment using an intuitive process (Ruland, 1996). Intuitive clinical judgment uses pattern recognition, commonsense, skilled knowhow, and deliberate rationality to present and to implement solutions (Benner, 1984, 1991; Benner et al., 1992, 1996; English, 1993; Nixon, 1995). Key elements of reflection, dialogue, and dialectical thinking enable the reconstruction of relationships and roles into partnerships which optimize health care delivery (Duchscher, 1999).

Cruz (1994) found evidence of three qualitatively different styles of decision making in a group of home health care nurses: skimming, surveying, and sleuthing. Experienced nurses switched from one style to another depending on the situation. A nurse using the skimming style delivers the required, but minimal service; skimming allows the nurse to expedite predetermined and well-defined tasks based upon priorities and available time frame. Surveying concentrates on gathering of concrete, observable data to infer specific problems, to formulate a reactive and short-term plan of care, and to address routine and recurrent situations. Sleuthing is used to manage ambiguous, complex, and unstructured problems by taking a flexible approach to gathering and evaluating information. On receiving incoming information, the decision maker redirects subsequent questions, following where the clues lead. Sleuthing often evokes heuristics based upon experience and clinical knowledge. Sleuthing also has the additional characteristic of future orientation, resulting in a proactive, adaptive, and realistic long-term plan.

Additional patterns of knowing beyond cognition, intuition, and experience inherent in clinical decision making were identified by Jenks (1993). The establishment of interpersonal relationships (knowing patients, peers, and physicians) with individuals during the decision making experience was a major influencing factor in the nurses' clinical decision making ability. In addition, factors in the patient care environment influenced the decision making abilities.

In a contrasting study, Wells (1995) concluded that decision making was mediated largely by systemic forces and that the patient's clinical trajectories were not a key element in shaping the process. In the majority of cases, decisions were made without the knowledge or understanding of the patients' disease experience; patient and family were approached only when decision had already been made. Decision making and communication were one-sided and systematically distorted. Social factors and organizational imperatives were a major concern to the professionals. Professional perceptions were functional or instrumental in orientation rather than holistic.

In a study of nursing executives (Johnson, 1990), beliefs, ideals, knowledge, and values of the nurses combined to form three sets of assumptions which guided decisions: mechanistic, organismic, and systemic. Mechanistic assumptions are derived from the belief that nursing is a closed entity, having no interaction with its environment. Mechanistic modes seek to keep communication closed within nursing, to foster loyalty and obedience, and to build a strong infrastructure. Organismic systems operate from a predetermined blueprint; nursing is inherently unstable in a passive environment. Goals and structures are faithfully maintained, ever increasing resources and contributing to

growth and stability of the department. Systemic nursing is viewed as a set of interrelated roles, functions, and processes. Nurses have unique competencies and knowledge for participating in decisions that affect work, communication, environment, and change processes.

Offredy (1998) identified strategies of decision making in an advanced practice setting. Hypothesis generation started from a known starting point and worked toward an unknown end point. Hypothesis generation allowed the nurse to transform a seemingly unmanageable problem into a manageable one by generating a set of possible diagnoses and then testing their appropriateness in further data collection. Decision trees provided methods to isolate a finding and to explore all possibilities. By following the tree branches, clinicians analyzed individual actions then reassembled them in a systematic way to provide an option. Pattern recognition focused on making a judgment based on a few critical pieces of information. Pattern recognition occurred on two levels: analytically, where information was chunked or intuitively, where the whole situation was grasped. Heuristics facilitated reasoning and often resulted in more effective decision making. Intuition, a judgment based upon individual experience, gave importance to recognizing the processes at an unconscious level for rapid, subliminal judgment of visual and verbal cues. Important factors related to decision making were the ability to recognize patterns in clinical situations; an appreciation of the consequences of inappropriate action; and the ability to concentrate simultaneously on complex and sometimes masked patient cues.

Decision maker characteristics. Watkins (1998) determined that expert nurses engaged in both rational and intuitive decisions. Characteristics of the expert decision maker embodied courage in spite of fear or uncertainty; caring and commitment to caring for the patient first; willingness to take ownership. Expert nurses cited their clinical experience and their nursing education as factors which developed skill in decision making.

Decision application in practice. Two other models of decision making have emerged in the literature. These models expand decision making to a group process and to a professional level (R. Jones & Beck, 1996).

The collaborative decision model incorporates a group or an interdisciplinary level to decision making (Baggs, 1994; Collins, 1996; Cruz, 1994; Glendon & Ulrich, 1992; Higgins, 1999; Luker, Hogg, Austin, Ferguson, & Smith, 1998; Marriner-Tomey, 1993; McMurray, 1994; Parsons, 1999; Porter-O'Grady, 1997a; 1997b; Taccetta-Chapnick, 1996). The collaborative model emphasizes participation, respect, and consensus. Land (1994) outlined an approach to collaborative decision making using a soft systems theory. Soft systems theory acknowledges that attitudes and views of participants within a system may present differing perspectives of problems and differing satisfaction with solutions. Using the mnemonic CATWOE (customers, actors, transformation process, *Weltanschauung* or world view, owners, and environmental constraints) pinpoints the key stake holders in a system and, subsequently, all the related activities which enable the system to function. In this holistic and realistic technique, optimal models may be compared with the real-world in one of four ways: finding

differences between the model and the real-world; applying criteria to specific activities in the model and in the real-world to identify possible change; operating the model system on paper and comparing with what might occur to what happens in the real-world; and overlaying the theoretical model with the real-world situation. The collaborative model works well in complicated, complex situations where other models have failed. A hallmark of the model is the ability to achieve consensus and commitment to change through participation by the players: customers, actors, and owners.

The scope of practice model is based upon the assessment of competencies to determine possible paths on the decision tree (DeSimone, 1999; Heller, 1992; Krejci & Malin, 1997; Maynard, 1996; P. Nolan, 1998). Competency is the individual's actual performance, integrating knowledge, skill, attitudes, and behavior; competence is the individual's capacity to perform job functions regardless of knowledge, skills, behaviors and personal characteristics (P. Nolan, 1998). Depth and breadth of knowledge to perform acts are evaluated in the light of safety and accountability. Training and experience lead to higher competency.

For nurses to work efficiently and effectively, the areas of competency must be identified for specific roles and settings (P. Nolan, 1998). Using the Nursing Interventions Classification system to select relevant areas of practice, nurses identified core competencies, with class labels and definitions. Performance criteria were determined, and actions or behaviors were defined to assist patients to reach a desired outcome. Competencies described the specific job requirements and job environment, useful for managers in selecting staff. Orientation of staff provided assessment and

validation of high-risk, high-frequency interventions, while ongoing education and training addressed high-risk, low-frequency interventions. Teaching strategies were planned to accommodate large number of learners, to reduce duplication of the same information, and to maximize resources. Planning on a regional level rather than a local level integrated core competencies into nursing curricula and, therefore, equipped the new graduate with adequate patient-care skills directly from the academic setting.

Decision Making Tools

Tools to measure aspects of decision making in nursing have been developed with a focus on decision types, attitudes, collaboration, critical thinking, participation, quality, and task analysis. None of the tools found in the literature contained all of the variables in the decision model being tested.

An early instrument was the Joseph Decision Making Tool (Joseph, 1982; Joseph et al., 1988) which measured attitudes and beliefs rather than decision making practices of registered nurses. The relationships examined were sex-role stereotypes, years of experience and education upon attitudes toward decision making. The instrument which has known reliabilities of Cronbach's alpha 0.79 consisted of 20 short scenarios that required nursing decisions. Similar findings have occurred in subsequent studies (Catolico, Navas, Sommer, & Collins, 1996).

The Clinical Decision Making in Nursing Scale (CDMN) (Jenkins, 1985) was developed to measure perceptions of clinical decision making by students. The scale is a 40-item Likert-type, with four subscales: search for alternatives; canvassing of objectives and values; evaluation and reevaluation of consequences; and search for information.

Cronbach's alpha was 0.78. Subsequent research has combined use of the CDMN with the Watson-Glaser Critical Thinking Appraisal (WGCTA) (Girot, 2000). The WGCTA is an 80-item questionnaire divided into five sections: inference, recognition, deduction, interpretation, and evaluation. No relationship could be found between the development of critical thinking and decision making in practice, using the two scales.

The Actual Decision Making instrument (Joseph et al., 1988) consists of 27 items which relate to nursing actions. Subjects choose an answer using a 5-point Likert-type scale. An alpha coefficient of 0.88 was obtained during preliminary testing.

The Perceptions of Collaboration instrument (Joseph et al., 1988) was developed as a 10-item questionnaire on a Likert-type format. Subjects rate their relationship with physicians. A preliminary reliability of 0.63 was obtained.

The Collaboration and Satisfaction About Care Decisions (CSACD) tool was developed by Baggs (1994) to measure collaboration and satisfaction of providers at the general practice level and at the level of a specific decision with another instrument, Decision About Transfer (DAT). The CSACD contained seven questions concerning collaboration, rated on a Likert-type scale. Cronbach's alpha score was 0.93. The DAT asked two questions about satisfaction during the decision about transfer; Cronbach's alpha was 0.63. The DAT was used subsequently by Higgins (1999) to measure nurses' perceptions of collaborative nurse-physician transfer decision making.

Hollen (1994) tested two scales: Decision Making Quality Scale (DMQS) and Decision Making Quality Inventory (DMQI). The DMQS was a 7-item Likert-type scale

used to screen decisions according to seven quality indicators. The DMQI was a 24-item Likert-type scale, used to assess decisions by teens and parents.

To evaluate line of reasoning methods in clinical decision making, a task analysis approach was developed (Narayan & Corcoran-Perry, 1997). Task analysis comprised a review of the literature on the subject, interviewing an expert nurse, and using the think-aloud process to identify decision tasks. The methodology was utilized to test a model for decision making task complexity (M. Lewis, 1997).

Parsons (1999) created a measure of delegation decision by use of a visual analog scale (VAS). The 10-point VAS ranged from no confidence to highly confident ratings. Reliability was not reported.

Anthony (1999) constructed a Participation in Decision Activities Questionnaire (PDAQ) to measure level of authority used in decision and level of involvement by nurse. The PDAQ listed 42 decision activities, 21 related to patient care and 21 related to unit operation. Cronbach's alphas ranged from 0.85 to 0.86.

Decision types were a focus of a study on decision-making activity and influence of nurses in teams (Banaszak-Holl et al., 1999). The researchers developed four questions on involvement in decisions and six questions on the quality of decisions. Cronbach's alpha ranged from 0.74–0.89.

Lauri and Salantera (1995, 1998; Lauri, Salantera, Gilje, & Klose, 1999) developed and tested a tool to distinguish between decision theory (information processing theory) and intuition (Dreyfus model) in nursing practice. The questionnaire consisted of 56 items on a five-point Likert-type scale. Half the items describe a

systematic-analytical and rule-based approach to decision making, and half a holistic-interpretive approach. Alpha coefficients ranged form 0.85 to 0.90 in initial testing, with similar values in subsequent studies.

Creativity

Creativity has been described since ancient civilizations; Plato understood the creative person as inspired and possessed by divine influence (D. Miller, 1989). Torrance described creativity as the process of becoming sensitive to problems, deficiencies, gaps in knowledge, missing elements, disharmonies; identifying the difficulty; searching for solutions, making guesses, or formulating hypotheses about the deficiencies (Ferguson, 1992). The creative process is teachable and allows for the development of more creative behaviors in all individuals. The creative process involves both conscious and unconscious thought processes, with much of the restructuring of thoughts or perceptions taking place on an unconscious level (Ackerman, 2000; James, Clark, & Cropanzano, 1999; Therivel, 1999).

Miller (1992) found that scientific creativity has two parts: (a) network thinking that leads to (b) the nascent moment of creativity. In network thinking, concepts from apparently disparate disciplines are combined by proper choice of mental image or metaphor to catalyze the nascent moment of creativity. This nonlinear thought process can occur unconsciously and is not necessarily in real time.

Simon's approach to creativity commences with a search along the branches and nodes of a decision tree (D. Miller, 1989). Simon's law of discovery means only finding patterns in the data that have been observed; whether the pattern will continue to hold for

new data that are observed subsequently will be decided in the course of testing the new law, not in discovering it.

Runco and Albert (1990) found several characteristics that led to creative behaviors: (a) begin with decisions; (b) knowledge of self; (c) highly intentional; (d) creativeness and personal identity are emergent in that both grow and change; (e) creativeness and personal identity both drive each other; and (f) engage the individual on the personal level of identities, abilities, and differences. Creativity may be viewed as an opposite of stasis; a manifestation of power; a special form of leadership; the ability to generate ideas; or the process of becoming.

Kirton (1989) developed the Adaption-Innovation Theory in which an individual difference construct represents different approaches to problem solving, decision making, and creativity. Adapters pose solutions which apply accepted, normal procedures, while innovators offer novel solutions which change the context in which the problem is embedded.

In nursing, Steele and Maraviglia (1981) added an idea-finding step to the nursing process to promote creativity in decision making. Deferred judgment, brainstorming, incubation, and divergent-convergent thinking are processes which facilitate creativity. These processes are currently reflected in the domain of critical thinking (Abegglen & Conger, 1997; M. Adams, Whitlow, Stover, & Johnson, 1996; Birx, 1993; Case, 1994; Daly, 1998; Dexter et al., 1997; Duchscher, 1999; N. Facione & Facione, 1996; Gendrop, 1996; Jacobs, Ott, Sullivan, Ulrich, & Short, 1997; Leppa, 1997; Maynard, 1996; Reynolds, 1994; Videbeck, 1997). The goals of the creative process outlined by Steele

and Maraviglia are in concert with those of the critical thinking genre: to find answers that have utility and perhaps novelty for meeting challenges and brining them to a successful conclusion.

In numerous studies, Amabile (1988, 1996, 1997, 1998) has ascertained characteristics of both individual and organizational creativity. Individual creativity is based upon expertise, creative thinking, and intrinsic task motivation. The work environment utilizes resources, management practices and organizational motivation to foster innovation. This work environment has a direct impact on individual creativity, while individual creativity feeds innovation in the work environment.

Li (1997) challenged the creator-centered model by viewing creativity as both a horizontal and a vertical process. Horizontal domains of creativity allow novelty to occur in all dimensions, resulting in divergent developments of the domain. Vertical domains, in contrast, possess certain stable elements that are existentially fundamental, thus permitting alteration only around certain dimensions. Some dimensions can be both horizontal and vertical.

Rogers (1996) recognized that an individual's decision is not an instantaneous act, but rather a process over time of actions and decisions. Rogers' model of diffusion of innovation consists of five stages: (a) a knowledge stage, in which insight or understanding develops; (b) a persuasion stage, during which an attitude (favorable or unfavorable) is formed about the innovation; (c) a decision stage, in which adoption or rejection of the innovation occurs; (d) an implementation stage, when an innovation is put

into use; and (e) a confirmation stage, when there is reinforcement of a decision already made.

Innovation, imagination, insight, initiative, critical thinking, fluency, flexibility, and value judgments are characteristics for the 21st Century nurse sought by nursing administrators (Barton, 1994; Cassey & Savalle-Dunn, 1994; Daly, 1998; Gendrop, 1996; Gillmore, 1993; Gilmartin, 1999; Glendon & Ulrich, 1992; Kerfoot, 1998; Koerner, 1996; Vaughan, 1997). Globalization, change, and constraints of time and money influence the creative ability of nurses. Nurses have moved into a broader arena of managing the care of aggregate groups and systems, establishing partnerships and collaboration. The issue is not control but rather connectedness. This link to chaos theory through quantum mechanics (Porter-O'Grady, 1997b; 1999) enhances the creativity of nurses by boosting courage to take risk (Greiner & Valiga, 1998), to act outside the norms, and to be willing to receive criticism (May, 1975). Organizations tend to protect the status quo and fail to invest the time, effort, energy and money into creative processes (Losee, 2000); yet thinking outside of the box leaves one open to many ideas, not bound by tradition, and not prejudging ideas prematurely. The nursing profession has promoted creativity and innovation for more than 30 years (Gilmartin, 1999). In today's health environment, the nursing professional ethic fosters the expertise of nurses, the openness to creativity and change, the development of creative skills, and the management of professional values within complex social systems.

Education

Carper (1978) proposed four fundamental ways of knowing in nursing: the empirical, ethical, personal, and aesthetic ways of knowing. Empirical knowing reflects knowledge that is systematically organized and consists of laws and theories to describe, explain and predict phenomena unique to the discipline of nursing. Aesthetics encompasses the art of nursing: the ability of the practitioner to perceive and grasp unique perceptions of patient's behavior within a specific context. Aesthetics incorporates envisioning valid modes of helping and responding with controlled balance, rhythm, proportion, integration and articulation of the whole which is observed as mastery of knowledge. Personal knowledge involves the perception and management of the self's feelings and prejudices within a situation in order to respond appropriately and to manage anxiety. This personal knowledge enables the practitioner to be connected within the situation and to demonstrate caring. The ethical way of knowing determines what is right or wrong and commits the practitioner to take action. When tension and conflicts exist between the ethical dimensions and the clinical components of a situation, the potential outcomes of these dissonances are significant determinants of the aesthetic response.

Fox (1997) concluded that Carper's ways of knowing could be separated into two groups: academic and practical knowledge. Academic knowledge includes formal education in clinical symptoms, medications, equipment, education of patients. Tacit knowledge is knowledge learned either through experience or through observations. Tacit knowledge is not formally taught during nursing education because each situation is complex and context dependent; thus, subtle changes are significant only in light of the

patient's history and current symptoms. The Practical Knowledge Inventory for Nurses (Fox, 1994) contained scenarios of typical practical problems for nurses. Each scenario fits into one of three categories, with either a local or global context: managing self, managing others, or managing tasks. Testing of the instrument indicated that both academic knowledge and tacit knowledge are required for effective decision making. While nursing education mainly focuses on knowledge of patients and working with patients, Fox recommended that nurses should be exposed to learning situations (such as mentoring relationships) in which tacit knowledge is acquired implicitly.

Kim (1993) found a widening gap between theory and practice in nursing. In a proposed model, practitioners bring both knowledge in the public domain and knowledge in the private domain to bear on the specific clinical situation. The complex clinical situation presents multiple phenomena which the practitioner perceives and then frames against knowledge from the two domains. Choices in intervention theories and strategies are made and implemented based upon four different modes of theory application: (a) coherence; (b) integrative; (c) pragmatic/eclectic; and (d) reflective. In the coherence mode nurses align with theories and philosophies which have ideological congruity with their own personal orientations. This mode may result in a conflict between varying philosophies of nurse and client. The integrative mode is an evolutionary mode of practice in which new theories and approaches from diverse sources are interwoven with previously established knowledge and experience in an ever-expanding context. In the pragmatic/eclectic mode, the focus is not on the practitioner but on the client and client's problems. This meta-model requires the practitioner to reject the idea of a single model

approach for nursing practice and instead to rely on a process of choices for application, rather than relying on habit. The reflective mode allows the practitioner to adopt new theories for their congruence with the situation and meanings gained from the practitioner's thoughts, actions, and interactions with the client's thoughts and actions. This action science method leads to continuous learning of new theories-in-use. The focus of the reflective mode is on the practitioner, the situation, and the client.

Approaches to nursing education are rooted in four historical views of the teacher and of the learner (Babcock & Miller, 1994): behaviorist, Gestaltist, humanist, and processor. The behaviorist views thinking as covert trial and error; learning changes behavior. The teacher directs the learning and the learner complies with the teacher's direction. The Gestaltist believes thinking to be knowing and perception; the aim of learning is to understand. The Gestaltist teacher designs programs in which the learner participates. The humanist discovers meaning through the thinking process; learning focuses on actualization. The teacher responds, while the learner initiates and evaluates the experience. The processor perceives thinking as processing information; learning occurs when information is registered, retained, or recalled. The teacher programs the educational content and the learner absorbs inputs of information and displays outputs of the same or transformed information.

Benner (1984; 1991; Benner et al., 1992; 1996) found that knowledge and education are hallmarks of expertise in nursing. Nurses may be categorized along a continuum from novice, or inexperienced, to expert.

Relating theories of knowledge and education into practice has been the focus of research in nursing education (Baker, 2000; Carty & Rosenfeld, 1998; G. Davis, 1994; Dierckx de Casterle, Janssen, & Grypdonck, 1996; Hart, 1999; Hawks, 1999; Ingersoll, 1998; Koch & McGovern, 1993; Koerner, 1996; Lindholm & Uden, 1999; MacCallum, Roznowski, & Necowitz, 1992; Minnick, 1998; Princeton, 1993; Rambur, 1999; Reinert & Fryback, 1997; Stevenson, Doorley, Moddeman, & Benson-Landau, 1995; Tschikota, 1993; Wheeler et al., 1995). Major themes in the findings of these studies were that (a) students processed information sequentially and in small amounts; (b) demonstration and validation were primary methods of nursing education; (c) mentorship played an increasing role to broaden the clinical experiences of students; (d) integration of theory and academic knowledge with practical, tacit knowledge stimulated learning and growth; (e) the culture, curriculum and educational strategies in the specific nursing education organization strongly influenced the theoretical and ethical choices of the students; (f) nursing education was a social event, integrating structure in the teacher-student relationship, enhancing communication and contact between the faculty and students, and creating connectedness or affiliation of students in a class structure; (g) successful strategies were based upon research utilization, centralized resources, supportive infrastructure for technology and information literacy for both students and faculty, and interdisciplinary collaboration to provide economical benefits and exciting educational opportunities; and (h) complex, conflicting worldviews, along with the information explosion, produced tensions and resultant ambiguity unless an atmosphere of questioning was created to critique existing practices.

A major focus of nursing education in the past three decades has been critical thinking (Birx, 1993; Dexter et al., 1997; N. Facione & Facione, 1996; Jacobs et al., 1997; Leppa, 1997; Maynard, 1996; Reynolds, 1994; Videbeck, 1997; Wells, 1995). Critical thinking incorporates both academic knowledge and tacit knowledge. Critical thinking is the purposeful, self-regulatory, judgmental process which incorporates interpretation, analysis, evaluation and inference (N. Facione & Facione, 1996). Critical thinking may be viewed as an educational outcome. The tools developed for measuring this outcome are the Watson-Glaser Critical Thinking Appraisal (WGCTA) (Watson & Glaser, 1980), California Critical Thinking Skills Test (CCTST) (P. Facione, 1990), Ennis-Weir Critical Thinking Essay Test (EWCTET) (Ennis & Weir, 1985), and Cornell Critical Thinking Test (CCTT) (Ennis, Millman, & Tomko, 1985). The WGCTA has been found to be the mostly widely used tool in nursing education with the CCTST serving as an alternative (M. Adams et al., 1996). All four tests have limitations because of small samples and lack of psychometric data; in addition, none of the tests are specific for the domain of nursing. Thus, critical thinking remains an elusive outcome evaluation standard for nursing programs, while at the same time critical thinking is an integral component of nursing education strategies focusing on clinical decision making. The role of critical thinking in decision making is to provide a careful analysis and judgment, to seek reasons and alternatives, to perceive the total situation, and to change one's view based upon evidence (Reynolds, 1994). Making a decision is an outcome of critical thinking and a component of professional nursing practice.

Educators, who simply transmit knowledge and ways of thinking only, exemplified an inertia of habit (Greiner & Valiga, 1998). To foster creativity in the decision making process, educators broke with tradition; helped learners to be aware of the world; heightened the consciousness of students; engaged learners as distinctive, questioning persons; and cultivated the perception of constant change in the world (Greene, 1995).

Leadership

Research on the concept of leadership has been focused on predicting leadership, determining leadership skills, and evaluating leadership effectiveness (Altieri & Elgin, 1994; McCloskey & Molen, 1987). Leadership in nursing has been traditionally viewed as the process of influencing people to accomplish goals. Nurse leaders exhibit roles as change agents, builders, and innovators. Trait theory has been used to describe the inborn characteristics of a leader, while behavioral theory has classified the functional aspects of leadership into four stages: autocratic, bureaucratic, participatory, and free-rein (Hanna, 1999). Another classification of leadership exposed four types (Rothschild, 1993): (a) risk takers are leaders who have a passion and genius to make dreams happen beyond the reach of others; (b) caretakers are leaders undergoing evolutionary growth rather than revolutionary; (c) surgeons are leaders who remove areas no longer needed or productive; and (d) undertakers are leaders who harvest, close, or merge operations, and show concern for survivors.

An alternative perspective is the behavioral approach to leadership and decision making (Rowland & Rowland, 1997): (a) assertive types decide what is right based on

one's own priorities but accounting for others' perspectives; (b) aggressive types decide what is right regardless of others' perspective; (c) manipulative types persuade others on common, shared priorities; and (d) submissive types decide according to other people's expectations. Leadership requires a learning environment to engage people in confronting challenges, to adjust values and perspectives, and to acquire new habits (Heifetz & Laurie, 1996).

Irurita (1994) found leaders optimize the situation, making the best of the options possible. Optimizing occurs in an environment prone to retardation (delay, impedance) and to turbulence. Leaders provide solutions that optimize survival, invest in the future, and transform the present environment. Failure to optimize led to a floundering state or inability to cope or to meet expectations. Optimizing leaders displayed caring values, were client-centered, and committed. Commitment was demonstrated by a pronounced identification with the decision, involvement in the processes and displayed loyalty to the work unit.

Transformational leadership (Barker, 1992; Marriner-Tomey, 1993; Manfredi, 1995; Taccetta-Chapnick, 1996; Pesut & Herman, 1998; Sosik, Kahai, & Avolio, 1998; Dixon, 1999; Perra, 1999) demonstrates a vision, increases creativity, and focuses on change and conflict resolution. Transformational leaders create not only the vision, but the climate for change; the vision creates conflict because change is inherent. Transformational leaders develop new leaders. Implementing the vision leads to professional satisfaction and growth. Five charismatic behaviors of transformational leaders were identified (Taccetta-Chapnick, 1996): (a) focusing attention on planned

actions; (b) encouraging risk taking and creativity; (c) listening and providing feedback; (d) demonstrating trustworthy behavior and commitment to the vision; and (e) expressing concern for others.

Quantum thinking proposed a dramatic departure from industrial age thinking in late 20th Century research on leadership and decision making (Bassingthwaighte et al., 1995; Bolland & Atherton, 1999; Goswami, 1996; Herbert, 1995, 1996; Ingersoll, 1998; Kupperschmidt, 1998; Lindholm & Uden, 1999; McMurray, 1994; A. Miller, 1992; Mishel, 1990; M. Morris, Speier, & Hoffer, 1999; Neuman, Newman, & Holder, 2000; P. Nolan, 1998; Northhouse, 1997; Offredy, 1998; Parsons, 1999; Perra, 1999; Pesut & Herman, 1998; Porter-O'Grady, 1997a, 1997b, 1999; Rambihar et al., 1999; Speier, Valacich, & Vessey, 1999; Starck, Warner, & Kotarba, 1999; Thompson, 1999a, 1999b; Vicenzi & Hamilton, 1999; Vogelsang, 1999; Williams, 1998; Winreich, 1999; Woods, 1999; Zausner, 1998). In a quantum orientation, linear thinking becomes meta-thinking; analyses shift from compartmental to whole systems; functions are subservient to outcomes; and predictable events are replaced by variable effects. Quantum thinking leaders work in teams, accept accountability for decisions, and provide an information infrastructure with immediate feedback. Leadership is focused at the point-of-service since the effectiveness of the decision process is in the hands of the provider. The process leader integrates resources, information, and generates knowledge and support for the provider to make effective decisions. Leadership is horizontal rather than vertical in quantum systems; leadership is relationship-oriented rather than control focused. Quantum thinking recognizes the integration of all things within a whole form of

reflection (Porter-O'Grady, 1997b; 1999). Issues of fit are paramount to issues of function. The tools of technology, comprehensiveness of information and demand for service integrity are the driving forces in the quantum age.

Leadership competencies for the 21st Century leader (Fralic & Denby, 2000; Gauthier, 1996; Hansten & Washburn, 2000; Hillesheim, 1998; Mahaffey, Kaplan, & Triolo, 1998; Neuman et al., 2000; Perra, 2000; Starck et al., 1999) were identified as utilization of technical knowledge and systems thinking; resource allocation to achieve goals, decision analysis; motivation; delegation; mentoring; conflict management; communication skills; and consensus building. Personal characteristics of successful 21st Century leaders were acknowledged as integrity, drive, dedication, flexibility, influencing, interactive empowerer. Other necessary skills embraced acclimatization to chaos, pattern recognition, coaching, and continuous learning.

Antrobus and Kitson (1999) ascertained that nursing leadership arose from fundamental knowledge about nursing practice. This philosophical understanding of nursing incorporated an ethic of care and legitimatized the leadership influence internally and externally to nursing. Leaders in nursing provided the bridge between policy and practice through interpretation and translation. Language was used within a context of practice, administration, or academic settings; leaders who performed this translation were viewed as credible and visible within multiple settings. A bi-cultural nature of nursing leadership stemmed from the leader's ability to embrace the values of nursing while recognizing and influencing the values of the organization. The skills repertoire for nursing leadership was summarized into five profiles: a powerful influential operator; a

strategic thinker; a developer of nursing knowledge; a reflexive thinker; and a process consultant. The powerful influential operator worked with others to empower them, creating and sustaining a work environment with common values and value-driven relationships. The strategic thinker created meaning and facilitated learning. Leaders enabled an emergent process by identifying patterns within the process and by shaping and articulating those patterns into a collective vision in a changing environment. A developer of nursing knowledge integrated research evidence with practice and explicated tacit knowledge from practice, using strategic processes to channel and translate nursing knowledge from the grassroots to collective efforts. The reflexive thinker understands self and values, along with purpose and personal meaning, within a complex and ever-changing environment. The reflexive thinker establishes support mechanisms and process to enable structured reflection within the environment. The process consultant works through and with others to intervene in human processes as appropriate to achieve transformational change. In-depth knowledge of human processes, communication patterns, problem solving and decision making is required. Thus, nursing leadership is a resource and a vehicle to influence and shape both policy and practice in political, managerial, academic, and clinical domains.

Recent researchers (Goleman, 1998, 2000; Perra, 1999, 2000; Strickland, 2000) have expanded the leadership styles to six categories: (a) coercive leaders who demand immediate compliance; (b) authoritative leaders who mobilize people toward a vision; (c) affiliative leaders who create emotional bonds; (d) democratic leaders who build a consensus through participation; (e) pacesetting leaders who expect excellence and

self-direction; and (f) coaching leaders who develop people for the future. Emotional intelligence is the ability to self-manage and to manage relationships effectively consists of four fundamental capabilities: self-awareness, self-management, social awareness, and social skill. Each capability is composed of sets of competencies. Self-awareness fosters the leader's ability to understand emotions and the impact of emotions on work performance and relationships; to perform a realistic self-assessment of strengths and limitations; and to portray self-confidence or a strong sense of positive self-worth. Self-management skills include self-control; trustworthiness, honesty and integrity; adaptability; achievement orientation; initiative; and conscientiousness or the ability to manage oneself and one's responsibilities. Social awareness concentrates on empathy, organizational awareness, and a service orientation to meet customers' needs. Social skills in leaders embody the vision to others through inspiration, influence, persuasion, communication, as well as through roles in developing others, in being a change catalyst, in managing conflict, and in building bonds, teamwork, and collaboration. Leaders need many styles; the most effective leaders switch flexibly among the leadership styles as needed. Leaders who have mastered four or more (especially the authoritative, democratic, affiliative, and coaching styles) have the best performance. Leaders do not mechanically match style to fit a checklist but rather are sensitive to the impact on others and seamlessly adjust style to get the best results. This fluid leadership in action is spontaneous, nimble and rapid in assessing the situation and in determining the best approach to employ to maximize results.

Studies using a qualitative approach have produced a rich understanding of leadership in nursing. Exploratory studies described leadership in autonomous professional practice (Ferguson-Pare, 1997; Spooner, Keenan, & Card, 1997); quality (Williams, 1998); transformational processes (Pesut, 1998; Pesut & Herman, 1998); beliefs and perceptions (D. Allen, 1998); image of leaders (Lehna et al., 1999); skills (Starck et al., 1999); and changes in leadership (Bleich, 1998). Ethnographic and grounded theory methods resulted in identification of leadership styles and characteristics (Antrobus & Kitson, 1999; Ferguson-Pare, 1997; Irurita, 1994). Case analysis, with reflexive comparison and reframing techniques, was used to describe the aspects of leadership within a decision framework (Pesut & Herman, 1998).

Tools to measure leadership in the literature focus on leadership behaviors, leadership factors, leadership competency, leadership styles, and leadership environment. The Ohio State Leader Behavior Description Questionnaire (W. Allen, 1995; Taunton, Boyle, Woods, Hansen, & Bott, 1997) was developed to determine behaviors exhibited by leaders. The Multifactor Leadership Questionnaire (Morrison, Jones, & Fuller, 1997; Stordeur, Vandenberghe, & D'hoore, 2000; Tepper & Percy, 1994) was used for evaluating transformational behaviors. Cronbach's alpha across these studies was 0.92, with intercorrelations among the transformational scales ranging from 0.68 to 0.85. Competencies were assessed in two studies with researcher developed scales: Leadership Competency Instrument (Krejci & Malin, 1997) and Leadership Competency Profile (DeSimone, 1999). Reliability for competency instruments was not reported. The Achieving Styles Inventory (Klakovich, 1996) examined styles of leadership used, while

the Job Activity Scale (Laschinger, Sabiston, & Kutszcher, 1997) gauged leadership activities. The effect of environment has been estimated using Chandler's Conditions for Work Effectiveness Questionnaire (A. Adams, Bond, & Hale, 1998; Laschinger et al., 1997; McDermott, Laschinger, & Shamian, 1996). Several studies employed tools created by the researcher without reported reliability (Bond & Fiedler, 1999; Ellefsen, 1998).

Experience

The value of experience in nursing has been explored by researchers (Benner, 1991; Benner et al., 1992, 1996; Bleich, 1998; C. Davis, 1995; Grobe et al., 1991; Leppa, 1997; M. Morris et al., 1999; Perra, 1999; Radwin, 1998; Stevenson et al., 1995; Tabak, Bar-Tal, & Cohen-Mansfield, 1996; Tishelman et al., 1999). Benner (1984; Benner et al., 1996) established through pioneering endeavors that the experienced nurse utilized intuitive, engaged, proactive reasoning more than scientific, disengaged, theoretical reasoning. Benner established five levels of practitioner based on reasoning and experience: (a) the novice nurse uses theoretical knowledge and rules; (b) the advanced beginner employs more objective facts and more sophisticated rules, learning to anticipate; (c) the competent nurse devises new rules, is responsible for outcomes, remains less detached, and formulates hierarchical choices; (d) the proficient nurse assimilates atheoretical, intuitive experiences and replaces reasoned responses with easier actions; (e) the expert nurse knows only what needs to be achieved, based on the practical and situational determinants of problem, skillful coping, and purposeful goal attainment.

Habitual practices and skills grow through reflection on experiences, using analytic clinical thinking.

The community of nursing is created through storytelling by nurses (Benner, 1991); these narratives share the embodiment of common nursing experiences to new nurses and to peers. Narratives of learning create an openness to experience. The narrative of learning may expose evidence of failure, in knowledge, in relational skills, or in judgments. A corrective narrative highlights poor clinical judgment in one example so other nurses may avoid similar errors in the future. The story becomes integrated with the feelings, thoughts, perceptual recognition, and memory of the individuals who recognize or project themselves as the characters in the story. Narratives of learning the skill of involvement foster relational skills appropriate to the practice of nursing. These narratives convey knowledge about getting the right kind of involvement and interpersonal distance to fit specific situations. The relational skills are context dependent, so biases and exclusions are encountered; therefore, new possibilities for connection and distance may be discovered. Nurses have an elaborate discourse on the right kind, level, and amount of involvement in the clinical situation; nurses identify over-involvement in which the ability to offer alternatives may be lost. A rich tradition of practical knowledge develops over time in situations and in dialogue with patients, families, and colleagues. Narratives of disillusionment convey the limits of others' knowledge. These stories related times when rules, policies, and procedures do not match the clinical situation or environment. These narratives are often characterized with humor, self-discovery, new insights, and sometimes wisdom. Disillusionment is

frequently a snapshot of the confrontation between theoretical, idealized visions of practice and the reality of true life situations. Narratives about death and suffering enable nurses to learn moral and practical lessons about presence, comfort, courage, anger, failed expectations, hope, and power. Liberative narratives depict nurses discovering the worth of their work and the importance of their voice for the patient and family. Narratives of liberation often contain narratives of disillusionment within them. Liberation themes include stories about breaking free from bias, intimidation, inhibition, fear of risk, vulnerability, visibility, responsibility, rules and procedures. The narratives promote a sense of nursing community in which stories, habits, practices, concerns, and experiential wisdom are exchanged through multiple perspectives.

Novices often rely on information and earlier examples from within the same or related domains (M. Morris et al., 1999); knowledge may be transferred from a known domain to a new problem space. However, the individuals may devise analogies that are not valid or relevant in the new domain.

Experience need not be entirely viewed as intuitively derived and validated (English, 1993; Radwin, 1998; Rolfe, 1997; Sutherland, 1997; Tabak et al., 1996). Researchers have found other characteristics of experience that foster development of clinical knowledge in nurses. Radwin (1998) found that confidence was a key component of experience. Confidence was the ability to ask difficult questions, to listen actively, and to learn of patient's perceptions. Confidence enabled the nurse to consider a broader range of interventions and enhanced the individual selection of interventions for the situation. Habitualization was more likely to develop as the nurse moved toward expert

levels of performance (Heath, 1998). Negative habitualization resulted in routine and coping dominated practice in response to external pressures. Habitual practices, and its awareness, originated spontaneously and contradicted efforts to improving practice over time.

Tabak et al. (1996) discovered that the complexity of the task and the consistency (or uncertainty) of information differentiated novice and expert decision making. Novices failed to see contradictions in the information and therefore maintained a posture of certainty and confidence, while the expert identified uncertainty in the scenario and offered more alternatives, with less confidence in any one pathway. Novice nurses differed from experts not only in relying on more effortful processing but also in basing their decisions on biased information and strategies that could lead them to wrong conclusions. Experienced nurses used intuition because their experience enabled them to develop the appropriate schemata. Analytical process was used when appropriate schemata was not available or when the problem was not too difficult to solve by piecemeal processing.

A reexamination of Benner's model found that expertise may be explained by abductive reasoning, or fuzzy logic, rather than on the basis of intuition alone (Rolfe, 1997). As reported by Benner, experts are often unable to verbalize their expertise; Benner relates this to intuitive deductive methods. Adaptive fuzzy systems concentrated not on what the expert verbalizes but rather what the expert does. A fuzzy system generates its own fuzzy rules based upon accumulated experience. Instead of applying the rules in a linear, step by step fashion, the fuzzy system applies the rules all at once but

to different degrees, depending on the situation. Thus, expert behavior can be reproduced with relatively few rules. The key is not to dictate how experts should practice (decision trees, protocols, algorithms can do that) but rather to illustrate how experts do practice. The strength of the fuzzy model is in descriptive ability, not in prescriptive power.

Experience, viewed as historical narratives or archival data, is amenable to cognitive process of induction, deduction, and retroduction (moving back and forth between induction and deduction to generate interpretations) (Sutherland, 1997). Retroduction is most often employed where new concepts or new associations are being evaluated. Information exists as a result of actual accounts perceived, interpreted, and reported by nurses. These accounts are temporal and contiguous. Creative and critical thinking are crucial intellectual modes for visualizing new patterns in behavior and in interpreting relationship and linkages among experiences.

Risk Taking

Risks are decisions made with an element of potential loss or danger (Umiker, 1997); action or inaction is taken under conditions of uncertainty. Risk is everywhere and unavoidable. Risk is a property of options that affects choices among the options (Pollatsek & Tversky, 1970; Raiffa, 1994). Options can be ordered with respect to their riskiness and their utility. The risk of an option is related to the variance of its outcomes. Perceived risk may be viewed as a vague and subjective notion; however, studies have found that people are consistently able to order choices with respect to riskiness (Jia, Dyer, & Butler, 1999; Zickar & Highhouse, 1998). Perceived risk increases when there is an increase in range, variance or expected loss. For the risk averter, the ordering of

choices by risk is the inverse of preference ordering based upon expected value. For the risk seeker, the ordering of choices is based upon expected value, coupled with the perceived risk, to maximize the outcome benefits. Outcome history influences risk taking (Sitkin & Weingart, 1995; Thaler & Johnson, 1990): a history of success leads to higher risk taking; a history of failure leads to lower risk taking. Decisions which have the potential to affect an individual's or organization's performance and position become strategic decisions because of the significance of actions taken, the levels of resources utilized, or the precedents set (Mittal & Ross, 1998). Data mining may find unexpected or hidden patterns in data (Padmanabhan & Tuzhilin, 1999); these unexpected findings challenge conventional wisdom. Patterns contradictory to prior knowledge are by definition unexpected. The interestingness of a pattern depends on the decision maker and not solely on the strength of the pattern. An interesting pattern may nonetheless have little added value to decision making.

Information reduces the perception of risk or, at least, increases the tolerance of risk in decision making (Jia et al., 1999; Tversky & Fox, 1995). Decision theory distinguishes between risky choices in which the probabilities of possible outcomes are known and uncertain possibilities in which the probabilities are not assumed to be known. When there is no risk, there is no uncertainty involved.

Using chaos theory, Mishel (1990) conceptualized uncertainty related to nursing practice. Two processes determine the value of uncertainty in a situation: inference and illusion. Inferences are evaluated under conditions of uncertainty based upon examples of related situations. If the inferences are as positive ones, the uncertainty may be

interpreted as an opportunity; if the inferences are threatening types, then the uncertainty may be interpreted as a danger. Opportunity and danger are parallel concepts, indicating the choice of one and only one path. Illusion may be explained as the construction of beliefs that have a positive outlook. Because of the vague and formless nature of uncertainty, an event may be transformed into a positive illusion. Coping mechanisms are activated to reduce uncertainty under conditions of danger, while coping mechanisms are activated to maintain uncertainty under conditions of opportunity.

Wurzbach (1991) discovered several judgmental heuristics and biases related to the inherent uncertainty of a decision outcome. Inferences may not be readily available to the decision maker or the decision maker may have overconfidence in their own erroneous reasoning. Accuracy in decisions is enhanced when all possible choices are outlined. However, people favor positive rather than negative evidence for choices and tend to disregard evidence inconsistent with the chosen path. The frame a decision maker adopts is controlled partly by the problem itself and partly by the norms, habits, and characteristics of the decision maker. Spurious judgments during decision making may be made by nurses who are unaware of their decision processes, who do not differentiate between inference and illusion, and who do not consider alternative explanations.

An exploration of personal risk taking by Dobos (1997) ascertained that nurses were guided by strongly held values and confident knowledge, as well as the utilitarian ethic. Problems were perceived as personal threats. Consequently, the nurses in the study tended to act in isolation rather than to collaborate with others to minimize risk for all. The research concluded that nurses who placed themselves at risk did so for the patient

and utilized a process of risk taking that was thoughtful, constructive, goal oriented, and value driven.

Umiker (1997) found that risk avoiders utilize self-protection and apathy in the face of change to reduce the fear of failure and loss of colleague support. Risk aversion is often a lifelong habit, characterized by procrastination, silent or noncommital stances, cynicism, and over-caution. Risk takers tend to seek increased responsibility and accountability, characterized by ownership, commitment, innovation, and sense of reality. Some people are risk obsessive, getting a thrill from the danger of risk taking, marked by explosive energy and change, exceeding authority, argumentative and insensitive treatment of others. Risks can be minimized with confidence from past successes, achievable goals, sufficient information, and preparation for some failures or setbacks.

A constraint to risk taking is the professional role conception (Kubsch, 1996) in which individual and organizational values about nursing influence the level of autonomy and power in decision making. Successful risk takers are role-breakers who increase tolerance for risk within the work environment. Using role switching and self-reflection, along with continual juxtaposition of roles within a nursing environment, a risk taker may question the adequacy of an individually based conceptualization of autonomy (Tishelman et al., 1999). Difficulties exist in opposing decisions assumed to be valid for a group, especially when supported by persons with a higher rank on a professional or organizational hierarchy. Conscious and systematic exploration of issues can offer new perspectives with the basic and often existential issues embedded in the situational decision process.

Informatics

Nursing informatics was first described as a combination of computer science, information science, and nursing science. The management of nursing information and knowledge supports the practice of nursing and the delivery of nursing care (Graves & Corcoran, 1989). Hannah (1988) expanded nursing informatics to include information technologies related to any function of nursing or to activities carried out by nurses. The boundaries of nursing informatics are dynamic, changing, and contiguous with those of nursing (Strachan, 1996). Nursing informatics has been visualized as the superhighway (Nagle & Ryan, 1996) which provides comprehensive access to and integration of information and knowledge in a holistic approach that transcends time, settings, and providers. A broad definition by the Nursing Informatics Working Group of the International Medical Informatics Association asserted that nursing informatics is the integration of nursing, its information and information management with information processing and communication technology to support health (Yensen, 1997).

The scope of nursing informatics was delineated by a task force on nursing informatics (American Nurses Association, 1994) as a speciality group within nursing that integrates nursing science, computer science, and information since in identifying, collecting, processing, and managing data to support nursing practice, administration, education, research, and the expansion of nursing knowledge. The practice of nursing informatics includes the development of applications, tools, processes and structures which assist nurses with the management of data. Activities involved in nursing informatics are identifying, naming, organizing, grouping, collecting, processing,

analyzing, storing, retrieving, or managing data and information. Nursing informatics intersects with supporting disciplines (such as computer science, psychology, management information science, organizational science, engineering, library science, information management, communication theory, and decision sciences) and with collaborating health providers which share programs and common data.

The functional areas of nursing informatics (American Nurses Association, 1994) encompass system analysis and design; system implementation and support; system testing and evaluation; human factors; computer technology; information management; professional practice, trends, and issues; and theories about informatics and related areas. In system analysis and design, a comprehensive needs assessment is conducted and turned into a set of functional specifications. The process of information management is depicted in algorithms, decision trees and flow charts. In the design phase, hardware and software requirements are determined along with data and file structures, information and process sequencing, and report definition and generation. Safety and security measures are integrated with a risk analysis and disaster recovery plan. Audits serve as checks for errors, provide exception reports, and a trail for problem solving. Systems implementation and support personnel develop strategies for education and training, policy and procedure developments, documentation materials, implementation strategies, and ongoing support mechanisms. The systems testing and evaluation foci are upon all areas of the application; the effectiveness and efficiency of the system are evaluated in terms of cost benefits, cost effectiveness, benefits, realization, and social impact. Human factors to consider in nursing include ergonomics and environment (physical aspects);

visual display, user interfaces, and data representation (software aspects); and user satisfaction. Computer technology is used to examine the hardware and software components as well as the processing and storage functions. Distribution and communication of information resources involve user access, telecommunications, networks, and reports. Information management is concerned with data analysis; data may be transformed, aggregated, or presented to users in a variety of ways. Updates, additions and deletions of the database ensure currency and purging of unnecessary files. Professional practice issues discuss the role, education, and ethics of nursing informatics. Trends and issues in health care, technology, and regulatory-accreditation requirements alter the design and implementation of nursing information systems. Nursing informatics employs borrowed theories from nursing and other sciences, such as communication, information, computer, behavior, management and systems. Group dynamics, change theory, organizational behavior and learning theory are major influences in the practice of nursing informatics. Within nursing informatics, theory development focuses on nomenclatures/vocabulary, taxonomies, and coding schemes.

The Staggers and Parks Nurse-Computer interaction framework represents nurses and computers interacting in a system of mutual influences with information as the medium of exchange between them (Staggers, 1996; Staggers & Parks, 1993). The dyad interacts within a context or environment and across time. Nurse characteristics and behaviors affect the initiation and response of the information system in the task of information exchange.

Goossen (1996; Goossen et al., 1996) expanded the definition by Graves and Corcoran to include the multidisciplinary endeavors of nursing informatics. The model created included the analyzing, formalizing, and modeling of how nurses collect and manage data; processing data into information and knowledge; making knowledge-based decisions and inference for patient care; and using empirical and experiential knowledge to enhance the quality of professional practice. Nursing informatics investigates determinants, conditions, elements, models, and processes in order to design and implement effective, efficient computerized systems. The framework for nursing informatics integrates the process of transforming data into information and knowledge to make decisions for actions and evaluation within the umbrella nursing information management system.

Turley (1996b) designed a three-dimensional model for nursing informatics in which cognitive science, information science and computer science are integrated to form informatics within the greater nursing science environment. Cognitive science is combined with the fields of psychology, linguistics, computer science, philosophy, and neuroscience. Cognitive science encompasses a wide range of perception, thinking, understanding, and remembering. Information processing theory is embedded within the cognitive science domain. Information science provides an understanding about organizations and information flow in the environment, while computer science includes hardware and software development. The convergence of these three intersected spheres (cognitive science, information science, and computer science) describes informatics and rests on a base of nursing science.

Humans are complex, adaptive systems in which information is a unifying concept (P. Jones, 1996). Information connects the mechanistic and the humanistic worlds of nursing. The sheer volume of information creates a bottleneck and requires compression of the data itself. However, individuals, from a chaotic environment, extract information that is significant and relevant for the individual. Human knowledge is doubling at an estimated rate of 33 years, while medical knowledge is doubling about every 19 years (Healthfield & Louw, 1999).

Perception of information in the environment may be viewed as two stages (Delvin, 1991): analog and digital. The first stage of perception is that in which information is directly accessible by way some type of sensor; this information flow is analog. The second stage of cognition involves the extraction of a specific item of information, in a conversion along a continuum from analog to digital information. Redundancy is a fundamental characteristic of information systems (P. Jones, 1996); this redundancy allows humans freedom of choice in constructing and interpreting message. Errors and uncertainty are created within the message but the overall message can be deciphered based upon past experiences, coding and classification schemes. Information technology is forging machines that are very small, even invisible to the average observer. This nanotechnology produces a medium for the development of quantum theories of information that apply across nanometers and macro scales. As data are gathered and manipulated into information, facts are deduced and concepts identified which lead to models, theories and laws of information. Knowledge is thus contained within this hierarchal paradigm.

Communication is a process within informatics: the exchange of information for some purposes (Caris-Verhallen, Kerkstra, & Bensing, 1997). Enormous diversity exists with respect to participants, settings, and types of exchanges. Most communicative behavior is classified as one of two types: verbal (conveying messages with language) and nonverbal (conveying messages without the use of language). The goal of effective communication is interpreting the messages and responding in an appropriate manner. Communication in health care has instrumental and affective aspects. Instrumental refers to task-related behaviors necessary in assessing and solving problems. Instrumental behavior is mainly verbal in nature. Affective refers to socio-emotional behaviors required to establish relationships, such as respect, comfort, and trust. This kind of behavior is transferred both verbally and nonverbally. Levels of communication may be categorized into four contexts of care: (a) rare or very brief task oriented communication (instrumental); (b) two-way discussion about care needs and instruction (instrumental); (c) communication about care or social talk in which the patient directs his own care (affective); and (d) intense dialog and supportive statements by the nurse for the purpose of having the patient understand the illness and treatment (mixed instrumental and affective).

Information systems rely on a taxonomy of data, information, and knowledge (Bliss-Holtz, 1990). Data are entities void of interpretation while information has structure, organization, and interpretation. Knowledge is synthesized information in clearly defined and formalized relationships. Mylopoulos (Wand, Monarchi, Parsons, & Woo, 1995) suggested that there are four types of knowledge related to information

systems: (a) the subject world or represented domain; (b) the usage world or the environment within which the system is used; (c) the development world or the process and environment with which the system is developed; and (d) the system work, or the information system itself. Analysis transforms the perceived real-world system into a model of the subject and usage worlds. Design transforms the model of the subject world into a model of the information system. Implementation transforms the model of the information systems into the implemented information system.

Information systems facilitate rapid, less expensive, more precise, and more selective communication across time and geographic location (Huber, 1990; Henry, Warren, Lange, & Button, 1998; Fralic & Denby, 2000). Information systems, in the context of decision making, allow the storage and retrieval of large amounts of information and the access of information outside of the organization. New information can be reconfigured with speed and accuracy to compactly store for use in decision models and to inexpensively report information about organizational transactions. Quality of decisions is direction dependent on the quality of analysis of information. Information systems affect structure and processes by reducing personnel and other resources required to maintain information. The organizational memory is standardized, indexed for retrieval and exchanged across boundaries. Internal and external environmental scanning examines problems and opportunities. Messages are screened, packaged, and interpreted by information systems; however, users may be vulnerable to overload of irrelevant and unintelligible messages.

The use of technology by nurses is contextual, affected by social, political, and economic forces (Bernardo, 1998). Technology enables nurses to perform functions accurately, quickly, and efficiently. The strength of technology lies in its potential to explain and predict effective health care for persons and families. Bernardo points outs that nursing is vulnerable in several areas in which technology may dehumanize the nurse-client relationship: (a) technology alienates the dyad through interference in the nurse's goals to assist the patient; (b) human parameters are interpreted by machines (use of monitoring probes); (c) the art of nursing is based on technology rather than human ecology; (d) technology focuses on the visible and tangible; (e) language connected with the technology is contrived and commonplace, de-emphasizing the individual's perspective.

Technological optimism views technology as beneficial for nursing, while technological romanticism views technology as disruptive and even dangerous to nursing (Sandelowski, 1993, 1996, 1997). Technological optimists reject the notion that technology is harmful to nursing, and in fact, believe the rejection of technology to be harmful. Nursing could be depicted as technology. For technological romantics, technology resists incorporation into the body and spirit of nursing because the seducing, deceiving, and diverting power of technology detracts from the art of nursing. Thus, romantics view technology at odds with nursing. In the real world of practices, nurses are pulled and pushed between these two opposing forces. Technology pushes or pulls in one direction, while the nurses pull back or push in other directions.

In a technology-driven world, division of labor occurs when problems are broken into successfully smaller parts (Ketner, 1996). This specialization may result in the regarding of hypotheses as facts. Technology is often tailored to work specifically within narrowly confined environments; applications do not work in all problem settings. While the main purpose of technology is control of a process and such control implies a causal environment, the nursing environment is chaotic, nonlinear, and dynamic. Science itself is not analogous to technology. Having a technological frame of reference may deny or neglect significant qualities of humanness in the nursing domain.

A review of the 181 research presentations at an international nursing informatics conference (Nursing Informatics New Zealand, 2000) pinpointed current research in 11 major areas: (a) education of nurses (53); (b) use of the internet (19); (c) management issues (18); (d) patient care applications (18); (e) medical records (17); (f) computer hardware and software development (12); (g) nursing languages and taxonomies (12); (h) nursing process implementation (12); (i) nurse attitudes and characteristics (10); (j) theory development and application in informatics (5); and (k) decision making and decision support services (5).

An examination of the 127 nursing research studies on informatics published during the last decade discovered the following general topics:

1. Language and taxonomy development which was the most frequent topic (22) (Bliss-Holtz, Taylor, & McLaughlin, 1992; Bowles, 1999; Button et al., 1998; Clark, 1998; M. Clarke, 1998; Elfrink, 1999; Goossen et al., 1998; Hardiker & Rector, 1998; Henry, Holzemer, Reilly, & Campbell, 1994; 1997; 1998; M. Johnson, 1998; Jones-

Baucke, 1997; Lowen, 1999; Martin, 1999; McCloskey & Bulechek, 1998; McCormick et al., 1994; Ozbolt, Fruchtnicht, & Hayden, 1994; Wand et al., 1995; Warren & Coenen, 1998; Westra & Solomon, 1999; Zielstorff, 1998).

2. Management functions (21) (Chase, 1994; Clifford, 1997; Coleman, 1997; Eck, 1999; Edgar, 1997; Fabray, 1992; Fortenberry, 1995; Hemman, 1998; Henry, 1995b; Hovenga, 1995; Ireson, 1995; Merryman, Sharbaugh, & Roberts, 1999; M. Nolan et al., 1997; Parson, 1995; Pollock, 1996; Preuss, 1998; Schonenman, 1999; Sun, 1994; Werth, 1998; Westbrook, 1994; Zia, 1997).

3. Education (18) (Bachman & Panzarine, 1998; Brown, 1999; Carty & Rosenfeld, 1998; Cobb, 1999; Connolly, Huynh, & Gorney-Moreno, 1999; Corliss, 1994; Drury, 1997; Edel, 1998; Graveley, Lust, & Fullerton, 1999; Graves, Amos, Huether, Lange, & Thompson, 1995; Hague & Gibson, 1998; E. Jones, 1992; D. Lewis, 1999; Mastrian & McGonigle, 1997; T. Morris & McCain, 1998; Ribbons, 1998; C. Smith, Young-Cureton, Hooper, & Deamer, 1998; Travis & Brennan, 1998);

4. Decision making and decision support (17) (Barton, 1993; Berner, Maisiak, Cobbs, & Taunton, 1999; Botter, 1998; Breitfeld, Weisburd, Overhage, Sledge, & Tierney, 1999; Bremner & Brannan, 2000; Gassert, 1988; Grand, 1997; B. Johnson, 1998; Kohli, 1994; Kolodner, 1991; Lamond, Crow, Chase, Doggen, & Swinkels, 1996; V. Lewis, 1996; Nelson, 1995; Prin, 1996; Rossi, 1991; Ruland, 1999; von Tettenborn, 1990);

5. Patient care issues (15) (Bosque, 1995; Bowman, 1991; Caris-Verhallen et al., 1997; Carlton, 1997; Clevenger, 1994; Downing, 1994; Ganong & Coleman, 1997;

Gassert, 1998; Gorman, 1995; Knestrick, 1999; Larrabee, 1999; Merrigan, 1998; Nightingale Tracker Field Test Nurse Team, 1999; Schrot, Foulis, Morrison, & Farese, 1999; Woolery, 1992);

6. Nurse attitudes and characteristics (14) (Boldreghini & Larrabee, 1998; Burke, 1993; Cuyar, 1998; Gregor, Alm, Arnott, & Newell, 1999; Leavenworth, 1994; Ngin, 1993; Roberts, While, & Fitzpatrick, 1995; Rolfe, 1997; Simpson, 1997; L. Smith, 1998; Staggers, 1991; Staggers & Kobus, 2000; Van Wynen, 1997; Weiner et al., 1999).

7. Computer hardware and software (8) (Duford, 1991; Sorensen, 1991; Carty, 1993; Newton, 1993; Romano, 1993; Rose, 1993; Charters, 1998; Chocholik, Bouchard, Tan, & Ostrow, 1999);

8. Nursing process (6) (Bakken, Cashen, Eneida, O'Brien, & Zieniewicz, 2000; Boswell, 1995; Finfgeld, 1999; Henry, 1995a; Maher, 1992; Renfro, 1995);

9. Use of the internet (4) (Fitch, 1999; Gomez, DuBois, & King, 1998; Hovenga, Hovel, Klotz, & Robins, 1997; Westberg & Miller, 1999);

10. Patient records (2) (Aronsky & Haug, 2000; Lauer, Joshi, & Browdy, 2000).

Summary of Chapter II

The review of literature encompassed the theoretical framework of chaos theory and the concepts in the model being tested: decision making, creativity, experience, leadership, education, risk, and informatics. Decision making approaches were found in the two broad areas of descriptive/behavioral or prescriptive/normative. Factors affecting decision making were the environment; information; heuristics; values; personal characteristics (styles); and processes utilized.

Nursing studies of decision making processes arose in the early second half of the 20th Century and incorporated both quantitative and qualitative methods. Decision making has not been a concept embraced by nursing theorists to describe the practice environment. The process of decision making in nursing primarily followed the nursing process, with allowances made for creativity and critical thinking. Information processing, decision theory, and intuition were the major theories utilized in exploring nursing decision making. Some effort has been made to distinguish individual, group and professional levels of decision making in nursing.

Decision tools in the literature focused on attitudes and beliefs; perception; collaboration or participation; quality indicators; or task analyses. Where reported, reliability coefficients ranged from 0.74 to 0.90. Most scales were Likert-type.

The review of literature by the author showed that model concepts have limited integration in nursing research. Creativity was usually visualized as a part of the nursing or critical thinking process, with individual and organizational components. Creativity in decision making was an attribute of nurse leaders sought by administrators but rarely addressed in nursing research. Nursing education was grounded in fundamental ways of thinking and in the critical thinking process. Leadership research concentrated on the qualities and behaviors of the leader; styles of leadership, and leadership competencies. The experience of the nurse in decision making has been found to be a useful classification tool for education and professional practice. The perception of risk or uncertainty in nursing situations was modified by information-seeking behaviors of the nurse. The framework for informatics evolved around the interaction of systems; the

management of information; the classification (taxonomy) of nursing practice; and the influence of technology.

Critique of the Review of Literature

No studies were found to have incorporated all of the concepts in the model being tested. Most studies were limited to one or two of the concepts and, rarely, to three of the concepts. No study utilized four or more of the seven concepts in the model. Study designs incorporated both qualitative and quantitative methodologies, with quantitative methods predominating. Samples were mostly non-random, convenience samples in limited settings. Tools which have been developed were limited in scope to measuring a single concept in the model. No tools were found which measured all seven concepts in the model.

Most studies reviewed focused on individual achievement in decision making. The main tendency was to evaluate individual responses or personal characteristics, rather than to discover the conceptual framework within the decision environment.

CHAPTER 3
METHODS

Research Methodology

The research design for this study was quantitative, descriptive, and non-experimental. A questionnaire consisting of demographic data and a bipolar scale on decision making was distributed to a random sample of registered nurses licensed in Florida. The data were analyzed using descriptive and inferential statistics. Correlations and path analysis were performed to answer the research question about the relationships among the study variables.

Specific Procedures

The study was approved by the Institutional Review Boards (IRB) at the University of Florida and at the University of Tampa. Names and addresses of registered nurses licensed in Florida were obtained from the Florida Department of Professional Regulation. Participants were informed of consent procedures and had the right to refuse participation in this study. No participant identifiers were included on the data collection tool; thus, confidentiality of the data was maintained.

Research Population or Sample

A random sample was selected from a list of all 162,705 registered nurses licensed in the State of Florida. Nurses who had a mailing address outside of Florida were excluded from the study, reducing the population to 140,202. Using a computer

software program, a random sample of 5,000 registered nurses was selected to participate in the study.

To estimate the sample size required for a covariance structure model, a procedure based on goodness-of-fit (Hoelter, 1983) and modified by Matsueda and Bielby (1986) was utilized as implemented in EX-SAMPLE (Brent, Mirielli, & Thompson, 2000). Using this procedure, for an alpha of 0.05, six degrees of freedom, and an effect size of 0.20, the sample size required to detect this effect size was estimated at 151. A rule of thumb (Bentler, 1989) recommendation that sample size be no lower than five times the number of parameters (in this study, 81) indicated that the final sample must be more than 405 responses to achieve a power of 0.80.

Instrumentation

A tool developed by the researcher was used to collect data from the participants. The first section was designed to collect demographic data about participant characteristics, such as age, experience, and education. In the second section, the investigator used a bipolar scale to evaluate the participant's degree of agreement with words which reflect the model concepts. The word list of 272 terms was developed through analysis of nurses' stories on decision making. The word list was reviewed by a panel of experts for content validity and reduced to 91 word pairs. These word pairs were examined for ability to distinguish concepts in the model, and a coding scheme was developed.

The instrument was tested in a sample of 67 baccalaureate and master’s students at a local university. Inter-item reliability analysis yielded a Cronbach’s alpha of 0.97 for

the full scale and a split-half reliability of 0.98. Word pairs were deleted if the total item correlation was below 0.30 or above 0.80 and if a subsequent increase in alpha would be detected if the item were deleted. Nine word pairs were deleted to form the final tool. The revised tool of 81 word pairs had a Cronbach's alpha of 0.88 for the full scale and a split-half reliability of 0.91.

Pilot Study

A pilot study of 67 undergraduate and graduate nursing students tested study procedures, data gathering techniques, and analysis of data. Correlation analysis demonstrated that all concepts in the model were significantly associated with the other concepts ($r = 0.44\text{-}0.97$). Using analysis of variance, a significant relationship was found on the effect of the six model concepts with decision making ($F = 287.04$, $p = 0.000001$). The six model concepts were regressed on the dependent concept of decision making, with a resulting adjusted R^2 of 0.96. Changes were made to the tool and to the research design and procedures. An over-identified path model was constructed for testing (see Figure 3).

Data Collection

The researcher mailed the questionnaire to the selected participants. Nurses completed and returned the questionnaire to the researcher with prepaid postage. Data collection was estimated at 20-30 minutes for each participant; the data collection phase was completed within one month of initiation of the study.

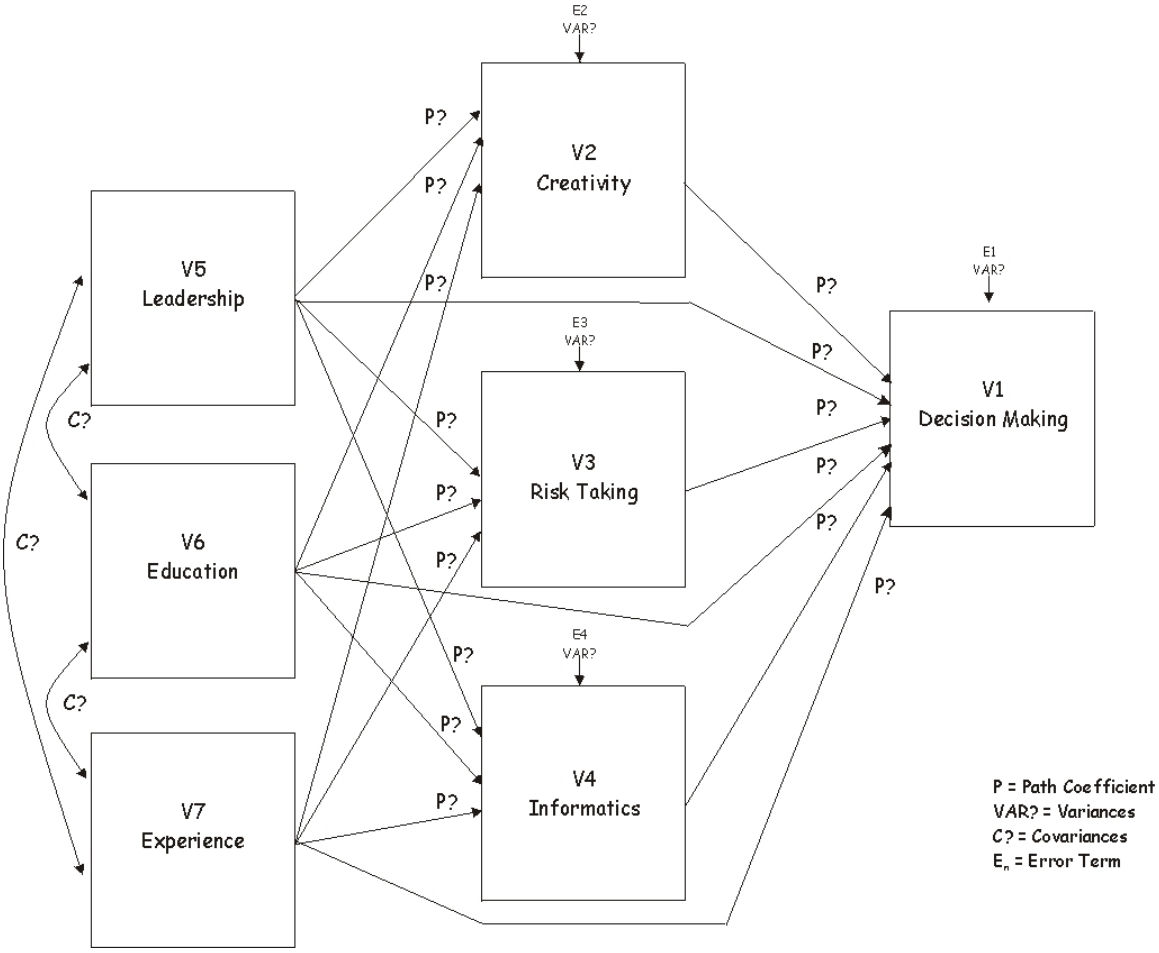

Figure 3 Hypothesized (Over-Identified) Decision Making Model for Nursing

Treatment of the Data

The data were coded for computer entry. Subscores for each concept and a total decision making score were calculated based on the scoring grid for the tool. Tests for internal consistency and inter-rater reliability were repeated to confirm previous findings about the tool.

Descriptive data were displayed in tables and analyzed using descriptive statistics. Inferential statistics performed were correlation, regression, and path analyses to test the decision making model as posed in the research question. Significance was set at the 0.05 level.

Summary of Chapter 3

Using a quantitative, non-experimental design and a random sample of registered nurses, this research study tested a decision making model for nursing. The data collection tool was constructed to collect demographic data on participants and used a bipolar scale to measure relationships among the six concepts in the model with decision making. Measures to protect anonymity and confidentiality were constructed, along with review by several IRB's. Data were coded for computer entry. Descriptive and inferential statistical tests included correlation and path analyses.

CHAPTER 4
RESULTS

Sample Characteristics

Of the 5,000 questionnaires distributed, 510 or 10.2% were returned. Of these, 19 were incomplete, leaving 491 usable questionnaires for a 9.8% return rate. The respondents were 92.9% female (n = 456) and 7.1% male (n = 35) (see Table 1). Most respondents (88.0%) were White, with the remainder African-American (5.5%), Hispanic (3.5%), Asiatic-Pacific Islander (2.6%), and Native American (0.4%). The majority of the respondents were married (66.6%); however, 31.1% of the respondents were single status (single 13.0%; divorced 14.1%; widowed 2.4%; and separated 1.6%). Only 11 or 2.3% of the sample reported a partnership.

Hospital nursing represented the area of practice for the largest number of respondents (57.0%). Home health had the second largest number of respondents with 8.0%, while clinic practice followed with 5.0% of respondents. Nursing home, public health, and school settings each composed less than 5% of the reported areas of practice.

Critical care was the largest speciality area represented, with 21.0% of respondents. Adult medical/surgical (15.1%), pediatrics (9.2%), women's health (7.1%), geriatrics (5.9%) outpatient areas (4.7%), psychiatric/mental health (4.5%), and rehabilitation (4.1%) were listed as speciality areas by the respondents; 28.5% of sample listed other areas not defined on the questionnaire.

Table 1: Number and Frequency of the Variables Gender, Ethnicity, Marital Status, Area of Practice, Specialty, Basic Nursing Education, Highest Level of Education, Level of Practice, Employment Status and Current Position for the Total Sample (N = 491)

Variable	Number	Percent
Gender		
Female	456	92.9
Male	35	7.1
Ethnicity		
White	432	88.0
African-American	27	5.5
Hispanic	17	3.5
Asiatic-Pacific Islander	13	2.6
Native American	2	0.4
Marital Status		
Married	327	66.6
Divorced	69	14.1
Single	64	13.0
Widowed	12	2.4
Partnership	11	2.3
Separated	8	1.6
Area of Practice		
Hospital	280	57.0
Home Health	39	8.0
Clinic	25	5.0
Nursing Home	18	3.7
Public Health	14	2.9
College/University	13	2.7
Elementary/High School	10	2.0
Other	92	18.7

Table 1 continued

Variable	Number	Percent
Specialty		
Critical Care	103	21.0
Adult Medical/Surgical	74	15.0
Pediatrics	45	9.2
Women's Health	35	7.1
Geriatrics	29	5.9
Outpatient	23	4.7
Psychiatric/Mental Health	22	4.5
Rehabilitation	20	4.1
Other	140	28.5
Basic Nursing Education		
Diploma/Associate Degree	300	61.1
Baccalaureate	191	38.9
Highest Level of Education		
Diploma/Associate	209	42.6
BSN	125	25.5
Baccalaureate (Other Field)	46	9.4
MSN	59	12.0
Master's (Other Field)	68	7.7
Doctorate	11	2.2
Other	3	0.6
Level of Practice		
Novice	6	1.2
Advanced Beginner	18	3.7
Competent	72	14.7
Proficient	182	37.0
Expert	213	43.4

Table 1 continued		
Variable	**Number**	**Percent**
Employment Status		
Full Time	362	73.7
Part Time	81	16.5
Retired	24	4.9
Not Employed	24	4.9
Current Position		
Staff	192	39.1
Administrator	56	11.4
Manager	54	11.1
Educator	37	7.5
Case Manager	35	7.1
Nurse Practitioner	25	5.1
Office/School/Industry	12	2.4
Private Duty	2	0.4
Other	78	15.9

Basic nursing education was predominately at the diploma/associate degree (61.1%), while the baccalaureate degree was the entry level for 38.9% of the respondents. A large portion (42.6%) of the sample did not hold another degree above the diploma/associate entry level. While 34.9% of the respondents stopped with a baccalaureate degree in nursing (25.5%) or in another field (9.4%), 21.9% had achieved a master's degree in nursing (12.0%), a master's degree in another field (7.7%), or a doctoral degree (2.2%).

Respondents rated their level of practice using Benner's (1984) classification scheme, with 1.2% at the novice level; 3.7% at the advanced beginner level; 14.7% at the

competent level; 37.0% at the proficient level; and 43.4% at the expert level. Nearly three-quarters of the sample were employed full time, with 16.5% in part time positions. Less than 5% of the respondents were retired from full time positions; however, many retired nurses indicated continued employment in part time positions. A small component (4.9%) was not employed at the time of the survey.

Staff nurses comprised the largest segment (39.1%) of the sample. Administrators (11.4%) and managers (11.1%) responded as well as educators (7.5%), case managers (7.1%), nurse practitioners (5.1%), and office/school/industry nurses (2.4%). Private duty nurses were only a small component of the respondents (0.4%), while a large segment (n = 78 or 15.9%) listed other types of positions on the survey.

The average age of the respondents was 45.4 years, with a range from 23 to 78 years (see Table 2). Age was not significantly different between females (45.6 years) and males (42.2 years) ($F = 3.75$, $p = 0.053$). Females tended to be in their current position for a longer period than males (6.3 years vs. 3.7 years respectively; $F = 5.38$, $p = 0.02$).

Males had significantly fewer total years of nursing experience (14.7 years) compared to females (19.8 years) ($F = 7.13$, $p = 0.008$). Other significant differences were found between males and females in characteristics of marital status ($\chi^2 = 19.54$, $p = 0.002$) and practice areas ($\chi^2 = 20.94$, $p = 0.004$).

Table 2: Summary Measures of the Variables Age (in years), Length in Current Position (in years), and Total Years of Nursing Experience for the Total Sample (N = 491)

Variable	Mean	Min	Max	SD
Age	45.4	23	78	9.99
Female	45.6	23	78	9.97
Male	42.2	24	60	9.91
Length in Current Position	6.1	1	55	6.19
Female	6.3	1	55	6.32
Male	3.7	1	13	3.25
Total Years of Nursing Experience	19.4	1	55	10.85
Female	19.8	1	55	10.85
Male	14.7	2	39	9.79

Instrument Testing

The instrument developed for this study, Analysis of Decision Making in Nursing, was examined for reliability. Four word pairs were found with inter-item correlations below 0.30 with a corresponding increase in alpha and were deleted from further analyses; no items had correlations above 0.80. Cronbach's alpha for the full scale was reported at 0.93, with split half reliability of 0.94.

Correlation analysis (see Table 3) demonstrated that all concepts in the model were significantly associated with the other concepts. High correlations were found between decision making and creativity (r = 0.60); decision making and informatics (r = 0.70); decision making and leadership (r = 0.76); decision making and education (r = 0.64); and experience (r = 0.71). Risk taking was weakly correlated with other model variables (r = 0.10-0.31).

Table 4 shows the summary measures for the model variables. The standard deviation for the informatics variable was considerably larger than all the other independent variables.

Path Analysis

Path analysis was performed to test the hypothesized theoretical model presented in Figure 4. All analyses were conducted using the SAS System's CALIS procedure (SAS, 1996). These analyses used the maximum likelihood method of parameter estimation, and all analyses were performed on the variance-covariance matrix. The direct, indirect and total effects of model variables on decision making were determined. Four regression equations were constructed to represent model paths. First, decision making was regressed on creativity, risk taking, informatics, leadership, education, and experience. Second, creativity was regressed on leadership, education, and experience. Third, risk taking was regressed on leadership, education, and experience. Finally, informatics was regressed on leadership, education, and experience.

Four path coefficients were found to have t values less than the absolute value of 1.96 ($p>0.05$) and were removed from the model. All path coefficients in the reduced model were statistically significant ($p<0.05$). (See Figure 5 for the reduced model.)

Adjusted R^2 values were calculated for decision making (0.86), for informatics (0.45), for creativity (0.20), and for risk taking (0.03). Covariances of the exogenous variables were determined between leadership and education (0.41); between leadership and experience (0.49); and between education and experience (0.54).

Table 3: Correlations among Model Variables

	Decision Making	Creativity	Risk Taking	Informatics	Leadership	Education	Experience
Decision Making	1.00000						
Creativity	0.60642*	1.00000					
Risk Taking	0.31803*	0.19840*	1.00000				
Informatics	0.70208*	0.41295*	0.10690*	1.00000			
Leadership	0.75620*	0.44636*	0.18435*	0.55642*	1.00000		
Education	0.63821*	0.25353*	0.12884*	0.49722*	0.41385*	1.00000	
Experience	0.71036*	0.29995*	0.10419*	0.56513*	0.49276*	0.53898*	1.00000

*$p<0.05$

Table 4: Summary Measures for Model Variables				
Variable	**Mean**	**Min**	**Max**	**SD**
Decision Making	239.65	167	287	19.09
Creativity	23.87	9	32	3.55
Risk Taking	14.26	7	24	2.72
Informatics	102.74	72	126	9.27
Leadership	26.43	12	32	3.93
Education	26.88	19	32	2.35
Experience	30.25	15	36	3.14

The goodness of fit indices for the reduced model are presented in Table 5. These indices provided a mixed review of the effectiveness of the model in explaining decision making. The chi-square statistic included in this table tested the null hypothesis that the reproduced covariance matrix has the specified model structure, or that the model fits the data. Based upon the chi-square results the null hypothesis was rejected ($\chi^2 = 35.47$, df = 7, p = 0.0001). Therefore, the chi-square test suggested that the model does not adequately represent the decision making framework. However, Goodness of Fit Index (GFI), the Normed Fit Index (NFI), and the Non-Normed Fit Index (NNFI), and the Comparative Fit Index (CFI) values above 0.95 indicated a relatively high fit of the model to the data. In addition a LaGrange multiplier test did not suggest further improvements to the model which had not previously been considered or rejected.

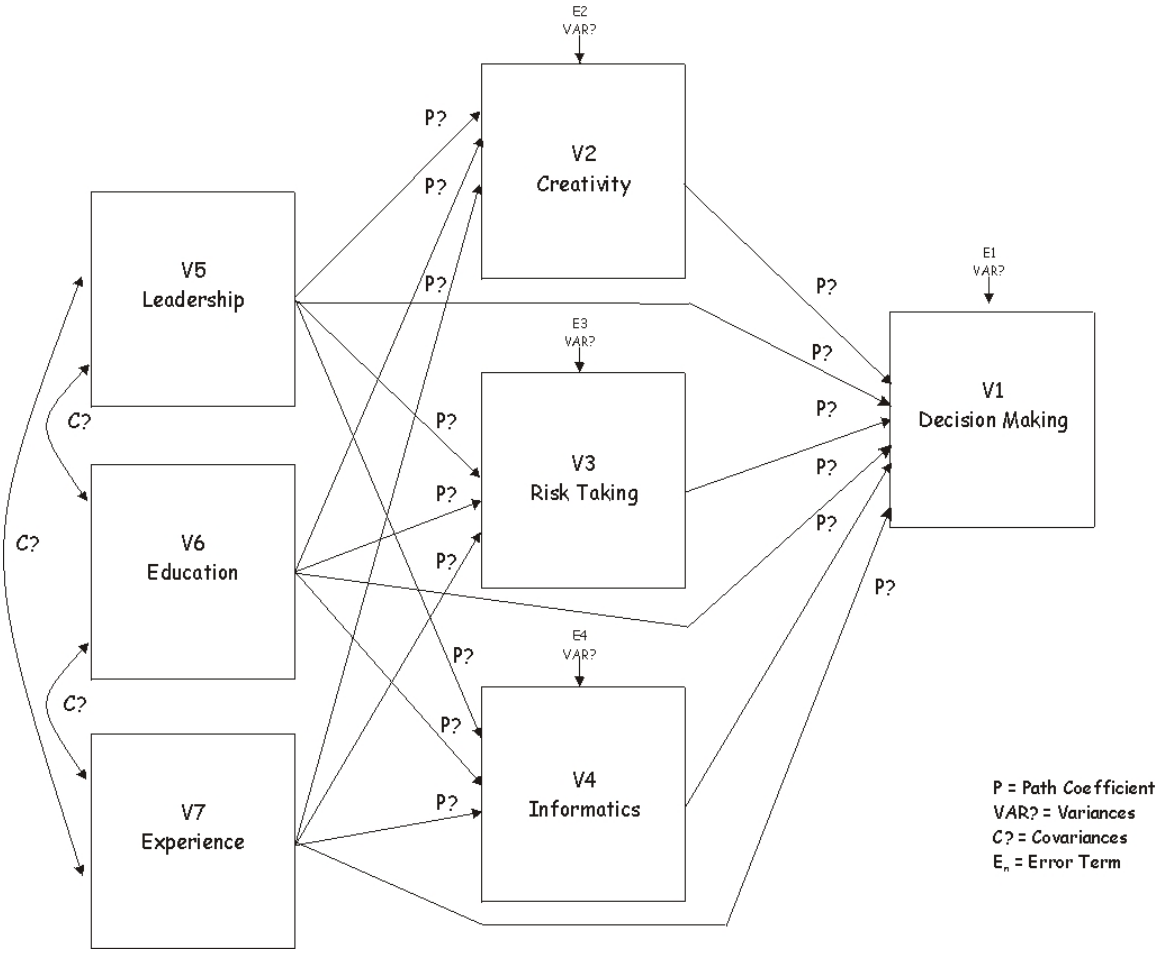

Figure 4 Hypothesized Decision Making Model for Nursing

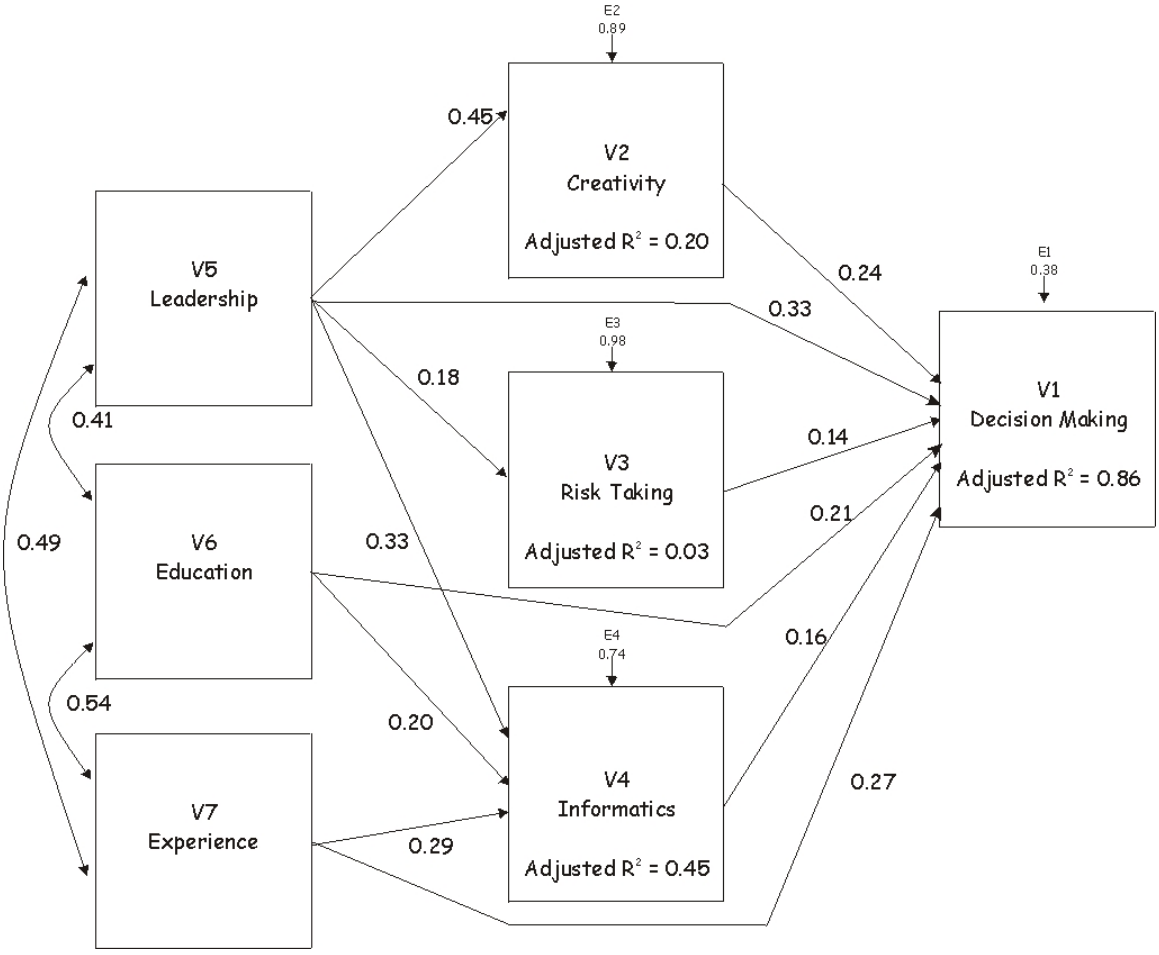

Figure 5 Reduced Decision Making Model for Nursing

The reduced model explained 86% of the variance in decision making. As shown in Table 6, leadership provided the largest direct effect (0.33), indirect effect (0.19), and total effect (0.52) on decision making. Experience (0.32), creativity, (0.24) and education (0.24) followed in total effect on decision making. Risk taking (0.14) and informatics (0.16) had the smallest direct effects on decision making.

Table 5: Covariance Structure Analysis: Maximum Likelihood Estimation Goodness of Fit

Index	Hypothesized Model	Reduced Model
Chi-Square	$\chi^2 = 27.51$ df = 3, p = 0.0013	$\chi^2 = 35.47$ df = 7, p = 0.0001
Comparative Fit Index (CFI)	0.9858	0.9835
Goodness of Fit Index (GFI)	0.9848	0.9803
GFI Adjusted for Degrees of Freedom	0.8585	0.9211
Non-Normed Fit Index (NNFI)	0.9008	0.9506
Normed Fit Index (NFI)	0.9843	0.9797

Table 6: Direct, Indirect, and Total Effect on Decision Making

Variable	Direct	Indirect	Total
Creativity	0.24		0.24
Risk Taking	0.14		0.14
Informatics	0.16		0.16
Leadership	0.33	0.19	0.52
Education	0.21	0.03	0.24
Experience	0.27	0.05	0.32

CHAPTER 5
DISCUSSION

Relating the Findings to the Original Conceptualization of the Problem

The purpose of this study was to determine the relationships among the concepts of a decision making model for nursing: creativity, experience, leadership, education, risk taking, and informatics. The population was registered nurses licensed in the State of Florida. Path analysis was performed to answer the first research question: whether the hypothesized model was adequate in explaining decision making in nursing. A reduced model was produced. Although goodness-of-fit indices indicated mixed results, the reduced model provided a minimally acceptable fit to the data using several criteria.

First, although the reduced model demonstrated a significant model chi-square test, this statistic does not provide a valid test of model fit in most applied situations and should be viewed more as a general goodness of fit index rather than as a statistical test (Frees, 1996; Joreskog & Sorborn, 1989). In support of the reduced model, the NFI exceeded 0.9 and the NFI and CFI were close to 1.0, indicating a good-to-superior fit between model and data (Hatcher, 1998).

Second, the reduced model incorporated only one modification from the original model, elimination of non-significant paths. The reduced model was more desirable in that an increase in NNFI occurred through a relatively small number of modifications (MacCallum et al., 1992) while CFI, GFI, and NFT remained stable.

Third, the reduced model remained clearly interpretable within the theoretical framework of chaos theory. LaGrange multipliers did not propose any modifications which were significant paths and which had not been previously considered in model development (Hatcher, 1998; MacCallum et al., 1992).

Fourth, all of the path coefficients on the reduced model were significant. The standardized path coefficients were not trivial in size, exceeding 0.05 in absolute value. The R^2 values for the endogenous variables of decision making and informatics were substantial in size.

Therefore, the majority of goodness-of-fit indicators supported tentative acceptance of the reduced model. Still, the reduced model was itself of admittedly questionable validity, since the model was created from data-driven modifications made to a rejected initial model and was based on a single sample of only moderate size. The model may not generalize to other samples or to the population.

These findings are consistent with previous nursing research utilizing path analysis to test model concepts. The adjusted R^2 for the endogenous variables in this study ranged from 0.03 to 0.86, while other nursing studies (Balneaves & Long, 1999; Fox, 1997; Musil, Jones, & Warner, 1998; Resnick, Palmer, Jenkins, & Spellbring, 2000; Richmond, 1997; Smyth & Yarandi, 1992; Trinkoff, Zhou, Storr, & Soeken, 2000) found adjusted R^2 values for the endogenous variables in a comparable range of 0.08 to 0.67. Several of these studies (Fox, 1997; Resnick et al., 2000) reported an initial or final model which had a significant value for the chi-square statistic, such as was found in this study. Other indices (CFI, GFI, NFI, and NNFI) used in prior research to promote acceptance of the final path models were the same ones used in this study.

Relationships among Model Concepts

The second research question explored the relationships among the concepts in the decision making model. The reduced model explained 86% of the variance in decision making. Leadership provided the largest total effect on decision making, followed by experience, creativity and education. Risk taking and informatics had the smallest direct effects on decision making.

All model variables were significantly correlated with each other. Moderate to strong correlations were found between decision making and creativity, informatics, leadership, education, and experience. Risking taking had only weak correlations with all other model variables. Creativity and risk taking would have been expected to have an inverse relationship; however, this study found a positive, albeit small, relationship. Informatics was the only endogenous variable besides decision making which had moderate correlations with the three exogenous variables in the model. Creativity was moderately correlated with informatics and leadership.

No studies were found in the literature which combined all of the variables in the decision making model tested in this study. Therefore, this study provided new information about the relationship of decision making with creativity, education, leadership, experience, risk taking, and informatics. The reduced model envisioned decision making as a complex process, which may vary according to task and context (Lauri & Salantera, 1998) and as a necessary skill for nursing leadership (Antrobus & Kitson, 1999; Hemman, 1998; Krejci, 1999; Krejci & Malin, 1997; Porter-O'Grady, 1999).

The substantial contribution of leadership (directly and indirectly through creativity) in the reduced model echoed the findings of other research studies on leadership in nursing (J. Anderson, Rungtusanatham, Schroeder, & Devaraj, 1995; King, 2000; Krejci & Malin, 1997): decision making is the most predominant leader behavior. Several leadership classifications (Antrobus & Kitson, 1999), such as developer of nursing knowledge, process consultant, and user of information, may be visualized in the reduced model pathways.

The relationships shown in the model between experience (tacit knowledge) and decision making were reinforced through prior investigations by Anderson et al. (1995), Fox (1997), Girot (2000), and Greenwood (2000). In those studies, tacit knowledge was acquired by nurse leaders and staff nurses through mentoring and role modeling processes in the work environment. The majority of decisions which nurses made were resolved by managing tasks or others through tacit knowledge of the nursing environment. This tacit knowledge combined with years of experience provided a foundation for information seeking behaviors and for evaluation of consequences (Girot, 2000); both of these behaviors are components of the informatics concept in the model. The direct and indirect effects of education and experience on decision making underpin previous research which found education and experience lead to more effective decision making (Girot, 2000) and to a higher level of reasoning (Benner et al., 1996).

In the reduced model, creativity and risk taking presented a smaller (and disappointing) role in decision making than the other model variables. Past research (Anthony, 1999; Gilmartin, 1999; Porter-O'Grady, 1997a) has established that, as a group, nurses reward conformity and punish creativity. Organizational constraints, workload

pressures, restricted resource, reduced autonomy, and derelict lack of encouragement by administrators impede creativity (Amabile, 1998). While domain expertise is the foundation of all creative work, nursing should manage this expertise, along with creative thinking skills, and should instill motivation to promote creative works.

Informatics has paths from all three exogenous model variables of leadership, education, and experience. The direct and indirect paths from informatics to decision making are significant in the model. These findings suggest that nurses in the sample may be a sandwich generation in the computer age: above those who have no computer experience but below those who utilize computers profusely. The components of informatics (communication, analysis, evaluation, inductive and deductive reasoning, systems thinking) were articulated in previous investigations as significant elements of tacit knowledge in nursing (Antrobus & Kitson, 1999; Byrnes & West, 2000; Porter-O'Grady, 1999).

Practical Implications of Research Results

This study contributes to the body of nursing knowledge on decision making with new knowledge about the relationships among the seven concepts in the model. A pattern of relationships and the strength of those relationships were revealed in the path analysis and resulting reduced model for decision making. Nursing may benefit from this research in the four domains of nursing practice: clinical, administration, research and education.

For the clinical nurse, this study provides a conceptual framework for understanding decisions in the chaotic practice environment. A nurse who is contemplating the complex care of a trauma patient may review the information available

or seek new information as needed in order to make a better decision about care. The nurse may need to rely on previous education and experience, intuitive judgments, values, beliefs, and technology to provide required information. Based upon that information, the nurse may weigh risks, advantages, and disadvantages of proposed actions. Imagination may spark innovation within the context of the care parameters. The leadership qualities of the nurse may enhance or may hinder the nurse's ability to carry out the selected care activities within the existing decision environment.

The administrative nurse utilizing these research findings may design policies and procedures for orientation and support of nurses at the bedside. The innovative environment thus created may enhance the quality of the patient care decisions and positively impact the use of resources for best practice.

In the education of nurses, curriculum changes may reflect the conceptual model being tested in nursing courses. Outcomes of student experiences may be framed in the context of the concepts. For instance, risk taking and the possibility of failure may be supported by the faculty, while at the same time ensuring patient safety. Student assignments may be assessed for the use and application of information and leadership parameters per the model.

Further research in the model might speculate on changes in the concept relationships over time and on the effect of environmental influences. Additional research studies may be designed to test model characteristics in different settings. The model may be examined for development of predictive theories which could be tested in the health care environment.

Limitations of the Study

This study was limited by the return rate of the questionnaire from the sample participants. Study procedures and time frames did not allow for follow up to encourage completion of the questionnaire. Although the overall number of usable returned forms was acceptable via several different methods, a return rate of 20-25% was desirable. The limitation for the small achieved sample is that results may not be applicable to all registered nurses in Florida.

The Analysis of Decision Making in Nursing instrument may not have been the best choice to measure the model variables. Several tools exist in the literature which measure leadership, creativity, and decision making. However, valid and reliable tools for nursing research in the areas of risk taking and informatics are lacking in the literature. Combining measurement of all model variables into one instrument was convenient but may have added the threat of multicolinearity to the results.

Path analysis is linear in nature while the original decision making model is framed in chaos theory's characteristic non-linearity. Forcing a nonlinear model into a linear format may have altered the relationships found in the original qualitative study and, therefore, may not be representative of the nurses' perception of the concepts in decision making. In addition, validity may be questioned since the reduced model was created from data-driven modifications made to a rejected initial model and was based on a single sample of only moderate size. The model may not generalize to other samples or to the population.

Implications for Further Research

Future researchers may use this model for decision making in nursing to construct computer programs, perhaps in a virtual reality environment, which enhance the decision making practices of nurses. Such programs might focus on model variables, such as creativity and risk taking. The program would present a nursing scenario requiring the use of those concepts; programming would direct the nurse through the decision maze, suggesting alternatives and envisioning outcomes based upon choices for courses of action. A research study of the effectiveness of such a computer program could measure differences in decision making, creativity, and risk taking in nurses completing the computer program with nurses who did not utilize the computer program.

Additional research may be required in the area of informatics. The ability of researchers in nursing informatics to explain nursing practice might be explored in a qualitative study of nurses. The concepts of information processing, communication, analysis, evaluation, and systems orientation could be applied to new definitions of nursing practice.

Conclusions

This study affirms the validity and usefulness of a decision making model for nursing using path analysis. This pioneering work in the field of decision making within the nursing profession may lead to a new interpretation of nursing itself, as an information owning, information driven, information controlling, and information giving discipline.

This investigation into the nature of the model components may not fully explain decision making in nursing, but the model does constitute a foundation for future efforts

to understand the dynamic relationships and characteristics of creativity, education, leadership, experience, risk taking, informatics, and decision making in nursing.

APPENDIX
ANALYSIS OF DECISION MAKING IN NURSING

ANALYSIS OF DECISION MAKING IN NURSING

Part I Directions: **Fill in the blank, or circle the number by the response you choose to each item.**

A. Age	**B. Gender**	**C. Ethnic or Racial Background**
_____ years	1. Female 2. Male	1. White 2. African-American 3. Hispanic 4. Asiatic/Pacific Islander 5. Native American/Alaskan
D. Marital Status	**E. Area of Practice**	**F. Specialty Area**
1. Single 2. Married 3. Separated 4. Divorced 5. Widowed 6. Partner 7. Other	1. Hospital 2. Clinic 3. Home Health 4. College/University 5. Public Health 6. Nursing Home 7. Elementary/High School 8. Other	1. Adult Medical/Surgical 2. Critical Care/Emergency 3. Psychiatric/Mental Health 4. Rehabilitation 5. Pediatrics 6. Women's Health 7. Geriatrics 8. Outpatient 9. Other
G. Basic Nursing Education	**H. Highest Level of Education Completed**	**I. Current Level of Practice**
1. Diploma or Associate Degree 2. Baccalaureate Degree	1. Diploma or Associate Degree 2. BSN 3. Baccalaureate in Another Field 4. MSN 5. Masters in Another Field 6. PhD, EdD, or Other Doctorate 7. Other	1. Novice Nurse 2. Advanced Beginner Nurse 3. Competent Nurse 4. Proficient Nurse 5. Expert Nurse
J. Employment Status	**K. Current Position**	**L. Length in Current Position**
1. Full Time 2. Part Time 3. Not Employed 4. Retired	1. Staff 2. Educator, Teacher 3. Manager, Charge Nurse 4. Supervisor, Administrator 5. Office, School, Industrial 6. Private Duty 7. Nurse Practitioner 8. Case Manager 9. Other	_____ years **M. Total Years of Nursing Experience** _____ years

Part II Directions: **Think of a recent decision that you made which had a great effect on patient care or on a patient outcome as you review the following list of word pairs**.

Place an "X" in the box for each item to indicate the extent to which the trait characterizes your behavior, thoughts, actions, or feelings when you made this decision.

Please make a choice for each of the 81 items.

The example shows a closeness with love and some distance from hate

.

Example	love		X			hate

ANALYSIS OF DECISION MAKING IN NURSING							
Creativity	1	change					constant
	2	clever					dull
	3	create					imitate
	4	discover					hide
	5	infinite					limited
	6	wonder					know
	7	pioneering					similar
	8	perceptive					blind
Leadership	9	command					obey
	10	determined					wavering
	11	direct					participate
	12	lead					follow
	13	persistence					hesitation
	14	strength					weakness
	15	act					delay
	16	assertive					passive
Experience	17	expert					novice
	18	real					imaginary
	19	independent					dependent
	20	intervene					observe
	21	qualified					incapable
	22	resourceful					wasteful
	23	skillful					inept
	24	confident					wary
	25	experienced					naive
Education	26	competent					incompetent
	27	insightful					unaware
	28	outcome					process
	29	questioning					accepting
	30	reason					intuition
	31	recognize					forget
	32	relate					contrast
	33	retrieve					store
	34	teacher					pupil

ANALYSIS OF DECISION MAKING IN NURSING							
Risk Taking	35	dispute					agree
	36	danger					security
	37	hazardous					safe
	38	liberal					conservative
	39	optimistic					pessimistic
	40	accidental					planned
Analysis	41	dissect					combine
	42	feasible					implausible
	43	flow					barrier
	44	rational					irrational
	45	detailed					general
	46	clarify					cloud
	47	study					scan
	48	understand					confuse
	49	interpret					vague
Implementation	50	materials					product
	51	technical					ordinary
	52	impact					useless
	53	effective					ineffective
	54	collate					divide
	55	gather					dispense
	56	control					yield
	57	automatic					manual
	58	achieve					abort
Design	59	structure					technique
	60	deliberate					impulsive
	61	procedure					result
	62	integrate					separate
	63	disaster					success
	64	exception					common
	65	adaptable					vulnerable
	66	sequence					unravel

ANALYSIS OF DECISION MAKING IN NURSING							
Evaluation	67	measurable					negligible
	68	initial					final
	69	efficient					inefficient
	70	beneficial					futile
	71	complex					simple
	72	original					copy
	73	trends					fixed
	74	ethical					dishonest
	75	judge					ignore
Communication	76	group					individual
	77	persuade					discourage
	78	send					receive
	79	confidential					indiscreet
	80	information					data
	81	message					feeling

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BIOGRAPHICAL SKETCH

Daniel Bruce Coble was born on November 3, 1[redacted] in Spangler, Pennsylvania, to Harry Edward and Elizabeth Klapak Coble. He attended elementary school in Arcadia, Pennsylvania, and graduated from Purchase Line High School in May 1967.

He attended Grove City College (Pennsylvania) as a music major from 1967-1970. He graduated from Westminster College in New Wilmington, Pennsylvania, with a Bachelor of Music in Church Music in May 1971. He attended Louisville (Kentucky) Presbyterian Theological Seminary from 1971-1972 and from 1974-1975. He obtained an Associate of Arts in Nursing degree from Indiana University Southeast, New Albany, Indiana, in May 1974; a Bachelor of Science in Nursing from the Regents College Program, Albany, New York, in January 1982; and a Master of Science in Nursing Administration from the State University of New York at Buffalo in February 1983. He began his studies toward a Doctor of Philosophy degree in the College of Nursing and in the Decision and Information Sciences Department of the College of Business Administration at the University of Florida, Gainesville, Florida, in September 1992.

He married the former Patricia Ann Gibbons of Portville, New York, on July 2, [redacted] He is the father of twin sons (b. 1978), Matthew Thomas and Timothy Andrew, and of a daughter, Amanda Christine (b. 1980 – d. 1999).

His nursing career includes the areas of emergency/trauma, critical care, pediatrics, administration and education, in Kentucky, Pennsylvania, New York, and

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