AD-A245 896

NPS-AS-92-004

NAVAL POSTGRADUATE SCHOOL

Monterey, California

DTIC
ELECTE
FEB 07 1992
S D
D

NEW DIRECTIONS FOR MILITARY DECISION MAKING RESEARCH IN COMBAT AND OPERATIONAL SETTINGS

Nancy C. Roberts

December 1991

Approved for Public Release; Distribution Unlimited

Prepared for: CNO's Executive Panel, Office of CNO
4401 Ford Av., Alexandria, VA. 22302-0268

92

92-03111

NAVAL POSTGRADUATE SCHOOL
Monterey, California

RADM. R. W. West, Jr.
Superintendent

Harrison Shull
Provost

This report was prepared in conjunction with research funded by the Naval Postgraduate School.

Reproduction of all or part of this report is authorized.

This report was prepared by:

Nancy C. Roberts
Department of Administrative Sciences

Reviewed by:

David R. Whipple, Chairman
Department of Administrative Sciences

Released by:

Paul J. Marto, Dean of Research

REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 0704-0188

Public reporting burden for this collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 22202-4302, and to the Office of Management Budget, Paper Reduction Project (0704-0188), Washington, DC 20503.

1. AGENCY USE ONLY *(Leave Blank)*	2. REPORT DATE	3. REPORT TYPE AND DATES COVERED
	December 1991	Technical

4. TITLE AND SUBTITLE
New Directions for Military Decision Making Research in Combat and Operational Settings

5. FUNDING NUMBERS
DFR

6. AUTHOR(S)
NANCY C. ROBERTS

7. PERFORMING ORGANIZATION NAMES(S) AND ADDRESS(ES)
Administrative Sciences Department
Naval Postgraduate School
Monterey, Ca. 93943

8. PERFORMING ORGANIZATION REPORT NUMBER
NPS-AS-92-004

9. SPONSORING /MONITORING AGENCY NAME(S) AND ADDRESS(ES)
CNO Executive Panel
Office of CNO
4401 Ford Ave.
Alexandria, VA 22302-0268

10. SPONSORING/MONITORING AGENCY REPORT NUMBER

11. SUPPLEMENTARY NOTES

12a. DISTRIBUTION / AVAILABILITY STATEMENT
Approved for public release; distribution is unlimited.

12b. DISTRIBUTION CODE

13. ABSTRACT *(Maximum 200 words)*

The major streams of decision making research are summarized and implications are drawn for future decision making research in combat and operational settings.

14. SUBJECT TERMS
Decision making

15. NUMBER OF PAGES
50

16. PRICE CODE

17. SECURITY CLASSIFICATION OF REPORT	18. SECURITY CLASSIFICATION OF THIS PAGE	19. SECURITY CLASSIFICATION OF ABSTRACT	20. LIMITATION OF ABSTRACT
Unclassified	Unclassified	Unclassified	Unlimited

New Directions for Military Decision Making Research In Combat and Operational Settings

Nancy C. Roberts
Associate Professor
Naval Postgraduate School

Accesion For
NTIS CRA&I ☑
DTIC TAB ☐
Unannounced ☐
Justification
By
Distribution /
Availability Codes
Dist | Avail and / or Special
A-1

PLEASE ADDRESS ALL CORRESPONDENCE TO:

Professor Nancy Roberts
Department of Administrative Sciences
AS/RC
Naval Postgraduate School
Monterey, CA 93943
(408) 626-8057

This report was prepared for the CNO's Executive Panel. Funding was provided by the Naval Postgraduate School.

New Directions for Military Decision Making Research In Combat and Operational Settings

How unique is the decision process in military settings compared to decision making in other situations? Of the knowledge gained from decision making research in other organizations, what can be transferred to military organizations, and what knowledge is specific to the military context? Can military decisions and decision making be improved, and if so, what recommendations, given the current state of research, can be made?

These questions are difficult to answer for a number of reasons. The literature on decision making is extensive. It spans well over a fifty-year time period and draws on voluminous research in economics, operations research, psychology, sociology, social psychology, political science, computer science, and management. Examining this massive accumulation of information is a daunting task, not to mention what would be required to integrate the results into coherent statements. Disciplined-based research efforts have produced results that are difficult to reconcile given competing assumptions, paradigms, methods and interpretations. Although the ultimate goal of most decision making research has been to improve decision making practice, transfer of the "lessons learned" has been limited by discipline boundaries, research methods, and lack of generalizability to all settings and situations. Appropriately, advice to the practitioner has been constrained.

Yet the questions of how to improve decision making practice persist. They are especially pertinent to military organizations

whose decisions can affect the lives of thousands of people. Despite the difficulties involved, officers still want and need to know how to improve their decision making processes and make better decisions.

With these needs in mind, a review of the decision making literature was undertaken to determine the general state of the field. Although a complete analysis of fifty years of research spawned from multiple disciplines was not possible given a limited amount of time, an overview of the major streams of decision making research was. The objective of this initial effort was to establish a base of general knowledge: Where had decision making research been? Where was it going? And most importantly, what relevance does it have to military decision making? Depending on the answers to these questions, recommendations then could be made on how to inform military decision making research in the future.

The structure of this paper, therefore, follows from these basic questions. The first section summarizes the major streams of decision making research regardless of the discipline base. Future trends in decision making research are anticipated in section two, especially in terms of their relevance for operations and combat. And finally, recommendations for future military decision making research are summarized in section three.

The Roots of Decision Making Research

There are three general streams of decision making research. The first stream, titled the **Rational Decision Making Approach**, is both generic and prescriptive. It is generic because decision making research in this mode is a search for general explanations of making decisions. The decision making theories that evolve are expected to be applicable to all organizations. Unique organizational processes and special individual attributes are not felt to be adequate to explain decision making behavior.

Since decision making theory is considered to be generic, researchers from this perspective can then prescribe the one best way of making decisions. The earliest of these prescriptions was based on economic rationality or the optimization of individual choice. This normative or prescriptive approach usually was advocated by economists to explain individual decision making, while the organizational analog was developed by management scientists, engineers, statisticians, and operations researchers (Tallman & Gray, 1990).

The rational decision making approach has several built in assumptions, some explicit, some implicit (March, 1981:205-244).[1] First, it is assumed decisions are uniquely determined by environmental constraints. Knowledge of individual and group decision processes within an organization is not expected to affect decision outcomes. Information about the constraints, such as competitive pressures, social class, and demography are alone adequate to predict action.

Secondly, decision making is willful. It results from intentional actions in the pursuit of individual or collective

purpose. It also presumes a knowledge of a set of alternatives for action, which are defined by the situation and known unambiguously; it presumes a knowledge of consequences of alternative actions, at least to a probability distribution; it presumes a consistent preference ordering that specifies an objective function by which alternative results of action can be associated with their subjective value; and it presumes a decision rule by which decision makers select an alternative on the basis on its consequences for the highest expected value.

Thirdly, the rational model of decision making presumes that the primary results of a decision process are decisions, and the results of these decisions are important to individuals, groups and organizations. In fact, the centrality of a decision for the observer assures centrality of the decision for the participants of the decision process. Furthermore, decisions can be understood by an analysis of the rational decision steps outlined above.

The second stream of decision making research, commonly espoused by psychologists, political scientists, and sociologists, challenges the assumptions of rational decision making. Characterized as **Descriptive or Behavioral Decision Making**, its objective is to call into question rational decision theory by pointing out its poor fit with actual individual and organizational behavior. However, the logic of this approach is not to abandon rational action. The point is to improve choice through a better understanding about how decisions actually are made. By improving assumptions about preferences, knowledge, and decision

rules, the expectation is that the decision maker could make better decisions, even if they were not optimal ones.

Behavioral or descriptive decision making begins by challenging the assumption of process irrelevance. It is argued that environmental constraints do not completely determine organizational action. Microbehavioral phenomena of choice are also important in determining behavior. Furthermore, the environmental constraints do not impose unique solutions on the organization. "Sloppy organizations adopt to somewhat sloppy environments in ways that make general sense, without reaching a unique solution" (March, 1981:209). Organizations act on the basis of incomplete information; their search rules emphasize feasibility more than optimality; decisions depend on the order in which alternatives are presented; decisions depend on the changing aspiration levels of the organization; and decisions depend on the way organizational slack operates to dampen major swings in environmental stringency. In addition, organizations can affect their environments, even create them. Environmental constraints are in part dependent on past organizational decision processes.

Secondly, decision processes are found to follow other kinds of logics besides the logic of intentionality and rationality. Four logics are identified in the literature: **the logic of bounded rationality; the logic of conflict and strategic action; the logic of rules and obligatory action; and the logic of ambiguity.**

The **logic of bounded rationality** is a theory of limited rationality. Rationality is constrained because there are limits on the number of alternatives known and considered, and there

are limits on the amount and accuracy of the information utilized in the decision process. This formulation of decision making is often characterized as problem solving. A failure to achieve a goal (problem) stimulates a search for a solution that continues until an alternative that is good enough to satisfy the existing goal (problem) is found. The search process concentrates in area of old alternatives, and through trial and error, selects a solution that makes marginal improvements to the present situation. Whether described as "muddling through" by Lindblom (1959;1979), as incrementalism by Mintzberg et. al. (1976), as feedback-react" procedures by Cyert and March (1963), or as cybernetic processes Steinbruner (1974), the concern is how attention, a scarce organizational resource, is allocated in the search process for solutions.

The **logic of conflict and strategic action** challenges rational decision making in describing organizations as conflict systems (March and Simon, 1958; Cyert and March, 1963, Pfeffer, 1981). Rather than having simple, consistent preference functions, organizational participants have different preferences, and different levels of resources to advance and defend those preferences. It is further assumed that each participant will use those resources to pursue his or her personal gain. To enhance one's of "winning," individuals mobilize and form coalitions which are maintained with exchange agreements, side payments and logrolling. Sequential attention to goals substitutes for collective agreement in order to keep the coalition together. Disputes between organizational coalitions are resolved by

"force." That is to say, those with the greater amount of power emerge as "winners," those with less, the "losers." Thus organizational decisions can be characterized as "weighted averages of individual desires, where the weights reflect the power distribution among individuals" (March, 1981:p. 216). Ultimately, power drives the decision logic of organizations, especially when resource scarcity is factored into the decision context, and limited resources must be allocated to multiple organizational coalitions.

The logic of **rules and obligatory action** takes issue with the logic of intentionality by arguing that most of the behavior in organizations is specified through standard operating procedures. These procedures are not necessarily written, but they are "standardized, known, and understood with sufficient clarity to allow discourse about them and action based on them" (March, 1981:222). Instead of searching for the optimal alternative, the search process in this case involves a probe into nature of the situation followed by a choice of behavior that fits the situation. The task becomes one of assessing the situation or position and then "deciding" how to behave appropriately. Rules guide this decision process so understanding how rules are learned, applied, broken, and change are central to this logic. "The intelligence of the process arises from the way rules store information gained through learning, selection, and contagion, and from the reliability with which rules are followed" (March, 1981:226).

The **logic of ambiguity** in contrast to the logic of rationality does not assume that people and organizations have prefer-

ences, nor does it assume that preferences are knowable and known, consistent, precise, or stable, Preferences are considered to be ambiguous; instead of driving action they are deduced from action. They are often expressed but not followed. They are inconsistent, imprecise and they change (Cohen, March and Olsen, 1972; Cohen and March, 1974; March and Olsen, 1976). Furthermore, this ambiguity over preferences is considered to be a form of organizational intelligence. It is argued that "ambiguity allows preferences to develop through action, that ambiguity reflects an intelligent modesty about the adequacy of guesses about future wants, that ambiguity is part of a sensible effort to manage the tendency for preferences to become inappropriate, and that ambiguity is a way of building protection from the political use of rational argument" (March, 1981:228).

Behavioral and descriptive decision theory also differs from the rational theory of decision making in a third important way in its assumption about outcome primacy or results. Behavioral theory does not assume that the major results of a decision process is a decision, nor that decisions are understood by an analysis of the process. Furthermore, the centrality of a decision for the observer does not ensure its centrality for a participant.

Instead, behavioral theory believes that the decision process captures only part of people's attention since it is embedded in a complex pattern of competing activities. To understand decisions one must understand how decisions fit into the fabric of peoples' lives, most particularly how people allocate scarce

attention among competing demands. Thus, the focus of this approach is on the analysis of decision attributes and the alternative claims of attention on the possible set of decision actors.

Behavioral theory also acknowledges that one of the most important elements of a decision is its symbolic significance. By demonstrating that decisions accomplish appropriate objectives, and are conducted in important ways, decisions confer legitimacy on decision makers and their organizations. They become important symbols and rituals. Thus, "decision making is in part a performance designed to reassure decision makers and others that things are being done appropriately" (March, 1981:232). Even more importantly, intelligent choice is elevated to a core tenet of modern ideology. Decision activities "are part of a set of rituals by which society assures itself that human existence is built around choice, and that human institutions are manifestations of intelligent control of human destiny through rational action" (March, 1981:232).

The third stream of decision making research can be characterized as a **Contingency Approach to Decision Making**. Challenging the rational model's one best way to make decisions, and building on the research from the behavioral and descriptive streams, proponents take the position that decision making varies and **should vary** by the situation or condition that embeds the decision. The objective is to understand the nature of the situation and to apply the decision process that seems most likely to fit under the circumstances.

Various contingency models have been developed (e.g. Thompson and Tuden, 1959; Thompson, 1967; Daft, 1989; Gandori, 1984;

Hrebiniak and Joyce, 1985). The following contingency model, adapted from the earlier work of Thompson (1967) and further developed by Daft (1989), serves as an example.

Two characteristics of organizations are believed to influence the decision situation: goal consensus or the degree of agreement among managers about which organizational goals to pursue; and technical knowledge, the degree of understanding and agreement about how to reach organizational goals. Exhibit 1 illustrates their relationship and the decision processes that result.

Insert Exhibit 1 About Here

In Cell 1, goals are agreed upon and cause-effect relationships are well understood. As a consequence, there is low uncertainty in the decision process and the rational approach to decision making can be used.

In Cell 2, there is low goal consensus and a high level of consensus about technical knowledge. This combination, according to Daft, produces high uncertainty in identifying problems, but low uncertainty in the identification of problem solutions. Under these conditions, managers tend to use the political or conflict model of decision making. Goals are determined through bargaining, debate, and coalition building. But once consensus on goals is achieved, the organization and its decision makers have will have the technology to implement them with a high level of certainty.

In Cell 3, decision makers face a high level of consensus on

goals, but alternative technical solutions are highly uncertain and techniques to make decisions are ill defined and poorly understood. Under these situations, the manager tends to rely on past judgment and experience to make a decision while the organization tends to rely on trial and error. Decisions are made incrementally as problems arise, a solution is identified, and through a sequential step-by-step process, the organization learns what solutions work and which do not. Eventually, over a period of time, the organization and its managers acquire sufficient experience to solve problems, eventually encoding their solutions into rules, standard operating procedures, and heuristics to guide action.

Cell 4 decision making is characterized by low consensus on goals and low consensus on technical knowledge. This condition produces a high degree of uncertainty for managers and organizations. Under high uncertainty, individual managers resort to building coalitions to establish goals and set priorities, while using judgment and/or trial and error to address and solve problems. They also resort to <u>inspiration</u> -- innovative and creative solutions not developed through rational means, and imitation -- adoption of decisions tried elsewhere in the hope that they will work in the new situation. When the "logic of ambiguity" pervades the entire organization, the "garbage can model of decision making" eventually evolves: decisions are made randomly as choice opportunities converge with decision makers, solutions, and problems in no particular order or sequence. Eventually, through trial and error, the organization makes decisions and

solves some problems, but without any degree of predictability or rationality.

The contingency approach to decision making research has led researchers on a quest for the situational and contextual variables that are expected to influence the choice of decision making strategies. For example, Fredrickson and Mitchell (1984) argue that organizational decisions are contingent upon the environment in which the decision is made, while Payne, Bettman, and Johnson, (1988) maintain that decisions are contingent upon the task and the context.

Researchers are expected to continue to probe these and other contingencies in the future.

Implications of Trends for Military Decision Making Research

Decision making research in the future will continue to move toward more refined contingency models of individual and organizational choice. We can expect these contingency models to build on the framework outlined above, as well as those that elaborate on other environmental and task contingencies.

Parallel to this general movement, we also can anticipate military decision making research to begin to develop its own contingency model of individual and organizational choice. Key to this development will be the identification of unique military contexts and the particular contingencies for those contexts.

For example, there are two general military contexts: the warfare or operational context and the peacetime context. Decision making in peacetime military organizations is expected to be similar to decision making in other organizational settings, especially public sector organizations (Rainey, 1989; 1991; Wilson, 1989). Public sector decision making research has been underway for a number of years and has produced various models and theories some of which have been briefly sketched in section one above. (See also Allison, 1971; Bozeman, 1987; Nigro, 1984).

On the other hand, warfare and high threat conditions present unique situations and contingencies for the military decision maker. Under warfare or threats of war, conditions are dynamic such that the situation can change and goals can shift from moment to moment. There are physical threats to well being at the same time individuals are expected to assume personal

responsibility for decision outcomes. Crisis conditions also force time compression on decision makers who are called on to make life or death choices in a matter of minutes or seconds (Klein, 1989). Decision makers on the Vincennes, for example, had approximately three minutes to assess the status of an incoming aircraft before they were required to take action. Combat decisions also require the participation of many people with competing values and viewpoints. They involve the processing of enormous amounts of information, much of which is ambiguous, difficult to interpret, (especially under conditions of stress), demanding heavy time commitment, resources, and coordination from those involved. And as we are well aware, the consequences of decisions in such situations can be far reaching; the price of "military misfortunes" and military decision making is great (Cohen and Gooch, 1990). Thus, operational contexts have properties such as uncertainty, complexity, time compression, and chance to factor into the decision calculus. "No other human activity," according to Carl von Clausewitz, "is so continuously or universally bound up with chance" (1976:85).

Unfortunately, research on military decision making under operational or warfare conditions has been relatively recent.[2] Consequently, some of the contingencies and their impact on decision making are not known nor well understood. For example, time pressure or time compression is thought to be an important contingency for military decision making under operational conditions, but time has rarely been treated in a systematic way by decision researchers (Tallman & Gray, 1990). The little research that has been conducted in other organizational contexts reveals

in general that time pressures force decision makers to simplify their decision tasks and to make more cautious decisions (Abelson & Leve 1985:282; Wright, 1974). Evidence also suggests that under time pressure, there is a tendency to overweigh negative information (Wright, 1974). Janis and Mann (1977:59-64) also found that under severe time pressures or other high stress conditions decision makers become "hypervigilent," or transfixed and do not use the limited time available for optimal processing of alternatives. These findings have led some researchers (Hammond et.al, 1984: Howell, 1984) to posit that time pressure would lead to decision strategies that were more intuitive and holistic in nature.

The level of affect or emotion may be another important contingency that impacts military decision making in operational contexts. While emotions in individuals and groups have been shown to affect decision making processes and outcomes, and differences in negative and positive feeling states and arousal levels have been shown to produce different levels of comprehensiveness in decision making (Elsbach, 1991), there has very little effort to incorporate this contingency in military decision making research.

Another contingency in operational military decision making may be the level of expertise of the decision maker. Experts and novices have been shown to use different decision strategies (Shanteau, 1988). Relative novices tended to rely on analytical decision strategies while more expert decision makers rely on what Klein refers to as "recognition-primed" decision making

strategies (Klein, 1989). Recognition-primed decisions are nonoptimizing and noncompensatory approaches to decision making that involve conscious deliberation to image the action that one wants to accomplish rather than evaluating alternative options that might be available. Given the level of training and education of military personnel, level of expertise is expected to be an important contingency in military decision making.

The search for these and other contingencies will be important steps in military decision making research for the future. Once the major contingencies have been identified, it will be incumbent on researchers to integrate them into a theory of operational military decision making to guide military practice.

Recommendations for the Future

The first recommendation for military decision making research is to be clear about the domain of study. Is the domain of interest really decision making or some other closely related area such as problem solving (MacCrimmon & Taylor, 1976; Smith, 1988; Tallman & Gray, 1990)? The question is an important one for it points out different approaches that can drive the research process. Decision making tends to put emphasis on selection from a provided set of alternatives, while problem solving puts the emphasis on the construction of new alternatives. (Stevenson, et.al.:285). Which is of interest?

That would depend, of course, on what one wants to know. In the case of the Iranian commercial airliner that was shot down by the U.S. Vincennes, killing all aboard, do we want to know how and why Captain Will Rogers made that decision among the alternatives available to him? Or do we want to know why and how the Iranian airliner came to be identified as plane launching an attach on the Vincennes, and what alternatives were generated and considered to solve that problem? How we answer these questions can set us on very different lines of research, courses of action, and ultimately provide answers to very different questions of interest.

From a decision making paradigm, the focus would be on individual or group choice, trying to understand people's motivation, stress, communication and coordination and so forth which prompted their selection of one particular alternative among a pre-established set of alternatives. From a problem solving perspective, the focus would be on how the problem got framed the

way it did, what factors -- human, technological, organizational, or environmental contributed to this framing, and what alternatives were generated and selected to deal with it. While both perspectives may be of interest, the problem solving approach is expected to be the more fruitful one if the objective is to understand how to prevent errors of this type in the future.

A second recommendation pertains to the multidisciplinary character of organizational decision making. Every effort must be made to incorporate the various disciplinary perspectives into future military decision making research. For too long, psychologists, sociologists, economists, operations researchers, political scientists, and others have conducted their decision research unaware of work in other areas. Yet the field of decision making is inherently interdisciplinary: it involves the study of an individual's emotional and cognitive processes, group dynamics and interaction, organizational structure and systems, and larger contextual, environmental, and market forces. While ideally each researcher should be informed of the research pertaining to all these disciplines, given the complexity and breadth of the decision making literature, such an expectation is not realistic. One can recommend, however, the formation of decision making research teams with members representing very different paradigms and disciplinary approaches. Their collective efforts in designing research, conducting the studies, and interpreting results could go a long way in providing a more integrated understanding of military decision making.

A third recommendation for future military decision making

research concerns research strategies. According to Mohr (1982), research can be classified in terms of two types -- variance or process. Most investigations of decision making research have employed the variance strategy. The variance approach views the decision as the final outcome or the dependent variable. The goal is then to explain its variance in terms of an array of independent variables. With the variance approach, the independent variables become the necessary and sufficient conditions to explain the variance of the dependent variable. Time is not of concern for the ordering of the variables, other than to assume that the dependent variable is a "final cause" of the independent variables.

The process strategy, on the other hand, investigates a phenomenon in terms of a succession of events. In this light, decision making is equifinal, with multiple interactions among the antecedent variables. Since there is an infinite number of possible interactions among antecedent variables, the best a researcher can do is to document a set of actions for a particular decision in a particular context. Thus, Mohr recommends a process approach for decision making research and avoidance of the variance approach which, he claims, is responsible for contradictory and inconclusive results in the literature.

Adopting Mohr's recommendation for military decision making research, leads to a fourth recommendation. What is implied in the process approach to decision making research is the application of different research methodologies and study designs. Use of clinical case studies (March and Olsen, 1976), simulations (Cohen, March and Olsen, 1972), and historical and anthropologi-

cal techniques (Pettigrew, 1973) are more appropriate for decision making research than other methods that rely on variance techniques. Methods of decision making research, in other words, should fit the research strategy employed.

As part of this endeavor, one should anticipate more field-based empirical research. If transfer and application of decision making research from other organizational situations to combat settings is suspect, and the position taken in this paper is that it is, then the logical step is to launch a separate stream of research devoted to the study of military decision making in operational settings. The ultimate goal would be to understand the context and its constraints in such a way as to build field-based theories specific to decision making in operational and combat settings. The methodology would also avoid some of the traditional problems associated with laboratory studies such as the use of novices or students instead of experienced decision makers, and the use of scenarios which lack comparability to threat and combat conditions.

In line with more field-based empirical research, new techniques such as cognitive mapping (both individual and collective maps) and relational and network analysis could be employed. For instance, the use of cognitive maps would enable the researcher to investigate whether decision makers shared the same metal models and decision rules during combat when forced into CIC decision choices. Relational analysis would be useful in investigating the dynamics of the decision process, and how decision teams coordinate their actions.

A final recommendation for military decision making research involves the use of performance indicators. Without some measure of performance to assess decisions, researchers are forever caught in what has been described as "Hume's guillotine" (Pennings, 1986:231). Factual descriptive statements follow other factual statements. Consequently, one can never proceed from statement of fact to normative or prescriptive statements about what ought to be. Unless there is some way to judge performance, one cannot "deduce ought from is." Thus, the search for performance indicators to gauge effective decision making should be paramount in the next generation of decision making research. By linking the decision making process to indicators of performance, researchers could demonstrate what processes are preferred over others because they minimize error, cognitive bias, or other destructive consequences.

NOTES

1. For the first two streams of decision making research, this section relies heavily on the outline of the field as presented by Jim March (1981).

2. Recent research on operational decision making has been conducted at the Naval Oceans Systems Center in San Diego, California, and at the Naval Training Systems Center in Orlando, Florida. The sponsored research has been devoted to the problem of tactical decision making under stress (TADMUS) and battle group decision making. Initial research findings can be reviewed in the studies of Alphatech, Athans et. al., Salas and his colleagues at the Orlando Center. The research of Feher, Callan and Feher, Gwynne and Feher, and Rudolph and Feher summarizes the initial results at the San Diego Center.

Exhibit 1

Goal Consensus

	High	Low
High	Cell 1 Rational Approach	Cell 2 Bargaining, Coalition Formation
Low	Cell 3 Judgment, Trial and Error; Incrementalism	Cell 4 Bargaining, Judgment, Inspiration, Imitation, Coalition Building Evolving to Garbage Can Model

REFERENCES

Abelson, R.P. & Levi, A. "Decision Making and Decision Theory." In Handbook of Social Psychology. G. Lindzey & E. Aronson (eds.). New York: Random House, 1985.

Ackoff, R.L. "The Future of Operational Research is Past." Journal of the Operational Research Society, 1979, 30:93-104.

Adler, M.J. Intellect: Mind Over Matter. New York: Macmillan, 1990.

Agre, G.P. "The Concept of Problem." Education Studies. 1982, 13:121-141.

Allison, G.T. Essence of Decision: Explaining the Cuban Missile Crisis. Boston: Little, Brown, and Co., 1971.

AlphaTech, Inc. Distributed Tactical Decision Making. Summary Report. Burlington, MA: AlphaTech, 1989.

AlphaTech. "Team Adaptation to Stress in Decision Making and Coordination with Implications for Naval Team Training: Technical Proposal. May 1991.

Anderson, P.A. "Decision Making by Objection and the Cuban Missile Crisis." Administrative Science Quarterly, 1983, 28:201-222.

Argyris, C. Reasoning, Learning, and Action. San Francisco: Jossey-Bass, 1983.

Argyris, C. and Schon, D.A. Organizational Learning: A Theory of Action Perspective. Reading, MA: Addison-Wesley, 1978.

Ashby, W.R. An Introduction to Cybernetics. London: Meuthuen, 1964.

Astley, W.B. and others. "Complexity and Cleavage: Dual Explanations of Strategic Decision-Making." Journal of Management Studies, 1982, 19(4):357-375.

Athans, M., Shaw, J.J. & Entin, E.E. "Leadership and Military Organizations Under Stress." Burlington, MA: Alphatech, January 1990.

Axelrod, R.M. The Evolution of Cooperation. New York: Basic, 1984.

Axelrod, R.M. The Structure of Decision: The Cognitive Maps of Political Elites. Princeton, N.J.: Princeton University Press, 1976.

Bandura, A. Social Foundations of Thought and Action: A Social Cognitive Theory. Englewood Cliffs, NJ: Prentice Hall, 1986.

Barnes, J.H.Jr. "Cognitive Biases and their Impact on Strategic Planning." Strategic Management Journal, 1984, 5:129-137.

Bartee, E.M. "A Holistic View of Problem Solving." Management Science, 1973, 20:439-448.

Bateman, R. & Zeithaml, C. "The Psychological Context of Strategic Decisions." Strategic Management Journal, 1989, 10:59-74.

Bazerman, M.H. Judgment in Managerial Decision Making. New York: John Wiley, 1986.

Beach, L.R. & Mitchell, T.R. "A Contingency Model of the Selection of Decision Strategies." Academy of Management Review, 1978, 3:439-449.

Bell, D.E., Raiffa, H., and Tversky, A. (Eds.) Decision Making: Descriptive, Normative, and Prescriptive Interactions. Cambridge: Cambridge University Press, 1988.

Beer, S. Diagnosing the System for Organizations. New York: John Wiley, 1985.

Beer, S. The Heart of the Enterprise. New York: John Wiley, 1979.

Beer, S. Decision and Control. New York: Wiley, 1966.

Berger, P.L. & Luckman, T. The Social Construction of Reality. Garden City, NY: Anchor, 1967.

Berkeley, D. & Humphreys, P.C. "Structuring Decision Problems and the `Bias Heuristic'." Acta Psychologia, 1982, 50:201-252.

Beyer, J.M. "Ideologies, Values and Decision Making in Organizations." In P.C. Nystrom and W.H. Starbuck (eds.). Handbook of Organizational Design, 2. Oxford: Orford University Press, 1981:166-202.

Bougon, M., Weick, K., & Binkhorst, D. "Cognitions in Organizations: An Analysis of the Utrecht Jazz Orchestra." Administrative Science Quarterly, 1977, 22:606-639.

Bourgeois, L.J. & Eisenhardt, K.M. "Strategic Decision Processes in High Velocity Environments: Four Cases in the Microcomputer Industry." Management Science, 1988, 34:816-835.

Bourgeois, L.J. "Strategy and Environment: A Conceptual Integration." Academy of Management Review, 1980, 5:25-39.

Bourne, L.E., Ekstrand, B.R., & Dominowski, R.L. The Psychology of Thinking. Englewood Cliffs, NJ: Prentice Hall, 1971.

Bower, G.J., & Cohen, P.R. "Emotional Influences in Memory and Thinking: Data and Theory." In M. Clark & S. Fiske (eds.) Affect and Cognition. Hillsdale, N.J.: Lawrence Erlbaum, 1982

Boyd, J.R. A Discourse on Winning and Losing. Unpublished manuscript, 1987.

Braybrooke, D., and Lindblom, C.E. A Strategy of Decision. New York: Free Press, 1963.

Brehmer, B. "Social Judgment Theory and the Analysis of Interpersonal Conflict." Psychological Bulletin, 1976, 83:985-1003.

Broadbent, D.E. Decision and Stress. London: Academic Press, 1971.

Builder, C. The Masks of War: American Military Styles in Strategy and Analysis. Baltimore: Johns Hopkins University Press, 1989.

Brunswik, E. Conceptual Framework of Psychology. Chicago: University of Chicago Press, 1952.

Campbell, D.T. "Reforms as Experiments." American Psychologist, 1969, 24:409-429.

Carnevale, P.J., & Isen, A.M. "The Influence of Positive and Negative Affect on the Discovery of Integrative Solutions in Bilateral Negotiation." Organizational Behavior and Human Decision Processes," 1986, 37:1-13.

Callan, J.R. & Feher, B. "Patterns of Information Use and Performance in Outer-Air Battle Decision Making." Unpublished paper, Naval Ocean Systems Center, San Diego, California.

Carley, K. "Coordination for Effective Performance During Crisis When Training Matters." Unpublished paper, Department of Social and Decision Sciences, Carnegie Mellon University, 1991.

Carver, C.S., & Sheier, M.F. "Origins and Functions of Positive and Negative Affect: A Control Process View." Psychological Review, 1990, 97:19-35.

Chaffee, E.E. "Three Models of Strategy." Academy of Management Review. 1985 (10):89-98.

Chi, M.T.H., Glaser, R., & Rees, E. "Expertise in Problem Solving. In R.J. Sternberg (Ed.), Handbook of Intelligence. Vol. 2. Hillsdale, N.J: Erlbaum, 1982.

Child, J. "Organization Structure, Environment and Performance: The Role of Strategic Choice." Sociology, 1972, 6:1-22.

Cohen, E.A. & Gooch, J. Military Misfortunes: The Anatomy of Failure in War. New York: Free Press, 1990.

Cohen, M.D., March, J.G., and Olsen, J.P. "A Garbage Can Model of Organizational Choice." Administrative Science Quarterly, 1972, 17:1-25.

Cohen, M.D. and March, J.G. Leadership and Ambiguity: The American College President. New York: McGraw-Hill, 1974.

Colman, A. Game Theory and Experimental Games. Oxford: Pergamon Press, 1982.

Connolly, T. "Information Processing and Decision Making in Organizations." In B.M. Staw and G.R. Salancik, (eds.). New Directions in Organization Behavior. Chicago: St. Clair, 1977:

Cowan, D.A. "Developing a Classification Structure of Organizational Problems: An Empirical Investigation." Academy of Management Journal, 1990, 33:366-390.

Cowen, E.L. "The Influence of Varying Degrees of Psychological Stress on Problem Solving Rigidity." Journal of Abnormal Social Psychology, 1952a, 47:512-519.

Cowen, E.L. "Stress Reduction and Problem Solving Rigidity." Journal of Consulting Psychology, 1952b, 16:425-428.

Cragan, J., & Wright, D. "Small Group Research of the 1970's: A Synthesis and Critique." Central States Speech Journal, 1980, 31:197-213.

Cray, D., Mallory, G., Butler, R., Hickson, D., and Wilson, D. "Sporadic, Fluid, and Constricted Processes: Three Types of Strategic Decision Making in Organizations." Journal of Management Studies, 1988, 23:13-39.

Crowston, K. "A Typology of Organizational Coordination Methods." Unpublished paper, Sloan School of Management, Massachussetts Institute of Technology.

Cyert, R.M. and March, J. A Behavioral Theory of the Firm. Englewood Cliffs, N.J.: Prentice Hall, 1963,

Daft, R.L. Organization Theory. St. Paul: West, 1989.

Daft, R.L., & Weick, K.E. "Toward a Model of Organizations as Interpretation Systems." Academy of Management Review, 1984, 9:284-295.

Davis, M.D. Game Theory. New York: Basic Books, 1970.

Dess, G.G. & Beard, D.W. "Dimensions of Organizational Task Environments." Administrative Science Quarterly, 1984, 29:52-73.

Dewey, J. How We Think. New York: D.C. Heath, 1910.

Douglas, M. How Institutions Think. Syracuse: Syracuse University Press, 1986.

Driskell, J.E., & Salas, E. "Group Decision Making Under Stress." Journal of Applied Psychology, 1991, 76:473-478.

Duncker, K. "On Problem Solving." Psychological Monographs, 1945, 58, Whole #270.

Dunnegan, K.J. "Automatic versus Deliberate" Funding Decisions: An Integration of Image Theory and Framing." Paper presented to Academy of Management, August 1991, Miami.

Dutton, J.E. & Jackson, S. "Categorizing Strategic Issues: Links to Organizational Action." Academy of Management Review, 1987, 12:76-90.

Easterbrook, J.A. "The effect of Emotion on Cue Utilization and the Organization of Behaviour." Psychological Review, 1959, 66:183-201.

Eden, C. "Perish the Thought." Journal of Operations Research Society, 36(9):809-819, 1985.

Eden, C. "Problem Construction and the Influence of O.R." Interfaces, 12(2):50-60, 1982.

Eden, C. and Sims, D. "Subjectivity in Problem Identification." Interfaces, 1191):68-75, 1981.

Eilon, S. "Structuring Unstructured Decisions." Omega, 1985, 13:369-377.

Einhorn, H.J. & Horgarth, R.M. "Behavioral Decision Theory: Processes of Judgment and Choice." Annual Review of Psychology, 1981, 32:53-88.

Einhorn, H.J. & Horgarth, R.M. "Decision Making: Going Forward in Reverse." Harvard Business Review, January-February, 1987:66-87.

Eisenberg, D.J. "How Senior Managers Think." Harvard Business Review, 1984, 62:80-90.

Eisenhardt, K.M. "Making Fast Strategic Decisions in High-Velocity Environments." Academy of Management Journal, 1989, 32:543-576.

Elsbach, K.D. "The Influence of Emotion on Comprehensiveness in Decision Making." Paper presented to the Academy of Management, Miami, August 1-14.

Elster, J. Nuts and Bolts for the Social Sciences. Cambridge: Cambridge University Press, 1989.

Elster, J. Solomonic Judgements: Studies in the Limitations of Rationality. Cambridge: Cambridge University Press, 1989.

Elster, J. Sour Grapes: Studies in the Subversion of Rationality. New York: Cambridge University Press, 1983.

Elster, J. The Cement of Society: A Study of Social Order. Cambridge: Cambridge University Press, 1989.

Elster, J. Ulysses and the Sirens. New York: Cambridge University Press, 1979.

Etzioni, A. The Moral Dimension: Toward a New Economics. New York: Free Press, 1988.

Evans, J.St.B.T. Bias in Human Reasoning: Causes and Consequences. Hillsdale, NJ: Erlbaum, 1989.

Eysenck, M.W. "Arousal and Speed of Recall." British Journal of Social and Clinical Psychology, 1975, 14:269-277.

Eysenck, M.W. Attention and Arousal. New York: Springer-Verlag, 1982.

Fahey, L. "On Strategic Management Decision Processes." Strategic Management Journal, 1981, 2:43-60.

Feher, B. "A Longitudinal Multi-Method Approach to Command Decision Making." Unpublished paper, Naval Ocean Systems Center, San Diego, California.

Fredrickson, J.W. "Effects of Decision Motive and Organizational Performance Level on Strategic Decision Processes." Academy of Mangement Journal, 1985, 28:821-843.

Fredrickson, J.W. "Strategic Process Research: Questions and Recommendations." Academy of Management Review, 1983, 8, 565-575.

Fredrickson, J.W. "The comprehensiveness of Strategic Decision Processes: Extension, Observations, Future Directions." Academy of Management Journal, 1984, 27:445-466.

Fredrickson, J.W. "The strategic Decision Process and Organizational Structure." Academy of Management Review, 1986, 11:280-297.

Fredrickson, J.W., & Mitchell, T.R. "Strategic Decision Processes: Comprehensiveness and Performance in an Industry with an Unstable Environment." Academy of Management Journal, 1984, 27:399-423.

Gandori, A. "A Prescriptive Contingency View of Organizational Decision Making." Administrative Science Quarterly, 1984, 29:192-209.

George, A.L. Presidential Decisionmaking in Foreign Policy: The Effective Use of Information and Advice. Boulder: Westview Press, 1980.

Gersick, C.J.G. "Time and Transition in Work Teams: Toward a New Model of Group Development." Academy of Management Journal, 1988, 31:9-41.

Gersick, C.J.G. "Time, Emotion, and Momentum In Performance: What Organizational Theorists Can Learn from Athletic teams. From a Symposium Proposal: The Influence of Emotion on Organizational and Individual Performance. 1990, National Academy of Management Meeting.

Ginsberg, A. & Venkatraman, N. "Contingency Perspectives of Organizational Strategy: A Critical Review of the Empirical Research." Academy of Management Review, 1985, 10:421-434.

Gist, M.E., Locke, E.A., & Taylor, M.S. "Organizational Behavior: Group Structure, Process, and Effectiveness." Journal of Mangement, 1987, 13:237-257.

Gladstein, D.L., & Reilly, N.P. "Group Decision Making Under Threat: The Tycoon Game." Academy of Management Journal, 1985, 28:613-627.

Gortner, H.F., Mahler, J. Nicholson, J.B. Organization Theory: A Public Perspective. Chicago: Dorsey Press, 1987.

Gouran, D.S. "The Paradigm of Unfulfilled Promise: A Critical Examination of the History of Research on Small Groups in Speech Communication." In T.W. Benson (ed.), Speech Communication in the Twentieth Century. Carbondale: Southern Illinois University Press, 1984.

Guzzo, R.A., & Walters, J.A. "The Expression of Affect and the Performance of Decision-Making Groups." Journal of Applied Psychology, 1982, 67:67-74.

Gwynne, J.W. & Feher, B. "Using Cognitive Networks to Assess Tactical Decision Making." Unpublished paper, Naval Ocean Systems Center, San Diego, California.

Hackman, F.R., & Morris, C.G. "Group Tasks, Group Interaction Process, and Group Performance Effectiveness: A Review and Proposed Integration. In L. Berkowitz (ed.), Advances in Experimental Social Psychology. Vol. 8. New York: Academic Press, 1975:45-99.

Hambrick, D.C. (Ed.) The Executive Effect: Concepts and Methods for Studying Top Managers. Greenwich, Conn: JAI Press, 1988.

Hambrick, D. & Mason, P. "Upper Echelons: The Organization as a Reflection of its Top Managers." Academy of Management Review, 1984, 9:193-206.

Hammond, K. Case-Based Planning: Viewing Planning as a Memory Task. Proceedings: Case-Based Reasoning Workshop. San Mateo, CA: Morgan Kaufmann, 1988.

Hammond, K.R., McClelland, G.H., & Mumpower, J. Human Judgment and Decision Making: Theories, Methods, and Procedures. New York: Praeger, 1980.

Hampden-Turner, C. Charting the Corporate Mind: Graphic Solutions to Business Conflicts. New York: Free Press, 1990.

Hampden-Turner, C. Maps of the Mind. New York: Collier Books, 1982.

Hayes-Roth, F., Waterman, D. & Lenat, D. (Eds.) Building Expert Systems. Reading, MA: Addison-Wesley, 1983.

Heller, F., Drenth, P., Koopman, P. and Rus, V. Decisions in Organizations: A Three-Country Comparative Study. London: Sage, 1988.

Hickson, D.J. "Decision Making at the Top of Organizations." Annual Review of Sociology, 1987, 13:165-192.

Hickson, D.J., Butler, R.J., Cray, D. Mallory, G.R., and Wilson, D.C. Top Decisions: Strategic Decision Making in Organizations. San Francisco: Jossey-Bass, 1986.

Hirokawa, R.Y., & Poole, M.S. Communication and Group Decision Making. Beverly Hills: Sage, 1986.

Hoffman, J.J., Carter, N.M., and Cullen, J.B. "The Role of Technology in Facilitating Performance-Enhancing Structures in Organizations." ND. Unpublished paper, College of Business Administration, Florida State University.

Hogarth, R.M. Judgement and Choice: The Psychology of Decision. New York: Wiley, 1980.

Hogarth, R.M. "Beyond Discrete Biases: Functional and Dysfunctional Aspects of Judgmental Heuristics." Psychological Bulletin, 1981, 90:197-217.

Holland, J.G., Holyoak, K.J., Nisbett, R.E., & Thagard, P.R. Induction: Processes of Inference, Learning and Discovery. Cambridge, MA: MIT Press, 1986.

Hrebiniak, L.G. "Top-Management Agreement and Organizational Performance." Human Relations, 1982, 35:1130-1158.

Hrebiniak, L.G. and Joyce, W.F. "Organizational Adaptation: Strategic Choice and Environmental Determinism." Administrative Science Quarterly, 1985, 30:336-349.

Huber, G. Managerial Decision Making. Glenview, Ill.: Scott-Foresman, 1980.

Huff, A.S. (Ed.) Mapping Strategic Thought. New York: Wiley, 1990.

Huff, A.S. & Reger, R.K. "A Review of Strategic Process Research." Journal of Management, 1987, 13:211-236.

Hunt, R.G. and Magenau, J.M. "A Task Analysis Strategy for Research on Decision Making in Organizations." In Decision Making in the Public Sector. L.G. Negro (ed.) New York: Marcel Dekker, 1984:117-150.

Isabella, L.A. "Evolving Interpretations as A Change Unfolds: How Managers Construe Key Organizational Events." Academy of Management Journal, 1990, 33:7-41.

Isen, A.M., & Means, B. "The Influence of Positive Affect on Decision Making Strategy." Social Cognition, 1983, 2:18-31.

Isen, A.M., Means, B., Patrick, R., & Nowicki, G. "Some Factors Influencing Decision-Making Strategy and Risk Taking. In M. Clark & S. Fisk (eds.) Affect and Cognition. Hillsdale, N.J.: Lawrence Erlbaum Associates, 1982.

Isen, A.M. & Patrick, R. "The Effect of Positive Feelings On Risk Taking: When the Chips are Down." Organizational Behavior and Human Performance, 1983, 31:194-202.

Isen, A.M. & Shalker, R.E. "Do You `Accentuate the Positive, Eliminate the Negative' When You Are in a Good Mood?" Social Psychology Quarterly, 1982:

Isenberg, D.J. "How Senior Managers Think." Harvard Business Review, 1984, 62:81-90.

Isenberg, D.J. "Some effects of time-Pressure on Vertical Structure and Decision-Making Accuracy in Small Groups." Organizational Behavior and Human Performance, 1981, 27:119-134.

Issack, R.F. "Intuition: An Ignored Dimension of Management." Academy of Review, 1978, 3:917-922.

Jackson, S.E., & Dutton, J.E. "Discerning Threats and Opportunities." Administrative Science Quarterly, 1988, 33:370-387.

Janis, I.L. Groupthink. Boston: Houghton Mifflin, 1982.

Janis, I.L. Crucial Decision. New York: Free Press, 1989.

Janis, I.L. and Mann, L. Decision Making. New York: Free Press, 1977.

Jemison, D.B. "Organizational versus Environmental Sources of Influence in Strategic Decision Making." Strategic Management Journal, 1981, 2:77-89.

Johnson, E.J., & Tversky, A. "Affect, Generalization, and the Perception of Risk." Journal of Personality and Social Psychology, 1983, 45:20-31.

Kahneman, D. Attention and Effort. Englewood Cliff, J.J.: Prentice-Hall, 1973.

Kahneman, D. Slovic, P. Tversky, A. Judgment Under Uncertainty: Heuristics and Biases. New York: Cambridge University Press, 1982.

Kahneman, D. & Tversky, A. "Choices, Values, and Frames." American Psychology, 1984, 39:341-350.

Kahneman, D. & Tversky, A. "Prospect Theory: An Analysis of Decision Under Risk." Econometrica, 1979, 47:263-291.

Kahneman, D. & Tversky, A. "Subjective Probability: A Judgment of Representativeness." Cognitive Psychology, 1972, 3:430-454.

Kaplan, M.F. & Schwartz, S. (Eds.). Hyman Judgement and Decision Processes. New York: Academic Press, 1975.

Kaplan, S. & Kaplan, R. Cognition and Environment: Functioning in an Uncertain World. New York: Praeger, 1982.

Keeney;, R.L. "Decision Analysis: An Overview." Operations Research, 1982, 30:803-838.

Kets, de Vries, M.F.R., & Miller, D. Unstable at the Top. New York: New American Library, 1987.

Kingsley, G.A. and Reed, P.N. "Decision Process Models and Organizational Context: Level and Sector Make a Difference." Public Productivity and Management Review, 1991, 14(4), Summer:397-413.

Klein, G.A. "A Recognition Primed Decision Model of Rapid Decision Making." In G.Klein, R.Calderwood, & J.Orasanu (ed.). Decision Making in Action: Models and Methods. Norwood, N.J: Ablex, in press.

Klein, G.A., & Calderwood, R. "How do People Use Analogues to Make Decisions? In Proceedings of the 4th Annual International Machine Learning Workshop. San Mateo, CA: Morgan Kaufmann, 1988.

Klein, G.A., Orasanu, J. & Calderwood, R. (Eds.). Decision-Making in Action: Models and Methods. Norwood, NJ: ABLEX (in press).

Kleinman, D.L. & Serfaty, D. "Contingent Coordination in Naval Team Decisionmaking: A Review of 1st Year Efforts." Paper presented to 1991 Coordination Meeting, Office of Naval Research University Research Initiative, George Mason University, Fairfax, VA, May 1, 1991.

Kleinman, D.L. and Song, A. "A Research Paradigm for Studying Team Decisionmaking and Coordination." Paper presented at the 1990 Symposium on Command and Control Research, Naval Postgraduate School, June 12-14, 1990.

Kolodner, J.L. "Extending Problem Solving Capabilities Through Case-Based Inference. In Proceedings of the 4th Annual International Machine Learning Workshop, 1987.

Levi, A. & Tetlock, P.E. "A Cognitive Analysis of Japan's 1941 Decision for War." Journal of Conflict Resolution, 1980, 24, 195-211.

Lindblom, C.E. "Comments on Decisions." In Perspectives on Organization Design and Behavior. Andrew Van de Ven and William Joyce (eds.) New York: John Wiley, 1981:245-248.

Lindblom, C.E. "The Science of Muddling Through." Public Administration Review, 1959, 29:79-88.

Luce, R.D. & Raiffa, H. Games and Decisions. New York: Wiley, 1957.

Luttwak, E.N. Strategy: The Logic of War and Peace. Cambridge, Harvard University Press, 1987.

Lyles, M.A. "Defining Strategic Problems: Subjective Criteria of Executives." Organization Studies, 1987, 8:263-280.

Lyles, M.A. and Mitroff, I.I. "Organization Problem Formulation: An Empirical Study." Administrative Science Quarterly, 1980, 25:102-119.

MacCrimmon, K.R., and Taylor, R.M. "Decision-Making and Problem Solving." In MD. Dunette (ed.). Handbook of Industrial and Organizational Psychology. Chicago: Rand McNally, 1976:1397-1453.

Mackinnon, A.J. & Wearing, A.J. "Complexity and Decision Making." Behavioral Science, 1980, 25:285-296.

McEachern, A.W. "Two Simple Versions of Multiattribute Utility Analysis." In Decision Making in the Public Sector. L.G. Negro (ed.) New York: Marcel Dekker, 1984:65-91.

McFarren, M.R. "Using concept Mapping to Define Problems and Identify Key Kernels During the Development of a Decision Support System." Master's Thesis. Air Force Institute of Technology, Air University, 1987.

McGowan, R.P. "Organizational Decision Making and Information Systems: A Case Analysis of State Agencies." In Decision Making in the Public Sector. L.G. Negro (ed.) New York: Marcel Dekker, 1984: 261-288.

McGrath, J. Groups, Interaction, and Performance. Englewood Cliffs, NJ: Prentice-Hall, 1984.

McGuire, B.C. & Radner, R. (Eds.) Decision and Organization. Amsterdam: North-Holland, 1972.

McMillan, C.J. "Qualitative Models of Organizational Decision Making." Journal of Management Studies, 1980, 5:22-39.

Malone, T.W. & Crowston, K. "Toward and Interdisciplinary Theory of Coordination." Technical Report # 120, Center for Coordination Science, Sloan School of Management, Massachussetts Institute of Technology, 1991.

Mandell, M.B. "Strategies for Improving the Usefulness of Analytical Techniques for Public Sector Decision Making." In Decision Making in the Public Sector. L.G. Negro (ed.) New York: Marcel Dekker, 1984:289-310.

Mandler, G. "Organization and Memory." In K.W. Spence & J.T. Spence (Eds.). Psychology of Learning and Motivation. New York: Academic Press, 1967.

March, J.G. "Bounded Rationality, Ambiguity, and the Engineering of Choice." Bell Journal of Economics, 1978, 9(2):587-608.

March, J.G. "Decisions in Organizations and Theories of Choice." In Perspectives on Organization Design and Behavior. Andrew Van de Ven and William Joyce (eds.) New York: John Wiley, 1981:205-244.

March, J.G. and Olsen, J.P. Ambiguity and Choice in Organizations. Bergen, Norway: Universitetsforlaget, 1976.

March, J.G. and Romelaer. "Position and Presence in the Drift of Decisions." In J.G. March and J.P. Olsen (eds.), Ambiguity and Choice in Organizations. Bergen: Universitetsforlaget, 1976:254-58.

March, J.G., & Shapira, Z. "Managerial Perspectives on Risk and Risk Taking." Management Science, 1987, 33:1404-1418.

March, J.G. and Simson, H.A. Organizations. New York: Wiley, 1958.

March, J.G. and Weissinger-Baylon, R. Ambiguity and Command: Organizational Perspectives on Military Decision Making. Marshfield, MA: Pitman, 1986.

Marcus, J. Zajonc, R.B. "The Cognitive Perspective in Social Psychology." In The Handbook of Social Psychology. G. Lindzey & E. Aronson (Eds.) New York: Random House, 1985:137-230.

Margolis, H. Patterns, Thinking, and Cognition: A Theory of Judgment. Chicago: University of Chicago Press, 1987.

Markus, H., & Zajonc, R.B. "The Cognitive Perspective in Social Psychology." In G. Lindsey & E. Aronson (Eds). The Handbook of Social Psychology. 3rd Ed. New York: Random House, 1985.

Miller, G.A. "The Magical Number seven, plus or minus two: Some limits on our capacity for processing information." Psychological Review, 1956, 63:81-97.

Miller, G.A., Galanter, E. & Pribram, K.H. Plans and the Structure of Behavior. New York: Holt, Rinehart & Winston, 1960.

Mintzberg, H. Raisinghani, D., and Theoret, A. "The Structure of `Unstructured Decision Processes." Administrative Science Quarterly, 1976, 21:246-275.

Mitchell, T.R., Rediker, K.J. & Beach, L.R. "Image Theory and Organizational Decision Making." In H.P. Sims & D.A. Gioia (Eds.). The Thinking Organization. San Francisco: Jossey-Bass, 1986:316.

Moch, M.K., Dass, P., Rubin, P. & Mendez, D. "Organizational Decision Making as a Dynamic Process: Problems and Solutions for Analyzing Time-Series Data." Paper presented to Academy of Management, Miami Florida, August, 1991.

Murray, E.A. "Strategic Choice as a Negotiated Outcome." Management Science, 1978, 24(9):960-972.

Murray, N., Sujan, H., Hirt, E.R., & Sujan, M. "The Influence of Mood on Categorization: A Cognitive Flexibility Interpretation." Journal of Personality and Social Psychology, 1990, 59:411-425.

Neisser, U. Cognition and Reality: Principles and Implications of Cognitive Psychology. San Francisco: Freeman, 1976.

Neustadt, R.E. and May, E.R. Thinking in Time: The Uses of History for Decision Makers. New York: Free Press, 1986.

Newell, A. and Simon, H.A. Human Problem Solving. Engelwood Cliffs, N.J.: Prentice-Hall, 1972.

Nickerson, R.S., Perkins, D.N., & Smith, E.E. The Teaching of Thinking Hillsdale, NJ: Erlbaum, 1985.

Nielsen, R.P. "Toward a Method for Building Consensus during Strategic Planning." Sloan Management Review, 1981, Summer, pp. 29-40.

Nigro, L.G. (Ed.) Decision Making in the Public Sector. New York: Marcel Dekker, 1984.

Nisbett, R.E., and Ross, L. Human Inference: Strategies and Shortcomings in Social Judgment. Englewood Cliffs, N.J.: Prentice-Hall, 1980.

Nisbett, R.E., and Wilson, T.D. "Telling More Than We Can Know: Verbal Reports on Mental Processes." Psychological Review, 1977, 84:231-259.

Nutt, P.C. Making Tough Decisions: Tactics for Improving Managerial Decision Making. San Francisco: Jossey-Bass, 1990.

Nutt, P.C. "Models for Decision Making in Organizations and Some Contextual Variables which Stimulate Optimal Use." Academy of Management Review, 1976, 1:84-98.

Nutt, P.C. "Types of Organizational Decision Processes." Administrative Science Quarterly, 1984, 29:414-450.

Ohmae, K. The Mind of the Strategist. New York: Penguin Books, 1982.

Orasanu, J.M. "Shared Mental Models and Crew Decision Making." Cognitive Science Laboratory, Princeton University. CSL Report 46, October 1990.

Orasanu, J.M. & Salas, E. "Team Decision Making in Complex Environments." G.Klein, J. Orasanu, & R. Calderwood (Eds.). Decision Making In Action: Models and Methods. Norwood, NJ: Ablex Publishing Corp (in press).

Padgett, J.F. "Managing Garbage Can Hierarchies." Administrative Science Quarterly. 1980, 25:583-604.

Park, O.S., Sims, & Motowidlo, S.J. "Affect in Organizations: How Feelings and Emotions Influence Managerial Judgment." In H.P. Sims & D.A. Gioia (Eds.). The Thinking Organization. San Francisco: Jossey-Bass, 1986:215-237.

Payne, J.W. "Contingent Decision Behavior." Psychological Bulletin, 1982, 92:382-402.

Payne, J.W., Bettman, J.R., & Johnson, E.J. "Adaptive Strategy Selection in Decision Making." Journal of Experimental Psychology, 1988, 95:371-384.

Pennings, J.M. (Ed.) Decision Making: An Organizational Behavior Approach. 2nd ed. New York: Markus Wiener, 1986.

Pennings, J.M. "The Nature of Strategic Decision Making." In Decision Making: An Organizational Behavior Approach. 2nd ed. New York: Markus Wiener, 1986:201-241.

Perrow, C. Normal Accidents. New York: Basic Books, 1984.

Pettigrew, A.M. The Politics of Organizational Decision Making. London: Tavistock, 1973.

Pfeffer, J. & Salancik, G.R. "Organizational Decision Making as a Political Process: The Case of the University Budget." Administrative Science Quarterly, 1974, 19:135-151.

Pfeffer, J. & Salancik, G.R. The External Control of Organizations: A Resource Dependence Perspective. New York: Harper & Row, 1978.

Pflum, G.D., & Brown, R.D. "The Effects of Conflict, Quality, and Time on Small Group Information Use and Behavior in Evaluative Decision Making Situations," Evaluation and Program Planning, 1984, 7, 35-43.

Pinfield, L.T. "A field Evaluation of Perspectives on Organizational Decision Making." Administrative Science Quarterly, 1986, 31:365-388.

Poole, M.S. & Roth, J. "Decision Development in Small Groups IV: A Typology of Group Decision Paths." Human Communication Research, 1989, 15:323-356.

Porter, L.W. and Von Maanen, J. "Task Accomplishment and Management of Time." In J.L. Perry and K.L. Kraemer (eds.), Public Management. Palo Alto, CA: Mayfield, 1983.

Pounds, W.F. "The Process of Problem Finding." Industrial Management Review, 1969, 11:1-19.

Puckett, T.R. "Rule-Based Expert Systems in the Command Estimate: An Operational Perspective." Master's Thesis. Fort Leavenworth, Kansas, 1990.

Quinn, J.B. Strategies for Change: Logical Incrementalism. Homewood, Ill.: Irwin, 1980.

Quinn, R.E. Beyond Rational Management: Mastering the Paradoxes and Competing Demands of High Performance. San Francisco: Jossey-Bass, 1988.

Rafaeli, A., & Sutton, R.I. "The Expression of Emotion in Organizational Life." In B.Staw (Ed.) Research in Organizational Behavior, Vol. I. Greenwich, Conn: JAI Press, 1989:1-42.

Rainey, H.G. "Public Management: Recent Research on the Political Context and Managerial Roles, Structures, and Behaviors." Journal of Management, 1989, 15:229-250.

Rainey, H.G. Understanding and Managing Public Organizations. San Francisco: Jossey-Bass, 1991.

Rajagopalan, N., Rasheed, A.M.A., & Datta, D.K. "Strategic Decision Processes: An Integrative Framework and Future Directions." Paper prepared for the Conference on Strategic Processes, Norwegian School of Management, 1991.

Rappaport, A. & Chammah, A. Prisoner's Dilemma. Ann Arbor: University of Michigan, 1965.

Redl, F. "Group Emotion and Leadership." Psychiatry, 1942, 5:573-596.

Reilly, A.H. "Effective Crisis Management: More than the Daily Routine." Paper presented to the Academy of Management, Organization and Theory Division, San Franciso, 1990.

Revelle, W., & Michaels, E.J. "The Theory of Achievement Motivation Revisited: The Implications of Inertial Tendencies." Psychological Review, 1976, 83:394-404.

Ring, P.S. and Perry, J.L. "Strategic Management in Public and Private Organizations: Implications of Distinctive Contexts and Constraints." Academy of Management Review, 1985, 10:276-286.

Rioch, M.J. "The Work of Wilfred Bion on Groups." Psychiatry, 1970, 33:56-66.

Roberts, K. "Some Characteristics of High Reliability Organizations." Organization Science.

Roberts, K.H., Hulin, C.L., & Rousseau, D.M. Toward an Interdisciplinary Science of Organization. San Francisco: Jossey-Bass, 1978.

Rochlin, G.I. "`High-Reliability' Organizations and Technical Change: Some Ethical Problems and Dilemmas." IEEE, September 1986:3-9.

Rochlin, G.I., La Porte, T.R., Roberts, K. "The Self-Designing High-Reliability Organization: Aircraft Carrier Flight Operations at Sea." Naval War College Review, October, 1987.

Rokeach, M. The Nature of Human Values. New York: Free Press, 1973.

Rudolph, W.P. & Feher, B. "Organizational Dynamics During Command Decision Making: A Case Study of Information Flow During a Naval Battle Exercise." Unpublished paper, Naval Oceans Systems Center, San Diego, California.

Rumelhart, D.L., & McClelland, J.L. Parallel Distributed Processing (Vol. 1). Cambridge: MIT Press, 1986.

Russel, J.A., Weiss, A., & Mendelsohn, G.A. "Affect Grid: A Single-Item Scale of Pleasure and Arousal. Journal of Personality and Social Psychology, 1989, 57:493-502.

Schilit, W.K. "An Examination of the Influence of Middle Level Managers in Formulating and Implementing Strategic Decisions." Journal of Management Studies, 1987, 24:271-293.

Schwieger, D.M., Sandberg, W.R., & Ragan, J.W. "Group Approaches for Improving Strategic Decision Making: A Comparative Analysis of Dialectical Inquiry, Devil's Advocacy, and Consensus." Academy of Management Journal, 1986, 29:51-71.

Schwenk, C.R. "Cognitive Simplification Processes in Strategic Decision Making." Academy of Management Review, 1986, 11:298-310.

Schwenk, C.R. The Essence of Strategic Decision Making. Lexington, MA: D.C. Heath, 1988.

Seligman, M.E.P., & Schulman, P. "Explanatory Style as a Predictor of Productivity and Quitting Among Life Insurance Sales Agents." Journal of Personality and Social Psychology, 1986, 50:832-838.

Serfaty, D., Entin, E.E., & Tenney, R.R. "Planning with Uncertain and Conflicting Information." Unpublished Paper, ND.

Serfaty, D., Kleinman, D.L. & Deckert, J.C. "Resource Allocation in Naval Command Teams (Raincoat): Preliminary Issues for an Experimental Study (Version 1.1). Unpublished Paper, March 1991.

Serfaty, D. & Michel, R.R. "Toward a Theory of Tactical Decisionmaking Expertise." Paper Prepared for Proceedings of Symposium on Command & Control Research, Naval Postgraduate School, Monterey, CA, June 12-14, 1990.

Shanteau, J. "Psychological Characteristics and Strategies of Expert Decision Makers." Acta Psychologica, 1988, 68:203-215.

Shanteau, J. "Psychological Characteristics of Expert Decision Makers." In J.L. Mumpower, O. Renn, L.D. Phillips, and V.R.R. Uppuluri (eds.) Expert Judgment and Expert Systems. Berlin: Springer-Verlag, 1987:289-304.

Shanteau, J. "Psychological Characteristics and Strategies of Experts." In G. Wright and F. Bolger (eds.). Expertise and Decision Support. New York: Plenum, (in press).

Shanteau, J. "The Psychology of Experts: An Alternative View." Organizational Behavior and Human Decision Processes (in press).

Shrivastiva, P. Bhopal: Anatomy of a Crisis. Cambridge, MA: Ballinger, 1987.

Shrivastiva, P., & Grant, J. "Empirically Derived Models of Strategic Decision-Making Processes." Strategic Management Journal, 1985, 6:97-113.

Shubik, M. Game Theory in the Social Sciences. Cambridge: MIT Press, 1983.

Simon, H.A. "A Behavioral Model of Rational Choice." Quarterly Journal of Economics, 1955, 69:99-118.

Simon, H.A. Administrative Behavior: A Study of Decision Making Processes in Administrative Organization. (2nd ed.) New York: Free Press, 1976.

Simon, H.A. "Making Management Decision: The Role of Intuition and Emotion." Academy of Management Executive, 1987, 1:57-64.

Simon, H.A. "Theories of Decision Making in Economics and Behavioral Science." American Economic Review, 1959, 49:253-280.

Simon, H.A. "The Structure of Ill Structured Problems." Artificial Intelligence, 1973, 4:181-201.

Simon, H.A. & Newell, A. "Human Problem Solving: The State of the Theory in 1970." American Psychologist, 1971, 26:145-159.

Sims, H.P. and Gioia, D.A. The Thinking Organization. San Francisco: Jossey-Bass, 1986.

Sinclair, R.C. "Mood, categorization Breadth, and Performance Appraisal: The Effects of Order of Information Acquisition and Affective State on Halo, Accuracy, Information Retrival, and Evaluations." Organizational Behavior and Human Decision Processes, 1988, 42:22-46.

Sjorber, L. "Volitional Problems in Carrying Through a Difficult Decision." Acta Psychologica, 1980, 45:123-132.

Slovic, P., Fischoff, B., Lichenstein, S. "Behavioral Decision Theory." Annual Review of Psychology, 1977, 28:1-39.

Smith, K.K., & Crandall, S.D. "Exploring Collective Emotion." American Behavioral Scientist, 1984, 27:813-828.

Solberg, P.O. "Unprogrammed Decision Making." Industrial Management Review, 1967, 8:19-29.

Sproull, L.S., Weiner, S., & Wolf, D.P. Organizing an Anarchy. Chicago: University of Chicago Press, 1978.

Srivastva, S., & Associates. The Executive Mind. San Francisco: Jossey-Bass, 1983.

Stagner, R. "Corporate Decision-Making: An Empirical Study." Journal of Applied Psychology, 1969, 53:1-13.

Stahl, M.J. Strategic Executive Decisions: An Analysis of the Differences Between Theory and Practice. New York: Quorum Books, 1989.

Starbuck, W.H. Organizations as Action Generators." American Sociological Review, 1983, 48:91-102.

Staw, B.M., Sandelands, L.E., & Dutton, J.E. "Threat-Rigidity Effects in Organizational Behavior: A Multi-Level Analysis." Administrative Science Quarterly, 1981, 26:501-524.

Steinbruner, J.D. The Cybernetic Theory of Decision. Princeton: Princeton University Press, 1974.

Stevenson, M.K., Busemeyer, J.R., & Naylor, J.C. "Judgment and Decision-Making Theory." 1990:283-374.

Stillings, N.A., Feinstein, M.H., Garfield, J.L., Rissland, E.L. Rosenbaum, D.A. Weisler, S.E. and Baker-Ward, L. Cognitive Science. Cambridge, MA: MIT Press, 1987.

Sun Tzu. The Art of War. Trans. by S.B. Griffith. London: Oxford University Press, 1963.

Suresh, S. and Associates. The Executive Mind. San Francisco: Jossey-Bass, 1983.

Swain, G.H. "Understanding the Organizational Decision Process at the Theater Commander-in-Chief Level of Command." Master's Thesis. Monterey, CA: Naval Postgraduate School, 1990.

Tallman, I. Gray, L.N. "Choices, Decisions, and Problem Solving." Annual Review of Sociology, 1990, 16:405-433.

Taylor, R.N. "Psychological Determinants of Bounded Rationality: Implications for Decision-Making Strategies." Decision Sciences, 1975, 6:409-429.

Thibault, G.E. (Ed.). The Art and Practice of Military Strategy. Washington, D.C.: National Defense University, 1984.

Thomas, J. "Strategic Decision Analysis: Applied Decision Analysis and its Role in the Strategic Management Process." Strategic Management Journal, 1984, 5:139-156.

Thompson, J.D. Organizations in Action. New York: McGraw-Hill, 1967.

Toda, M. "Emotion and Decision Making." Acta Psychologica, 1980, 45:133-155.

Tolman, E.C. "Cognitive Maps in Rats and Men." Psychological Review, 1948, 55:189-208.

Tversky, A. "Elimination by Aspects: A Theory of Choice." Psychological Review, 1972, 79:281-299.

Tversky, A., & Kahneman, D. "Availability: A Heuristic for Judging Frequency and Probability." Cognitive Psychology, 1973, 5:207-232.

Tversky, A., and Kahneman, D. "Judgment Under Uncertainty: Heuristics and Biases." Science, 1974, 195, 1124-1131.

Tversky, A. and Kahneman, D. "Rational Choice and the Framing of Decisions." Journal of Business, 1986, 59:251-278.

Van Creveld, M. Command in War. Cambridge: Harvard University Press, 1985.

Van Over, D. & Kinney, S. "Effects of Electronic Communication and Decision Support on Decision Making By Dispersed Groups." Technical Report # 56, Department of Management, University of Georgia.

Velton, E. "A Laboratory Task for Induction of Mood States." Behavior Research and Therapy, 1968, 6:473-482.

Vickers, G.C. The Art of Judgement. London: Chapman Hall, 1965.

Von Glinow, M.A. & Mohrman, S. (Eds.). Managing Complexity in High Technology Organizations, Systems, and People.

Wallsten, R.S. (Ed.). Cognitive Processes in Choice and Decision Behavior. Hillsdale, NJ: Erlbaum, 1980.

Walsh, J.P. "Selectivity and Selective Perception: An Investigation of Managers' Belief Structures and Information Processing." Academy of Management Journal, 1988, 31:873-896.

Wamsley, G.L. and Zald, M. "The Political Economy of Public Organizations." Public Administration Review, 1973, 33:62-73.

Watson, D., & Tellegan, A. "Toward a Consensual Structure of Mood." Psychological "Bulletin, 1985, 98:219-235.

Weldon, E. & Gargano, G.M. "Cognitive Effort in Additive Task Groups: The Effects of Shared Responsibility on the Quality of Multiattribute Judgments." Organizational Behavior and Human Decision Processes, 1985, 36:348-361.

Weick, K. "Cognitive Processes in Organizations." In B.M. Staw (Ed.), Research in Organizational Behavior. Greenwich, CT:JAI Press, 1979.

Weick, K. & Bougon, M.G. "Organizations as Cognitive Maps: Charting Ways to Success and Failure." In H.P. Sims, D.A. Gioia (Eds.). The Thinking Organization. San Francisco: Jossey-Bass, 1986:102-135.

White, S., Dittrick, J., & Lange, J. "The Effects of Group Decision Making Process and Problem-Situation Complexity on Implementation Attempts." Administrative Science Quarterly, 1980, 25:428-440.

Wilson, J.Q. Bureaucracy: What Government Agencies Do and Why They Do It. New York: Basic Books, 1989.

Witte, E. "Field research on complex decision making processes -- The Phase Theory." International Studies of Management and Organization. Fall, 1972:156-182.

Woodward, B. The Commanders. New York: Simon & Simon, 1991.

Wooldridge, B. & Floyd, S.W. "Strategy Process, Middle Management Involvement and Organizational Performance." Strategic Management Journal, 1990, 11, 231-242.

Woolley, R.N. & Pidd, M. "Problem Structuring -- A Literature Review." Journal of Operations Research Society, 1981, 32:197-206.

Wright, G. Behavioral Decision Making. New York: Plenum Press, 1985.

Wright, P. "The Harassed Decision Maker: Time Pressures, Distractions and the Use of Evidence." Journal of Applied Psychology, 1974, 59:555-561.

Yates, J.F. Judgment and Decision Making. Englewood Cliffs, NJ: Prentice-Hall, 1990.

Zagare, F.C. Game Theory: Concepts and Application. Beverly Hills: Sage, 1984.

Zajonc, R.B. "Feeling and Thinking: Preferences Need No Inferences." American Psychology, 1980, 35:151-175.

Zelditch, M., Harris, W., Thomas, G.M. & Walter, H.A. "Decisions, Nondecisions, and Metadecisions." In Research in Social Movements, Conflicts, and Change. Greenwich, Conn: JAI Press, 1983.

DISTRIBUTION LIST

Defense Technical Information Center Cameron Station Alexandria, VA 22314	2
Dudley Knox Library Naval Postgraduate School Monterey, CA 93943-5100	2
Dean of Research (Code 08) Naval Postgraduate School Monterey, CA 93943-5100	1
Library, Center for Naval Analyses 4401 Ford Avenue Alexandria, VA 22302-0268	1
Department of Administrative Sciences Library Code AS Naval Postgraduate School Monterey, 93943	1
CNO Executive Panel OP OOK Office of CNO 4401 Ford Ave. Alexandria, VA 22302-0268	5
Captain Keith Hahn CNO Executive Panel OP OOK Office of the CNO 4401 Ford Ave. Alexandria, VA 22302-0268	1
Professor Nancy Roberts AS/RC Naval Postgraduate School Monterey, CA 93943	25