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Human Factors Influencing Decision Making

by

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July 1998

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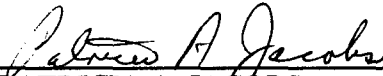
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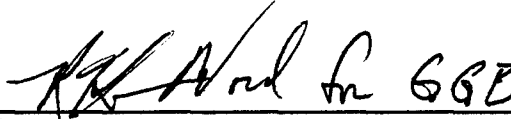Superintendent
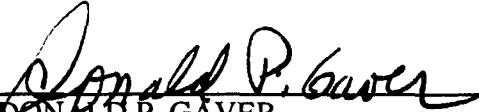
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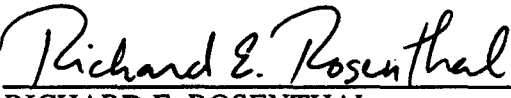
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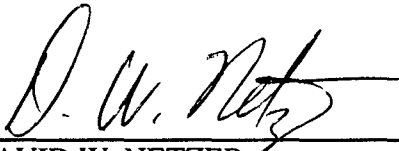Professor of Operations Research

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This report supplies references and comments on literature that identifies human factors influencing decision making, particularly military decision making. The literature has been classified as follows (the classes are not mutually exclusive): features of human information processing; decision making models which are not mathematical models but rather are descriptive; non-personality factors influencing decision making; national characteristics influencing decision making; personality factors influencing decision making; decision making in a military organization.

The decision maker is influenced by many factors both internal to the decision maker and external to him/her. The environmental context in which a decision is made makes it difficult to associate personality traits with specific decision making behavior. Internal factors that influence decision making include limited information processing and memory capabilities. These limitations can result in biases in processing information such as anchoring (undue weight for evidence supporting the initial hypothesis) or recency (undue weight on more recent evidence). The limitations can also result in decision making heuristics. Training and experience can lessen the effects of limited information processing and memory capabilities.

The first part of the report is a summary of the findings of the literature survey. This is followed by detailed endnotes concerning the references.

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Human Factors Influencing Decision Making

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Abstract

This report supplies references and comments on literature that identifies human factors influencing decision making, particularly *military* decision making.

The literature has been classified as follows (the classes are not mutually exclusive):

(1) Features of human information processing

(2) Decision making models

(3) Non-personality factors influencing decision making

(4) National characteristics influencing decision making

(5) Personality factors influencing decision making

(6) Decision making in a military organization

The impact of the above is that much examination of the human decision making process has occurred, and continues. In summary, this literature tends to show that

(1) Humans have limited information processing and memory capabilities. These limitations can result in biases: information processing biases can be towards an original "belief anchor," *but*, in other cases, can be over-responsive to recent information. These are different responses that may be characteristic of individuals, groups, or cultures, and may even change depending upon circumstances. If such biases are consistent, opponent decision makers can exploit them. Training and experience can lessen the effects of limited information processing and memory capabilities.

(2) Models of decision making are usually not mathematical models but rather are descriptive of the processes that humans may use to make decisions. Two such models are the naturalistic model and the analytic model. The naturalistic model is an adaptive decision model that, for dynamic situations, includes developing situational awareness, course of actions, acquiring data to confirm or refute situational awareness and decision making. The findings are usually based on interviews. The models have been used to develop training procedures and in artificial intelligence applications. The analytic model focuses on the time of one decision; it often tries to understand the mechanisms for "unreasonable" decisions.

(3) The environmental context in which a decision is made makes it difficult to associate personality traits with specific decision making behavior.

The first part of the report is a summary of the findings of the literature survey. This is followed by detailed endnotes concerning the references.

Human Factors Influencing Decision Making

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Introduction

This report supplies references and comments on literature that identifies human factors influencing decision making, *particularly* military decision making. Much examination of human decision making has occurred and continues. The U.S. military has sponsored many studies. Certain of these studies have been motivated by the need to develop decision aids to assist the decision maker; cf. Wickens (1992). Other studies have been motivated by the need to develop training for decision makers; cf. Cohen et al. (1997). There have been laboratory studies and observational studies. The laboratory studies use simple decision or judgment tasks on which data can be collected. The observational studies are less controlled in the choice of task and often have a narrative aspect to them in which the decision maker is asked questions about his choices.

The decision maker is influenced by many factors both internal to the decision maker and external to him/her. The environmental context in which a decision is made can influence the choice; cf. Perry and Moffat (1997); Adelman et al. (1997); Hogarth and Einhorn (1991); Zeelenberg et al. (1997). This environmental context also makes it difficult to associate measured personality traits with specific decision making behavior; cf. Janis (1989) and Ajzen (1988). Further, there are many different definitions of personality, cf. Driskell et al. (1987).

Internal factors that influence decision making include limited information processing and memory capabilities; cf. Janis and Mann (1977) and Hogarth (1987). Thus, people adopt decision making heuristics. These limitations can result in biases in processing information such as *anchoring* (undue weight for evidence supporting the initial hypothesis) or *recency* (undue weight on more recent evidence); cf. Wickens (1992). These errors can result in bad decisions; cf. Tolcott et al. (1989). Bad decisions can also be the result of staff errors; cf. Janis (1989); Kahan et al. (1989).

Training and experience can lessen the effects of limited information processing and memory capabilities; cf. Weick (1985); Cohen et al. (1996); Cohen et al. (1994); Cohen (1993); Janis and Mann (1977). It can also make staff work more efficient; cf. Knapp (1998).

The next section presents a summary of the literature. The literature has been classified as follows (the classes are not mutually exclusive):

    (1) Features of human information processing

    (2) Decision making models

    (3) Non-personality factors influencing decision making

    (4) National characteristics influencing decision making

    (5) Personality factors influencing decision making

    (6) Decision making in a military organization (this may differ with organization and nationality)

This summary is followed by detailed endnotes concerning the references.

1. Features of Human Information Processing:

There are biases in human processing of information.

The initial piece of evidence provides a cognitive "anchor" for the decision maker's belief in one of several hypotheses.

> Wickens[1] (1992): Errors in processing information such as anchoring (undue weight for evidence supporting initial hypothesis) or recency (undue weight on more recent evidence); other references Tolcott, Marvin and Bresnick (1989); Three mile island: Rubenstein and Mason (1979) and Sheridan (1981); Hogarth and Einhorn (1978); Vincennes incident: Tolcott, Marvin and Bresnick (1989) and U.S. Navy (1988).

> Hogarth and Einhorn (1989)

> Tolcott, Marvin, and Bresnick (1989)

> Allen (1982)

> Einhorn and Hogarth (1982)

> Lopes (1982)

> Navon (1979)

> Tversky and Kahneman (1974)

> Du Charme (1970)

> Edwards, Phillips, Hays, and Goodman (1968)

There can also be a tendency to overweight those cues that have occurred most recently (recency).

> Hogarth (1987)

There is a tendency to seek far more information than decision makers can absorb.

> Samet, Weltman, and Davis (1976)

Decision makers do not combine information in a Bayesian fashion.

> Schun (1975)

> Johnson, Cavanagh, Spooner, and Samet (1973)

> Kahneman and Tversky (1973)

Two heuristics for incorporating information: *representiveness* (the degree to which data "look like" those of a hypothesis) and *availability* (the ease of recalling a hypothesis) are simplifying techniques for incorporating information.

> Kahneman, Slovic, and Tversky (1982)

> Tversky and Kahneman (1974)

Operators can tend to seek information that confirms the chosen hypothesis and to avoid information or tests whose outcome would not confirm it. In the incident at the Three Mile Island nuclear plant, the incorrect initial formulation of a hypothesis was a major cause of the crisis.

> Tolcott, Marvin, and Bresnick (1989)

> U.S. Navy (1988)

> Schustak and Sternberg (1981)

Einhorn and Hogarth (1979)

Mynatt, Doherty, and Tweney (1977)

Wason and Johnson-Laird (1972)

2. Decision making Models:

These are not usually mathematical models but rather proposed frameworks to understand the decision making process.

> Brander and Scard[2] (1994): Report summarizes and reviews a range of models of decision making. The viewpoint is to relate different types of decision making models to the development of decision aids.

There are two main themes:

Analytical: focused upon the moment of choice and is concerned with how the decision maker selects a course of action. Often concerned with "errors" in decision making.

> Mellers, Schwartz, and Cooke[3] (1998): Review of research from 1992-1996 concentrating on rational choice theory.

> Adelman, Bresnick, Christian, Gualtieri, and Minionis[4] (1997): The results of an experiment using a Patriot simulator support a hypothesis that contextual features of a task can significantly effect the type of judgment processes people use both individually and in two person teams and in turn the type of information order effect observed. People may use anchoring and adjustment as a default strategy when there is no basis for interpreting information.

> Zeelenberg and Beattie[5] (1997): People are motivated to minimize post-decision regret. As a result people can become risk averse or risk seeking depending on which of the possible choice options is the regret minimizing option.

> Kuhn and Budescu[6] (1996): Subjects rate vaguely specified scenarios as more risky.

> Svenson[7] (1996): Proposes a framework to understand decision making.

> Kerstholt[8] (1995): Reports results of experiment with college students to assess the effect of false alarms on the timeliness of making a decision.

> Rogers[9] (1994): An analytical approach to decision making seems to run contrary to the requirements of the modern battlefield. He advocates "intuitive decision making." A commander must be unpredictable (to the opponent), imaginative and instinctive. Analytical decision making is more appropriate to the staff function and preparation of the battlefield.

> Whyte and Levi[10] (1994): The context in which a decision is made may influence judgment.

> Adelman, Tolcott, and Bresnick (1993): Finds empirical evidence of recency effects in an experiment with Patriot air defense officers.

> Morgan and Henrion[11] (1993): Discusses various decision criteria and group decision making.

> Veit and Callero[12] (1993): Statistical analysis to find cues that influence decisions. About ½ century ago, psychologists began developing experimental designs that made it possible to test judgment theories expressed in the form of algebraic functions.

> Hogarth and Einhorn[13] (1992): There has been a great deal of work studying the effects that the *order* in which evidence is made available to a decision maker has on the updating of his

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belief concerning a specific proposition or hypothesis; sometimes the first in a series of items dominates (primacy), sometimes the latter (a recency effect).

Shanteau and Stewart[14] (1992): Multiple linear regression methods for modeling information affecting judgment suggest that decision makers use relatively few cues.

Ashton and Ashton (1990): Hogarth and Einhorn's experiments were with college students. There is, however empirical support for recency effects with experienced personnel.

Maule and Mackie (1990): Deadlines to complete static tasks cause subjects to speed up processing of information and switch to simpler decision strategies which can use less information.

Ford, Schmitt, Schechtman, Hults, and Doherty (1989): Process-tracing studies of decision-making behavior have consistently shown that the selection of a decision strategy depends on task factors such as complexity of the environment and time pressure.

Serfaty, Entin, and Tenny (1989): Evidence of recency effects with experienced personnel.

Payne, Bettman, and Johnson (1988): Deadlines to complete static tasks cause subjects to speed up processing of information and switch to simpler decision strategies which can use less information.

Hogarth (1987): Internal factors that influence decision making include limited information processing and memory capabilities.

Pitz and Sachs[15] (1984): "A judgment or decision making (JDM) task is characterized either by uncertainty of information or outcome or by a concern for a person's preferences or both. The prescriptions for consistent behavior are generally derived from formal probability theory and from Expected Utility (EU) theory. Bayesian decision theory is a prescriptive theory of choice based on a combination of probability theory and EU theory. Numerous authors have demonstrated that judgments depart significantly from the prescriptions of formal decision theory. To account for the findings, investigators have explored the information processing strategies, or heuristics, that people use when making judgments. The significance of these inconsistencies and the status of judgmental heuristics have been a matter of dispute. The current paper is concerned with the degree to which prescriptive models clarify the JDM process itself.

Einhorn and Hogarth[16] (1981): There is a conflict inherent in taking action. The resolution of the conflict can be either avoidance or confrontation.

Tversky (1972): People make choices using combinations of simple decision rules to find one alternative that meets a minimal set of requirements.

Slovic and Lichtenstein (1971): Develop and test algebraic models that represent strategies for evaluating and combining information.

Naturalistic: concentrates on explaining how decision makers develop an understanding of the problem situation and arrive at a course of action. It includes adaptive decision making in a dynamic situation.

Lipshitz and Strauss[17] (1997): An empirical investigation of how military officers conceptualize uncertainty and how they cope with it.

Nygren[18] (1997): Empirical study of the application of how a task is framed (presented) and the choice that is made.

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Perry and Moffat (1997): The results of an experiment involving officers with the mission of escorting an amphibious landing force to a designated site, found that the participants chose to avoid risk because of the vulnerability of the amphibious force.

Brander and Scard[2] (1994): Report summarizes and reviews a range of models of decision making. The viewpoint is relating different types of decision making models to the development of decision aids.

Rogers[9] (1994): An analytical approach to decision making seems to run contrary to the requirements of the modern battlefield.

Howell[19] (1993): "Naturalistic decision making concentrates on the decision making problems faced by real decision makers in complex and often multi-person systems characterized by high levels of uncertainty, information load, time pressure, and decision importance.

Payne, Bettman, and Johnson (1993): Decision strategy selection is fundamentally adaptive; individuals select a strategy that results in fairly accurate decisions but with minimum effort.

Tolcott (1991): "The naturalistic decision making movement has grown to the point where it is perhaps the dominant theme in current human factors activity in the U. S. Military."

Beach[20] (1990): A proposed framework to understand decision making.

Kahan, Worley, and Stasz[21] (1989): The commander spends time ensuring that subordinate commanders understand his vision; one result is faster information passing and delegation of responsibilities. In training situations the commanders want knowledge of the personal character or habits of the enemy commander. If the commander's image of the battlefield is not shared with his staff, the staff may not view a datum that does not support the image as necessitating a change of plan; surprise could result.

Klein (1988): "Klein's naturalistic decision making strategy includes his RPD (Recognition primed decision) model."

Cohen, Tolcott, and McIntyre (1987): Found that fighter pilots combine assumption-based reasoning with preparing for potential risks.

MacCrimmon and Wehrung (1986): "A description of behavior in a risky situation is that the decision maker copes with 3 determinants of risk: lack of time, lack of information, and lack of control.

Bahl and Hunt (1984): "The Bahl-Hunt model divides decision making into four distinct features: 1) a definition of the situation in the form of a cognitive "model"; 2) a set of alternatives; 3) the selection of a choice; and 4) an overt action."

Pugh and Kerchner[22] (1982): Description of some of the decision making algorithms in TAC BRAWLER.

Wohl (1981): Janis and Mann do not consider military decision making. As a result, Wohl proposes modifications to Janis and Mann's paradigm to include the risks and costs of information seeking as opposed to giving information to the enemy, particularly information regarding position and intent. He also proposes a new behavior pattern called "offensive pursuit." His modified paradigm is relatively independent of personality variable and individual differences in tolerance of stress and uncertainty.

Leedom (1979): "Surveyed the literature in cognitive and behavioral sciences and concluded that one can only construct a partial model of decision making."

Janis and Mann[23] (1977): The decision maker satisfices rather than maximizes; that is, he looks for a course of action that is "good enough" and that meets a minimal set of requirements.

3. Non-personality Factors Influencing Decision Making:

Dupuy[24] (1985): Professional military experience is used to assign numbers to intangible factors such as leadership, training/experience, and morale.

Fatigue

Halbert[25] (1998): Fatigue causes cognitive skills to degrade.

Bradshaw[26] (1995): During sleep deprivation mental ability is affected first. This results in decreased ability to process information and to make decisions.

Fishburne[27] (1991): Physical abilities and endurance are less impaired by sleep deprivation than are cognitive abilities.

Belenky, Krueger, Balkin, Headley, and Solick (1987): "Literature review pertaining to sleep deprivation shows that physical strength and endurance are less impaired by limited or no sleep than are cognitive abilities."

Haslam (1987): Sleep loss and military performance.

Suedfield, Corteen, and McCormick (1986): General Lee was more fatigued than General Grant.

Van Fleet and Yukl[28] (1986): "A study of World War I veterans suggested that the presence of hunger, thirst, fatigue, ignorance of plans and idleness increases the danger from fear."

Dupuy[24] (1985): One term in the combat equations is for unit exhaustion.

Time Stress

Edland and Svenson (1993): "Effects of time pressure include a reduced focus of attention and an over-reliance on negative information in the decision making process or an increased reliance on fewer attributes or dimensions in making choices."

Payne, Bettman, and Johnson (1993): Deadlines to complete static tasks cause subjects to speed up processing of information and switch to simple decision strategies.

Svenson and Maule (1993): "Effects of time pressure include a reduced focus of attention and an over-reliance on negative information in the decision making process or an increased reliance on fewer attributes or dimensions in making choices."

Wright (1974): "Under time stress, decision-making performance deteriorated when more rather than less information was provided."

Thirst

Halbert[25] (1998): Cognitive skills degenerate when very thirsty or tired or in excessive heat.

Stress

Arnsten (1998): The responses to acute uncontrollable stress include distraction and disorganization, the decrease in working memory abilities, and the tendency of prepotent or habitual responses to control behavior. "The memories of the stressful event can be better than usual. Humans exposed to loud noise stress are less able to sustain attention or to inhibit inappropriate responses. In contrast, performance of simple, well-rehearsed tasks can actually be better than usual after stress exposure."

Nygren[18] (1997): "Anxiety can produce a disrupting effect on the encoding of new information into long-term memory, which in turn may lead to inefficiencies in learning. People may rigidly stick with the strategy they start with. High levels of perceived stress, negative affect,

or framing-induced anticipated potential losses may have little or marginal effect on simple perceptual task performance but appear to have a potentially debilitating effect on developing and using more cognitively complex decision making strategies. Individuals experiencing these influences appear to do more than simply tunnel their focus and disproportionately weight negative information. Framing effects may do more than merely change focus; they can be so disruptive as to be detrimental to the incorporation and adoption of new information into dynamic decision making strategies."

Heslegrave and Colvin[29] (1996): Investigations of measures to predict successful performance under stress; people who are able to cope with stress successfully tend to be more introverted, task-oriented, and self-confident.

Bradshaw[26] (1995): "Combat stress causes battle casualties. A combat stress casualty is a soldier rendered combat ineffective due to the psychological strain of battle.

Payne, Bettman, and Johnson[30] (1992): "There is evidence that people scan alternatives in a more nonsystematic fashion under stress."

Davies and Parasuraman (1982): Found that anxiety can produce a disrupting effect on the encoding of new information into long-term memory, which may lead to inefficiencies in learning.

Sheridan (1981): Operators fail to process information that is contradictory to, or inconsistent, with the initially formulated hypothesis.

Broadbent (1971): Attempts to set out a complete methodology for studying the effects of stress and individual differences on human performance.

High work load

Knapp (1998): Human performance proficiency models; task input-throughput modeling. ARI at Fort Huachuca has developed human factors models for work load in commander and staff work in brigade and below.

Janis[31] (1989): When managers believe that the complexities of the issues exceed their capabilities or the organization lacks adequate resources to make a good decision, they will make a crucial policy decision without examining the pertinent information carefully. He proposes different personality traits that influence decision making; he states that there are few generalizations that can be made about the interaction of personality and the situational factors of the decision. He discusses factors associated with poor decision making in the civilian world.

Decision Science Applications[32] (1982): Proposal to develop a simulation of pilot workload capabilities

Sheridan (1981): Operators fail to process information that is contradictory to or inconsistent with the initially formulated hypothesis.

Experience

Reisweber[33] (1997): "There is ample evidence to suggest that battle command skills are a function of not only raw talent, but years of practice, experience and maturation."

Cohen and Freeman[34] (1996): More experienced decision makers buy themselves more time for resolving uncertainty by a) explicitly asking how much time they have before they must commit to a decision and b) estimating this time more precisely. Results of an experiment in which the decision was whether or not to engage an incoming gunboat found that less experienced decision makers tend to prematurely reject alternative hypotheses.

Cohen, Freeman, Fallesen, Marvin, and Bresnick[35] (1996): Report assesses the merit of training methods to improve an officer's critiquing and correction skills for battlefield planning.

Cohen, Adelman, Tolcott, Bresnick, and Marvin (1994): Experts have more automatic responses; experts are more proactive in their planning; experts are less likely to act prematurely or to wait too long. In a study of ship-based anti-air engagement decisions, more experienced officers tended to wait longer before deciding to engage than less experienced officers. The more experienced officers also adopted contingency plans (enabling very rapid engagement in case of a hostile act).

Rogers[9] (1994): "There is a fundamental link between training, experience and technological competence that provides the knowledge required to make intuitive decisions."

Cohen (1993): In the context of Naval anti-air warfare decisions, it was found that more experienced officers not only waited longer before engaging an unknown contact but adopted contingency plans (enabling very rapid engagement in case of a hostile act). More experienced officers were better able to generate alternative interpretation of cues regarding target identity or intent.

Rabbitt and Maylor[36] (1991): "Reviews studies of ways in which performance in choice reaction time, visual search, and simple memory tasks are affected by individual differences in age and intelligence, by alcohol, and by practice."

Kahan, Worley, and Stasz[21] (1989): The commander spends time ensuring that subordinate commanders understand his vision; one result is faster information passing and delegation of responsibilities. In training situations the commanders want knowledge of the personal character or habits of the opposing commander. If the commander's image of the battlefield is not shared with his staff, the staff may not view a datum that does not support the image as necessitating a change of plan; surprise could result.

Dupuy[24] (1985): There is a training and/or experience factor in the combat potential.

Staff

Knapp (1998): Human performance proficiency models; task input-throughput modeling. ARI at Fort Huachuca has developed human factors models for work load in commander and staff work in brigade and below. It is important to assign people to tasks based on training. Each person has a finite capacity to perform tasks.

Foss[37] (1997): The staff must be forward looking helping the commander to anticipate.

Rogers[9] (1994): The staff can provide a safety check to intuitive decision making.

Kahan, Worley, and Stasz[21] (1989): A commander's perceived incompetence of staff slows decision making. The commander spends time ensuring that subordinate commanders understand his vision; results of a common vision are faster information passing and delegation of responsibilities. In training situations the commanders want knowledge of the personal character or habits of the enemy commander. If the commander's image of the battlefield is not shared with his staff, the staff may not view a datum that does not support the image as necessitating a change of plan; surprise could result.

Janis and Mann[23] (1977): Concurrence seeking from policy advisors can lead to disregarding conflicting information about the future success of a current operation.

Training

Knapp (1998): Human performance proficiency models; task input-throughput modeling. ARI at Fort Huachuca has developed human factors models for work load in commander and staff

work in brigade and below. It is important to assign people to tasks they have been trained for. People have a finite capacity to perform tasks.

Cohen, Freeman, Fallesen, Marvin, and Bresnick[35] (1996): Report assesses the merit of training methods to improve an officer's critiquing and correction skills for battlefield planning.

Bradshaw[26] (1995): "Training under realistic conditions builds necessary soldier trust in themselves and the organization."

Rogers[9] (1994): "Training time with troops and teaching at military schools are the crucial jobs in the development of future battlefield commanders. Commanders will have to lead and maneuver soldiers on the training battlefield to develop intuition. It is important in training to develop situations that allow individuals to make intuitive decisions, which means experimentation and tolerating mistakes."

Hunt and Phillips[38] (1991): "Training can modify behavior. Skill development techniques under high stress situations involve over learning through extended practice to produce automatic responses."

Van Fleet and Yukl[39] (1986): "The most important factors in controlling fear are: devotion to cause, leadership, training and materiel."

Weick (1985): Training can modify behavior; some appropriate skill development techniques under high stress situations involve over learning through extended practice. Training can speed the decision making process.

Gaeth and Shanteau (1984): Found that judgments were adversely influenced by irrelevant factors, although that influence could be reduced with training.

Janis and Mann[23] (1977): Prior training can improve decision making in emergency situations.

Leadership skills

Foss[37] (1997): "The future battlefield will be less forgiving of slow decisions than ever before. Good commanders anticipate. Not only do they anticipate the enemy, they anticipate their subordinates' needs and provide help and support to facilitate overall mission accomplishment."

Reisweber[33] (1997): "An officer Personnel Management System study conducted by the Department of History at the United States Military Academy, West Point, New York, found that successful leaders are able to assess rapidly changing situations and continually assimilate large quantities of conflicting information."

ARI Newsletter[40] (1996): The Center for Leadership and Organizations Research (CLOR) is administering measures of transformational and transaction leadership for inclusion in the baseline officer longitudinal data set.

Bradshaw[26] (1995): "A commander can directly decrease a unit's combat stress casualties though his personal activities, proper treatment of casualties and leading by example."

Okechuku[41] (1994): "The purpose of this study is to provide a descriptive comparison of the relative influence of certain Western-conceptualized managerial abilities, traits and motivations in assessing managerial effectiveness in the PRC and Hong Kong relative to a Western society such as Canada."

Rogers[9] (1994): "The use of instinct or intuition in decision making is related to lack of information and time available and is more useful in battle command than in battle preparation. If a commander ties himself to a command post, his decisions will be slow and predictable. Information received at the command post may not be sufficient to paint an

accurate tactical picture and valuable time could be lost trying to confirm the actual combat situation. The commander cannot afford to wait until all information has been gathered and processed."

Smith, Misumi, Tayeb, Peterson, and Bond[42] (1989): "Study using shop-floor work teams and their immediate supervisors in Britain, the United States, Hong Kong and Japan. Where individualistic values prevail a leader's options may be expected to include the option of exerting direct pressure towards a goal. Where collectivist values prevail, leadership is more likely to emphasize reciprocal influence processes."

Jaques, Clement, Rigby, and Jacobs (1986): Single skill mentioned most often by 41 general officers was *consensus building* to ensure they get the resources needed to carry out the decision. Consensus may need adjustment, opportunity to adapt, accommodate to sharp situation changes, "getting everyone on board."

Van Fleet and Yukl[43] (1986): Planning and problem solving are important for leadership effectiveness in combat situations. Interpersonal relations are less important to both leaders and to subordinates in crisis situations.

Isenberg (1985): Observations of 6 senior managers; they create new alternatives, keep options open, delay decision points, search for more information, and include more people in the decision making function.

Yukl and Van Fleet[44] (1982): "Aspects of leadership found effective: performance emphasis; inspiration; role clarification; provide clear directions; criticism-discipline; planning and problem solving was important in combat situations. Friendly interpersonal relations become less important both to leaders and to subordinates in crisis situations."

Quantity and quality of information

Nygren[18] (1997): "It is well documented that the way a static choice task is "framed" (presented) can dramatically alter choice behavior, often leading to observable preference reversals. A study was conducted to examine the hypothesis that framing can introduce affective components to the decision making process and can influence, either favorably (positive frame) or adversely (negative frame) the implementation and use of decision making strategies in dynamic high workload environments. Results indicate that negative frame participants were significantly impaired in developing and employing a simple optimal decision strategy relative to a positive frame group."

Kuhn and Budescu (1996): Numerous empirical studies on risky decision making have demonstrated that decision makers are generally averse to taking risks with imprecisely specified (vague) probabilities and are even willing to pay a premium to avoid vagueness.

Kerstholt (1995): Kerstholt conducted an experiment in which the college students were asked to monitor the fitness level of a fictitious athlete and intervene if necessary. If the fitness level decreased, the subjects could either intervene directly or ask for diagnostic information. The subjects were also presented with false alarms and the time needed for intervention was varied. The subjects tended to ask for diagnostic information rather than act directly. The greater the false alarm rate, the longer the time until the subjects intervened.

Rogers[9] (1994): The more information a commander obtains, the more reluctant he may be to make a decision; he may become overloaded or delay making a decision in the belief that he may receive a vital piece of information. *Someone* has to set course, decide on COA.

Payne, Bettman, and Johnson[30] (1992): "The apparent completeness of a display can blind a decision maker to the possibility that important information is missing from a problem description."

Task Complexity

Johnson and Bruce[45] (1998): "Study analyzes a large sample of decisions made by individuals in UK offcourse betting markets. The investigation focuses on the comparative impacts of complexity defined in terms respectively of alternatives and attributes. The results suggest that the risk strategy employed is affected by task complexity. Complexity does not affect the size of risk accepted but alternative- and attribute- based complexity together influence the propensity to accept greater degrees of risk. In addition, the effect of attribute-based complexity on risk taking appears to be modified by the use of risk-hedging strategies."

Payne, Bettman, and Johnson[30] (1992): "A hypothesis is that the more complex a decision problem, the more people will use simplifying decision heuristics."

4. National Characteristics Influencing Decision Making:

Blood[46] (1998): His organization has done work on forecasting battlefield attrition of US forces in combat against various opponents. As part of this effort they have tried to make some estimates of soft factors in combat outcomes.

Halbert[47] (1998) and Morrow[48] (1998): National Ground Intelligence Center rates factors such as leadership, training, readiness, morale, cohesion, and ability to execute logistics for foreign ground forces. The rating scale is from 1 to10. There are criteria for each rating. A group of at least three experts scores the factors for each country. The National Ground Intelligence Center has panel of experts rate factors such as leadership, training, readiness, morale, cohesion, and ability to execute logistics for foreign ground troops.

Ungvarsky (1998): The attitude of commanders towards troops. The US has a current strong desire to minimize casualties. Some other nations view troops as cannon fodder. The concern commanders have for the soldiers or sailors influences the decisions made in combat.

Blood, Rotblatt, and Marks[49] (1996): Naval Health Research Center in San Diego assembled subject matter expert panel to assess some soft factors: societal homogeneity (measured by religious and ethnic homogeneity), technical sophistication (measured by amount of electricity used), and troop commitment (measured by length of enlistment and percent of GNP used to support military). A composite factor for various countries is determined in a study to estimate US casualties in conflict.

Bond and Smith[50] (1996): "The general functions that effective leaders must carry out appear to be universal across nationalities. The specific ways in which these functions are expressed differs."

Yates, Lee, and Shinotsuka[51] (1996): Study of overconfidence in judgment tasks of mainland Chinese, Japanese, Taiwan Chinese, and Americans. The judgment task is to specify the correct answer to a general knowledge question. The subjects were then asked to assess how correct their answer is.

Kaplan[52] (1991): Contains references of human factors type studies in different countries.

Goralski and Freeburg (1987): "The Nazis surveyed abilities of slave labor. "During WWII the German Reich commissioner of labor, Fritz Sauckel surveyed each foreign group (slave labor) working at synthetic plants and compared the results with German workers." The report concluded the French were 80-90 percent as efficient; Belgian 75-85; etc."

Dupuy[24] (1985): Describes calculating measure of combat effectiveness called casualty inflicting capability for each side of historical battles. Calculates combat effectiveness scores of one nationality versus another for historical battles.

5. Personality Factors Influencing Decision Making:

Winter, Stewart, Duncan, John, and Klohnen[53] (1998): "After reviewing classic and current conceptions of trait (as measured by questionnaires) and motive (as measured by the Thematic Apperception Test [TAT] or other imaginative verbal behavior), the authors suggest that these 2 concepts reflect 2 fundamentally different elements of personality-conceptually distinct and empirically unrelated."

Ackerman and Heggestad[54] (1997): "The authors review theories of intelligence, personality and interest as a means to establish potential overlap. Evaluations of relations among personality construct, vocational interests and intellectual abilities lead them to propose that the development of personality-interest-intelligence traits proceeds along mutually causal lines; that is abilities, interests, and personality develop in tandem."

Ghosh and Ray[55] (1997): Reports results of experiments using MBA students. "Both risk attitude and ambiguity intolerance determine choice behavior. The presence of ambiguity may often be interpreted/perceived as risk. Decision makers who are less risk averse and have more tolerance for ambiguity display greater confidence in their choice. Individuals with a low tolerance for ambiguity may interpret lack of information or lack of precise information as risk and take action that incurs cost without yielding benefit. Risk seeking and ambiguity tolerant individuals may take no action where such action may be necessary."

Reisweber[33] (1997): Successful battle commanders have the traits of cognitive complexity and behavior complexity.

Atwater, Dionne, Avolio, Camobreco, and Lau[56] (1996): One of a series of studies of cadets at the Virginia Military Institute. Among the characteristics found to be of clear consequence to leadership are cognitive ability, conscientiousness, self-confidence, energy/activity level, values, and tolerance for stress. There is work on attempting to find an instrument that measures the characteristics, cf. Lord and Hall (1992), Army Research Institute (1996), and Avolio, Dionne, Atwater, Lau, Camobreco, Whitmore and Bass (1996).

Avolio, Dionne, Atwater, Lau, Camobreco, Whitmore, and Bass[57] (1996): Study of measures of leadership conducted at Virginia Military Institute. "Early studies of leadership emergence and effectiveness concentrated on linking leader personality traits to various leader effectiveness or performance measures. Generally, clusters of characteristics seemed to differentiate effective from ineffective leaders, though no specific trait or characteristic could be deemed essential."

Schwager and Evans (1996): Measures of leadership at US Military Academy.

Spector and O'Connell[58] (1994): "Negative affectivity locus of control and type A personality have all been suggested as playing an important role in the job stress domain. Negative affectivity (NA) is defined as the tendency for an individual to experience a variety of negative emotions across time and situations. Locus of control is a personality variable that concerns people's generalized expectancies that they can or cannot control reinforcements in their lives. People who hold expectancies that they control reinforcements are considered to be internals, and people who hold expectancies that outside forces or luck controls reinforcements are considered to be externals. There are two aspects to type A personality: impatience-irritability and achievement striving." Paper reports results of a study assessing a cohort of graduating college seniors while in school and again after graduating and beginning a job. The results show that personality relates to incumbent reports of job stressors and strains.

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Robertson and Kinder[59] (1993): Results of a study to assess the criterion-related validity of some personality variables are reported.

Lord and Hall[60] (1992): "There is a need for an effective method for measuring leadership behavior. This report considers the Cadet Performance Report (CPR). CPR is a 12-dimensional leadership behavior rating system currently used to develop and evaluate the leadership performance of USMA cadets. The report examines the use of CPR to measure cadet leadership behavior."

Driskell and Salas[61] (1991): "It does not appear promising to use personality measures to predict unit effectiveness."

Jacobs and Jaques[62] (1991): Research on Meyers-Briggs Temperment Indicator (MBTI) suggests that it can be used to infer individual preference types for information source processing and cognitive style.

McGregor, Eveleigh, Syler, and Davis[63] (1991): "The type A behavior pattern has been characterized by the following traits: A sense of time urgency; Competitive achievement striving; High levels of aggressiveness and/or free-floating hostility. In contrast, Type B individuals are defined by the relative absence of these Type A characteristics."

Byrne and Reinhart[64] (1989): "Study of people in Australian Public Service. Type A behavior pattern is associated with more working weeks/year, more discretionary work hours/week, and more days/ year spent on occupation-related travel. This time commitment is instrumental in facilitating occupational achievement among those with a type A behavior pattern."

Hunt, Krzystofiak, Meindl, and Yousry[65] (1989): Decision makers of a particular cognitive style tend to prefer advisors of the same style.

Janis[66] (1989): Proposes different personality traits that influence decision making; he states that there are few generalizations that can be made about the interaction of personality and the situational factors of the decision. Discusses factors associated with poor decision making in the civilian world.

Ajzen[67] (1988): "Both theory and empirical findings negate the possibility of measuring general attitudes or personality traits and effectively/usefully using the resulting scores to predict any single behavior under a set of circumstances. There is low predictive validity of personality characteristics. The search for explanations of narrowly defined behaviors in terms of global personality traits has been difficult. There is little ability to predict specific or narrowly defined behaviors from the knowledge of people's personality characteristics. Behaviors depend too much on the specific situation."

Driskell, Hogan, and Salas (1987): "There are many different definitions of personality. It is difficult to discover consistent relationships between personality variables and stress resistance given the scarcity of reliable measures of stress proneness or stress vulnerability."

Lord, Devader, and Alliger (1986): Did a meta-analysis review of the leader trait literature. They concluded that traits did account for appreciable variance in the perception of leadership.

Nutt (1986): Studied 197 financial decision makers and found associations between information source preferences and risk aversion.

Streufert[68] (1986): Investigates personality traits associated with risky behavior: traits are type A personality; high tolerance for incongruity between past experience and contemplated risks; low cognitive complexity. Investigated personality traits that resulted in the likelihood

of adopting risky actions with highly adverse consequences. Personality traits are a Type A (success driven, time driven, competitive), high tolerance for incongruity between past experience and contemplated risks; low cognitive complexity (less integrative multidimensional information processing).

Suedfield, Coteen, and McCormick (1986) and Huntford (1980): Knowledge and understanding of personality characteristics of great leaders is sparse.

Van Fleet and Yukl[43] (1986): A study of traits and skills of leaders in military organizations found the following: ethical conduct, personal integrity; leadership effectiveness and achievement; willingness to assume responsibility; courage, daring; maintaining coordination and team work; ascendance, dominance and team work; emotional balance and control; intellectual skills; social and interpersonal skills; technical skills; group task supportiveness.

Isenberg (1985): Describes observations of six senior managers. Leaders have a high tolerance for ambiguity and perceived and understood novelty. The managers focus on defining problems so solutions can be found. They create new alternatives, keep options open, delay decision points, search for more information, and include more people in decision making functions.

Mitroff (1983): Utilized a classification scheme that recognized that individuals differ in the way that they acquire information and in the methods that they use to process data.

Sanders and Malkis[69] (1982): "Type A behavior is characterized primarily by the combination of a highly competitive achievement orientation, a sense of time urgency, and excessive hostility in response to frustration. Type As seem to have a strong investment in demonstrating that they can deliberately cause desired consequences--that is, they have a high need for control. The desire to master their environment is presumed to underlie Type As concern with competition, their strong reaction to being thwarted by frustration, and their fear of missing deadlines or wasting time."

Behling, Gifford, and Tolliver (1980): Association between cognitive style and risk taking in a betting situation.

Henderson and Nutt (1980): "Field independence is the ability to separate an object or phenomenon from its environment. Individuals showing high field independence were thought to prefer problem solving approaches which emphasize detail and basic relationships. The field dependent person shows less ability (or perhaps less inclination) to separate objects from their environment. Field dependent individuals would prefer more global, perhaps intuitive, approaches to problem solving."

Glass (1977): "Demonstrated that Type A individuals displayed greater reactions than did Type Bs to uncontrollable events that were very salient, whereas the opposite was true for events of low salience."

Glass, D., Snyder, M., and Hollis, J. (1974): "Type A individuals displayed greater impairment on a task requiring a response delay than did Type Bs. The type A subjects consistently overestimated the passage of time and responded before the delay interval had timed out."

McKenny and Keen (1974): "Have both an information-gathering and an information-evaluation dimension of style. The information-gathering dimension differentiates receptive, data-sensitive (i.e. analytic) individuals from perceptive data-filtering (i.e. intuitive) individuals. The information-evaluation dimension differentiates systematic structured decision makers (i.e. analytic) from holistic, trial and error (i.e. intuitive) problem solvers. Combination of the two dimensions results in four cognitive styles: systematic-perceptives, systematic-receptives, intuitive-perceptives and intuitive-receptives."

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6. Decision Making in a Military Organization:

Kahan, Worley, and Stasz[21] (1989): Commander spends time ensuring that subordinate commanders understand his vision; one result is faster information passing and delegation of responsibilities. In training situations the commanders want knowledge of the personal character or habits of the enemy commander. If the commander's image of the battlefield is not shared with his staff, the staff may not view a datum that does not support the image as necessitating a change of plan; surprise could result.

Van Fleet and Yukl[43] (1986): Business and industrial organizations tend to be heavily utilitarian (members perform for money) in terms of the modes of compliance obtained within them. Military organizations are normative (members perform out of duty) and to a lesser extent coercive. Normative organizations stress values more than utilitarian organizations would. A study of traits and skills of leaders in military organizations found the following to be important.

Ethical conduct, personal integrity

Leadership effectiveness and achievement

Willingness to assume responsibility

Courage, daring

Maintaining coordination and team work

Ascendance and dominance

Emotional balance and control

Intellectual skills

Social and interpersonal skills

Technical skills

Group task supportiveness

Leaders in combat situations plan for enemy actions, effectively organize and schedule unit activities and take decisive action in dealing with immediate crises.

End Notes

[1] Wickens, C.D. Engineering Psychology and Human Performance, 2nd Edition, Harper Collins Publishers, New York NY, 1992.

Summary of Chapter 7 on factors affecting decision making

Factors affecting perception

Quotations from book

Anchoring:

"The initial piece of evidence provides a cognitive "anchor" for the decision maker's belief in one of several hypotheses. Subsequent sources of evidence are not give the same amount of weight in updating beliefs but are used only to shift the anchor slightly, particularly if those sources provide evidence for the other hypothesis."

References:

Tversky, A. and Kahneman, D. (1974) "Judgment under uncertainty: heuristics and biases" Science 185 pp1124-1131

Einhorn, H. and Hogarth, R. 1982 Theory of diagnostic interference I: imagination and the psychophysics of evidence (Technical Report no. 2) Chicago: University of Chicago, School of Business

"Several researchers have developed mathematical models to describe the conservatism and anchoring involved in updating hypotheses on the basis of sequential data."

References:

Hogarth R. and H. Einhorn. "Order effect in belief updating: the belief adjustment model," Cognitive Psychology, 24 (1992) pp. 1-55.

Lopes, L.L. (1982, October). Procedural debiasing (Technical report WHIPP 15). Madison: Wisconsin Human Information Processing Program.

"Other authors have offered explanations for the phenomenon"

References:

Du Charme, W. "Response bias explanation of conservative human inference," Journal of Experimental Psychology, 85 (1970) pp. 66-74.

Edwards, W., L. D. Phillips, W. L. Hays, and B. C. Goodman. "Probabilistic information processing systems: design and evaluation," IEEE Transactions on Systems, Science, and Cybernetics, SCC-4 (1968) pp. 248-265.

Navon, D. "The importance of being conservative," British Journal of Mathematical and Statistical Psychology, 31 (1979) pp. 33-48.

"A study of professional Army intelligence analysts demonstrates anchoring. The analysts were given varying pieces of information regarding the intent of an enemy force. After establishing an initial hypothesis, the analysts gave considerable more weight to evidence consistent with that initial hypothesis than to evidence that was contrary."

References:

Tolcott, M. A., F. F. Marvin, and T. A. Bresoick. "The confirmation bias in military situation assessment," Decision Science Consortium, Reston VA, 1989.

"One implication of the anchoring heuristic is that the strength of belief in one hypothesis over another will be different, and may even reverse, depending on the order in which evidence is perceived."

References:

Allen, G. (1982) "Probability judgment in weather forecasting" Ninth Conference in Weather Forecasting and Analysis. Boston: American Meteorological Society

Hogarth R. and H. Einhorn. "Order effect in belief updating: the belief adjustment model," Cognitive Psychology, 24 (1992) pp. 1-55.

"Because of limits in memory, people encounter a number of problems when aggregating evidence over time. These may be attributed to the tendency to give undue weight to early cues in a sequence (primacy) and the initially formulated hypothesis (anchoring) as well as the tendency to overweight those cues that have occurred most recently and therefore are fresh in working memory (recency)."

"Under time stress, decision-making performance deteriorated when more rather than less information was provided."

Reference:

Wright, P. "The harassed decision maker: time pressures, distractions, and the use of evidence," Journal of Applied Psychology, 59 (1974) pp. 555-561.

"Despite these limitations, people have an unfortunate tendency to seek far more information than they can absorb adequately. The admiral or executive, for example, will demand all the facts."

Reference:

Samet, M. G., Weltman, G., and Davis, K. B. (1976, December). Application of adaptive models to information selection in C3 systems (Technical Report PTR-1033-76-12) Woodland Hills CA: Perceptronics.

"Decision makers can extract more implications from unreliable data than are warranted."

References:

Johnson, E. M., R.C. Cavanagh, R. L. Spooner, and M. G. Samet. "Utilization of reliability measurements in Bayesian inference: models and human performance," IEEE Transactions on Reliability, 22 (1973) pp. 176-183.

Schun, D. "The weighing of testimony of judicial proceedings from sources having reduced credibility," Human Factors, 17 (1975) pp. 172-203

"Even those well trained in statistical theory do not down-weight unreliable predictions of a criterion variable when making "intuitive" predictions."

Reference:

Kahneman, D. and A. Tversky. "On the psychology of prediction," Psychological Review, 80 (1973) pp. 251-273.

"The two heuristics, representativeness (the degree to which the data "look like" those of a hypothesis) and availability (the ease of recalling the hypothesis), are simplifying techniques that the decision maker uses intuitively and automatically to approximate information concerning the data and prior probabilities, respectively."

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References:

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

        Tversky, A. and D. Kahneman. "Judgment under uncertainty: heuristics and biases,". Science, 211 (1974) pp. 453-458.

"In the incident at the Three Mile Island nuclear plant, the incorrect initial formulation of a hypothesis was a major cause of the crisis."

Rubenstein, T. and A. F. Mason. "The accident that shouldn't have happened: an analysis of Three Mile Island," IEEE Spectrum, (1979, November) pp. 33-57.

"Operators tend to seek (and therefore find) information that confirms the chosen hypothesis and to avoid information or tests whose outcome could not confirm it."

References:

        Einhorn, H. J. and R. M. Hogarth. "Confidence in judgment: persistence of the illusion of validity," Psychological Review, 85 (1978) pp. 395-416.

Mynatt, C. R., M. E. Doherty, and R. D. Tweney. "Confirmation bias in a simulated research environment: an experimental study of scientific inference," Quarterly Journal of Experimental Psychology, 29 (1977) pp. 85-95.

Schustak, M. W. and R. J. Sternberg. "Evaluation of evidence in causal inference," Journal of Experimental Psychology: General, 110 (1981) pp. 101-120.

        Wason, P.C. and P.N. Johnson-Laird. Psychology of Reasoning: Structure and Content, Batsford, London, 1972.

"This Bias produces a sort of "cognitive tunnel vision" in which operators fail to encode or process information that is contradictory to or inconsistent with the initially formulated hypothesis. Such tunneling seems to be enhanced under conditions of high stress and workload."

References:

Sheridan, T. "Understanding human error and aiding human diagnostic behavior in nuclear power plants." In J. Rasmussen and W. Rouse (Eds.), Human Detection and Diagnosis of System Failures, Plenum Press, New York, 1981.

"A study of the Vincennes incident concluded that operators of the radar system hypothesized early on that the approaching aircraft was hostile, and they did not interpret the contradictory (and as it turned out, correct) evidence offered by the radar system about the aircraft's neutral status."

References:

Tolcott, M. A., F. F. Marvin, and T. A. Bresoick. "The confirmation bias in military situation assessment," Decision Science Consortium, Reston VA, 1989.

        U.S. Navy, (1988) Investigation report: formal investigation into the circumstances surrounding the downing of Iran air flight 655 on 3 July 1988. Washington, DC: Department of Defense Investigation Report.

"The one part of the study of military intelligence analysts by Tolcott, Marvin and Bresnick (1989) analysts were offered their choice of information to seek that would confirm or refute their initial hypothesis about the hostile situation of the enemy. Consistently analysts sought that information that would confirm the hypothesis."

Keeney (1988) has summarized 12 "facts" about risks that should guide the choices people make in everyday life. Other discussion relating to risk perception and public policy

References:

Keeney, R. L. "Facts to guide thinking about life threatening risks," Proceedings of 1988 IEEE Conference on Systems, Man and Cybernetics. Pergamon-CNPIEC, Beijing, China, 1988.

Slovic, P., B. Fischhoff, and S. Lichtenstein. "Behavioral decision theory perspectives on risk and safety," Acta Psychologica, 56 (1984) pp. 183-203.

Sprent, P. Taking Risks: The Science of Uncertainty. Penguin, England, 1988.

"The last 2 articles point out the extent to which moral and ethical issues become involved in risk perception and public policy."

Other papers of some interest may be

Tversky, A., and Kahneman, D. (1984) Choices, values, and frames. American Psychologist, 39, pp341-350.

Kahneman, D. and A. Tversky. "On the psychology of prediction," Psychological Review, 80 (1973) pp. 251-273.

Arkes, H. and R. R. Harkness. "The effect of making a diagnosis on subsequent recognition of symptoms," Journal of Experimental Psychology: Human Learning and Memory, 6 (1980) pp. 568-575.

Brehmer, B. "Models of diagnostic judgment." In J. Rasmussen and W. Rouse (Eds.), Human Detection and Diagnosis of System Failures, New York, Plenum Press, 1981.

Dawes, R. M., D. Faust, and P. E. Meehl. "Clinical versus statistical judgment," Science, 243 (1989) pp. 1668-1673.

Edwards, W. "Decision making." In G. Salvendy (Ed), Handbook of Human Factors (pp. 1061-1104), Wiley, New York, 1987.

Einhorn, H. J. and R. M. Hogarth. "Confidence in judgment: persistence of the illusion of validity," Psychological Review, 85 (1978) pp. 395-416.

Gardiner, P. D. and W. Edwards. "Public values: multiattribute ability measurement for social decision making." In M.F. Kaplan and B. Schwartz (Eds.), Human Judgment and Decision Processes, Academic Press, New York, 1975.

Klayman, J. and Y. W. Ha. "Confirmation, disconfirmation, and information in hypothesis testing," Journal of Experimental Psychology: Human Learning and Memory, (1987) pp. 211-228.

Kleinmutz, D. "Cognitive heuristics and feedback in a dynamic decision environment," Management Science, 31 (1985) pp. 680-702.

Kleinmuntz, B. "Why we still use our heads instead of formulas: toward an integrative approach," Psychological Bulletin, 107(3), (1990) pp. 296-310.

Slovic, P., B. Fischhoff, and S. Lichtenstein. "Perceived risk: psychological factors and social implications." In F. Warner and D. H. Slater (Eds.), The Assessment and Perception of Risk (pp. 17-34), Royal Society, London, 1981.

Slovic, P., S. Lichtenstein, and B. Fischhoff. "Decision making." In R. C. Atkinson, R. J. Herrnstein, G. Lindzey, and R. D. Luce (Eds.) Stevens Handbook of Experimental Psychology (2nd edition), Wiley, New York, 1988.

Slovic, P., B. Fischhoff, and S. Lichtenstein. "Behavioral decision theory," Annual Review of Psychology, 28 (1977) pp. 1-39.

Sniezek, J. A. "Judgments of probabilistic events: remembering the past and predicting the future," Journal of Experimental Psychology: Human Perception and Performance, 6 (1980) pp. 695-706.

Tversky, A. and D. Kahneman. "The law of small numbers," Psychological Bulletin, 76 (1971) pp. 105-110.

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[2] Brander, G. N. and N. Scard. "Models of Human Decision Making" DRA/CIS/CSS5/CR94024/1.0, Defence Research Agency, Farnborough, Hampshire, GU14 6TD, United Kingdom, Oct. 1994.

"The report summarizes and reviews a range of models of human decision making. The viewpoint of the report is relating different types of decision-making models to the development of decision aids. This report addresses the various different types of models and their purposes and provides a flavour of the alternative approaches over the past few decades, leading up to the current naturalistic approaches. The focus of the review and of the models it describes is on decision making or the cognitive behavior of experts in response to uncertain information usually under time stress and wherever possible in the complex open and adversarial system domain which is the arena for military decisions and actions.

The report concentrates on the differentiation between what appear to be two main themes: analytical and naturalistic approaches.

Analytical strategies tend to focus upon the moment of choice and are concerned with how the decision maker selects a course of action. This selection process requires the consideration of more than one option. Additionally, analytical approaches usually assume that the decision maker is rational, in that he will always seek to optimize the outcome by choosing the option that will produce the maximum benefit.

Naturalistic decision approaches emphasize the way people make decisions in their daily lives, on a personal level, as well as in their work. Naturalistic strategies concentrate on explaining how decision makers develop an understanding of the problem situation and arrive at a course of action. Real world, real-time problems are often characterized by uncertainty, time pressure and risk. Situation understanding is critical and naturalistic approaches offer models of how human decision makers construct their situation assessments.

The relationships and similarities between the models are discussed with respect to the development of human expertise and with reference to what cognitive processes might occur during an evolving decision scenario. The naturalistic approach is selected as offering the most intuitively elegant explanation of human decision making strategies.

The naturalistic decision making movement has grown to the point where it is perhaps the dominant theme in current human factors activity in the US Military;" (Tolcott, M. A. "Understanding and aiding military decisions" Paper presented at the 27th International Applied Military Psychology Symposium Stockholm, Sweden, June 1991). "The models beginning to emerge from this work, which has a great emphasis on field research, are empirical, descriptive, and have much explanatory power."

Leedom, D. K. "Representing human thought and response in military conflict simulation models" in Symposium on Modelling and Simulation of Avionics systems and Command and Control Systems. AGARD (NATO) Conference Proceedings No. 268, National Technical Information Service. Oct. 15-19, 1979: "surveyed the literature in cognitive and behavioral sciences and concluded that one can only construct a partial model of decision making".

Wohl (Wohl, J. G. "Force management decision requirements for Air Force tactical command and control" IEEE Transactions on Systems, Man and Cybernetics, 1981, Vol. SMC-11 no. 9, pp618-639):"introduces the SHOR paradigm as basically an extension of the stimulus-response paradigm of classical behaviorist psychology and providing explicitly for the necessity to deal with two realms of uncertainty in the decision making process:

a) Information input uncertainty, which creates the need for hypothesis generation and evaluation

b) Consequence of action uncertainty, which creates the need for option generation and evaluation

Wohl is supportive of Janis and Mann's conflict theory paradigm. He suggests that three determinants of decision making behaviour clearly and directly affect the creation, evaluation and selection of hypotheses and options by influencing information seeking behavior. These three determinants are

a) Risks: information about potential losses

b) Alternatives: information about availability of potential new alternatives

c) Time: information about deadline pressures or time available for deliberation

Janis and Mann do not consider military decision making. As a result, Wohl proposes modifications to Janis and Mann's paradigm to include the risks and costs of information seeking as opposed to giving information to the enemy, particularly information regarding position and intent. He also proposes a new behavior pattern called "offensive pursuit." His modified paradigm is relatively independent of personality variable and individual differences in tolerance of stress and uncertainty."

Klein, G. A., "Naturalistic models of C3 decision making" In Science of Command and Control: Coping with Uncertainty. Johnson, S. E. and Levis, A. H. (Eds.). 1988 Washington, DC: ATCEA International Press: "Klein's naturalistic decision making strategy includes his RPD (Recognition primed decision) model. The major components of the RPD model are

a) Recognition of situations

   Feature matching

   Story generation

   Managing the situations: by incremental decision making or by developing plans

   Expectancies

   Typical actions

b) Serial evaluation

   COA options are generated and evaluated serially until one that seems to be satisfactory is identified; satisfying strategy

c) Progressive deepening.

   Evaluating a COA by imagining the implementation of that action

Klein does not advocate the RPD model as the only model of human decision making, merely as one of the strategies used by experts under time stress and uncertainty."

MacCrimmon, K. R. and Wehrung, D.A Taking Risks, The Management of Uncertainty, Free Press 1986: "description of behavior in a risky situation is that the decision maker copes with 3 determinants of risk:

a) Lack of time

b) Lack of information and

c) Lack of control

For some characteristics of people that account for variance in the behavior." See Wickens, C. D. Engineering Psychology and Human Performance 2nd edition, Harper Collins Publishers, New York, NY, 1992.

"Janis and Mann address the sort of decisions in which the decision maker is not, or cannot be an expert. It is focused on decisions in which it is far from clear what courses of action are likely to be appropriate.

It is unknown if the naturalistic decision strategies persist at higher levels of command.

To augment the fidelity of combat simulations to include representative human decision making responses it is probably unnecessary to have models, which fully emulate human decision making. What is required are models which exhibit responses typical of the intelligent behavior of experts in responding to familiar situations and which can make typical error of situation assessment of response activation. See Morgon's Adaptive Decision Maker as an option."

Morgon, P. D. "Simulation of an adaptive behavior mechanism in an expert decision maker" IEEE Transactions on Systems, Man and Cybernetics Vol. 23, No. 1, 1993, pp. 65-76.

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[3] Mellers, A. A. Schwartz, and A. D. J. Cooke. "Judgment and decision making," Annual Review of Psychology, 49 (1998) pp. 447-477.

"Review of research on judgment and decision making from 1992-1996. It concentrates on rational choice theory and argues that changes may be needed."

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[4] Adelman, L., T. A. Bresnick, M. Christian, J. Gualtieri, and D. Minionis. "Demonstrating the effect of context on order effects for an Army air defense task using the Patriot simulator," J. of Behavioral Decision Making, 10 (1997) pp. 327-342.

Hogarth and Einhorn's experiments were with college students. There is, however empirical support for recency effects with experienced personnel:

Ashton, R. H. and A. H. Ashton. "Evidence-responsiveness in professional judgement: effects of positive versus negative evidence and presentation mode," Organization Behavior and Human Decision Processes, 46 (1990) pp. 1-19.

Serfaty, D., E. Entin, and R. Tenny. "Planning with uncertain and conflicting information." In Johnson, S. E. and Levis, A. H. (Eds.), Science of Command and Control: Coping with Complexity, (pp. 91-100), AFCEA International Press, Fairfax VA, 1989.

Adelman, L., M. A. Tolcott, and T. A. Bresnick. "Examining the effect of information order on expert judgment," Organizational Behavior and Human Decision Processes, 56 (1993) pp. 348-369.

Adelman, L. and T. A. Bresnick. "Examining the effect of information sequence on expert judgement: an experiment with Patriot air defense officers using the Patriot air defense simulator," Organizational Behavior and Human Decision Processes, 53 (1992) pp. 204-228.

Adelman, L., T. A. Bresnick, M. Christian, J. Gualtieri, and D. Minionis. "Demonstrating the effect of context on order effects for an Army air defense task using the Patriot simulator," J. of Behavioral Decision Making, 10 (1997) pp. 327-342.

The authors did an experiment using a Patriot simulator. The experiment involved deciding if an incoming aircraft was friend or foe. "The results of the experiment support a hypothesis that contextual features of a task can significantly affect the type of judgment processes people use, both individually and in two person teams and, in turn, the type of information order effect observed. The context of the information can alter meaning of information, leading to information reinterpretations People may use anchoring and adjustment as a default strategy when there is no basis (e.g. explanation) for interpreting information. The participants in the experiment saw the Patriot's system identification of an incoming aircraft. Participants had minimal hesitation in disagreeing with the system's recommendation. Training protocols and decision support algorithms are supposed to eliminate order effects." Another paper of possible interest is

Pennington, N. and R. Hastie. "A theory of explanation-based decision making." In G. A. Klein, J. Orasanu, R. Calderwood, and C. E. Zsambok (Eds.), Decision Making in Action: Models and Methods, (pp. 188-201), Ablex, Norwood NJ, 1993.

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[5] Zeelenberg M. and J. Beattie. "Consequences of regret aversion 2: additional evidence for effects of feedback on decision making," Organizational Behavior and Human Decision Processes, 72 (1997) pp. 63-78.

"People are motivated to avoid or minimize post-decisional regret. As a result people can become risk averse or risk seeking, depending on which of the possible choice options is the regret minimizing option. This motivation exerts impact on their decisions, because the possibility of future regret is anticipated and taken into account when making decisions and because experienced retrospective regret promotes decisions that make this regret disappear (the so-called regret management). There might be cases, however, in which one can argue that regret results in bad decisions or in reduced learning from experience (because feedback is avoided)"

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[6] Kuhn K. M and D. V. Budescu. "The relative importance of probabilities, outcomes, and vagueness in hazard risk decisions," Organizational Behavior and Human Decision Processes, 68 (1996) pp. 301-317.

"Numerous empirical studies on risky decision making have demonstrated that decision makers are generally averse to taking risks with imprecisely specified (vague) probabilities and are often even willing to pay a premium to avoid vagueness.

Individual attitudes toward risk and toward vagueness are not closely associated suggesting that attitude toward vagueness is an important, distinct and independent factor in decision behavior.

Vagueness is only aversive if it makes decision makers feel comparatively less knowledgeable or informed; the observed bias results from an aversion to choosing options with missing information that could consequently lead to greater blame or regret if the decision proves to be a poor one.

Vagueness includes: being unable to specify exact probabilities for all consequences; the magnitude of the resulting outcomes; or even what all the possible outcomes may be.

The effects of vagueness on the outcome dimension of risks have received much less attention than has the probability dimension. In Subjective Expected Utility (SEU) vagueness of information about outcomes is modeled by a probability distribution on values around a point estimate.

The authors do a study to investigate the joint effects of vagueness about both the probability of a loss and the actual magnitude of the loss on evaluations of hazard risks.

The authors found a clear tendency for the subjects to rate vaguely specified scenarios as more risky."

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[7] Svenson, O. "Decision making and the search for fundamental psychological regularities: what can be learned for a process perspective," Organizational Behavior and Human Decision Processes, 65 (1996) pp. 252-267.

"Author proposes differentiation and consolidation theory to provide a framework to discuss developments in decision making and to study regularities in decision making

(Following the paper is commentary on Svenson's paper by H. R. Arkes

Arkes, H. R. "The temperature of diff con theory," Organizational Behavior and Human Decision Processes, 65 (1996) pp. 268-271.

Hot cognition errors have come to mean motivated mistakes. Cold cognitive errors are considered to be unmotivated. Instead they are a consequence of the normal operation of the human information processing system.)

The purpose of a decision process is to select one of two or more decision alternatives. The goal of a decision process is to create an alternative that is sufficiently superior in comparison to its competitor(s) through restructuring and application of one or several decision rules. The structuring principles are not derived from one rule only (e.g. subjective expected utility (SEU) or dominance) but from a number of different rules contingent on the situation and the person in that situation. This process is named differentiation. The corresponding postdecision process in support of the chosen alternative is called consolidation."

Reference:

Busemeyer, J. R. and J. T. Townsend. "Decision field theory: a dynamic-cognitive approach to decision making in uncertain environment," Psychological Review, 100 (1993) pp. 432-459.

"Diff Con theory assumes that sufficient differentiation protects the decision maker from external (e.g. poor outcome) and internal (e.g. change of own values) threats to the preference of the chosen alternative. The goal in Diff Con theory is to achieve differentiation in a balanced way in which pros and cons together contribute to a sufficient degree of differentiation. Diff Con theory assumes that a minimization of effort principle is at work. It is assumed that retrospectively questioning a chosen alternative or changing it generally requires effort, which a decision maker wants to minimize. However, predecision differentiation also requires energetic effort, which leads to a readiness to learn from decisions and routinize them. Following a decision several threats against the choice appear (loosing the good aspects of the non-chosen alternative, stuck with the poor aspects of the chosen alternative, unpredicted events, new perspectives on the decision in retrospect, etc.) which have to be handled. Diff Con theory assumes that one way of handling this post-decision regret or dissonance is to continue differentiating the chosen alternative after the decision in what is now called consolidation.

Diff Con theory uses an alternative x attribute representation."

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[8] Kerstholt, J. H. "Decision making in a dynamic situation: the effect of false alarms and time pressure," J. of Behavioral Decision Making, 18 (1995) pp. 181-200.

Kerstholt conducted an experiment in which the college students were asked to monitor the fitness level of a fictitious athlete and intervene if necessary. If the fitness level decreased, the subjects could either intervene directly or ask for diagnostic information. The subjects were also presented with false alarms and the time needed for intervention was varied. The subjects tended to ask for diagnostic information rather than act directly. The greater the false alarm rate, the longer the time until the subjects intervened.

Process-tracing studies of decision-making behavior have consistently shown that the selection of a decision strategy depends on task factors such as complexity and time pressure; see

Ford, J. K., N. Schmitt, S. L. Schechtman, B. M. Hults, and M. L. Doherty. "Process tracing methods: contributions, problems, and neglected research questions," Organizational Behavior and Human Decision Processes, 43 (1989) pp. 75-117.

In the book

Payne, J. W., J. R. Bettman, and E. J. Johnson. The Adaptive Decision Maker. Cambridge University Press, Cambridge, England, 1993.

The authors conclude that decision strategy selection is not just contingent but fundamentally adaptive: individuals select a strategy that results in fairly accurate decisions, but with a minimum amount of effort.

Deadlines to complete static tasks cause subjects to speed up processing of information and switch to simpler decision strategies which can work with less information; see

Payne, J. W., J. R. Bettman, and E. J. Johnson. "Adaptive strategy selection in decision making," J. of Experimental Psychology: Learning, Memory and Cognition, 14 (1988) pp. 534-552.

Maule, A. J. and P. Mackie. " A componential investigation of the effects of deadlines on individual decision making." In Borcherding, K., Larichev, O. I., and Messick, D. M. (Eds.) Contemporary Issues in Decision Making" North –Holland, Amsterdam, 1990.

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[9] Rogers, C. T. "Intuition: an imperative of command," Military Review, (March 1994) pp. 38-50.

"The more information a commander gets, the more reluctant he is to make decisions. He either becomes overloaded or delays making a decision in the belief that if he waits he will receive the vital piece of information that tends never to come. Advances in technology are actually speeding up the actions and slowing down the decision making in any decision/ action cycle. An analytical approach to decision making seems to run contrary to the requirements of the modern battlefield.

Intuitive decision making is high risk and relies on a degree of rationality in the individual making the decision. The stresses and strains of the battlefield, however, can undermine this rationality, whether it is fear or lack or sleep. The need for a safety check on intuitive decisions made by a military commander is vital.

There is a fundamental link between training, experience and technological competence that provides the knowledge required to make intuitive decisions

Maneuver warfare can be broken down into 2 components. First, the physical ability to move and apply force faster than the enemy, which in simple terms relates to equipment and technology and second on the speed of decision making. If all things are equal, then decision making speed relative to that of the enemy becomes all important.

A commander must be unpredictable, imaginative, and instinctive and must weigh the factor of surprise as critical to his plans. To achieve this, a commander needs initiative or "command pull" based on intuition rather than "staff push" which is akin to the more analytical decision making. Analytical approach to decision making has its place before the battle when time is not pressing and there is the ability to analyze problems exhaustively.

The use of instinct or intuition in decision making is related to lack of information and time available and is more useful in battle command than in battle preparation. If a commander ties himself to a command post, his decisions will be slow and predictable. Information received at the command post may not be sufficient to paint an accurate tactical picture and valuable time could be lost trying to confirm the actual combat situation. The commander cannot afford to wait until all information has been gathered and processed.

Maneuver warfare implies that you accept and encourage confusion and the accompanying "friction of war". It is with this uncertainty that the analytical approach to command has difficulty. It craves for certainty that is not there in warfare, and this craving leads to a requirement for more information, which is in itself time consuming.

There are two basic methods of decision making: Decisions based on an exhaustive analysis of factors; and one based on intuition which emphasizes decisions based on the ability of a commander to rapidly process information gained from knowledge and experience. The demand for certainty on the battlefield leads to a demand for more information. The danger is that the commander may believe that he never has sufficient information to make a decision and so he delays that decision.

In a battle command situation it is important that commanders are not bombarded with information but have sufficient knowledge themselves to ask the right questions of their staff.

Training time with troops and teaching at military schools are the crucial jobs in the development of future battlefield commanders. Commanders will have to lead and maneuver soldiers on the training battlefield to develop intuition. It is important in training to develop situations that allow individuals to make intuitive decisions, which means experimentation and tolerating mistakes.

Commanders must be technologically competent with their weapon systems and their equipment. They must know the capabilities, limitations and the most effective means of employment for every system they control. To develop intuition there is a need to concentrate on warfighting with emphasis on uncertainty and speed of thought.

Intuition is the product of a well-organized body of experience and knowledge that can be rapidly processed to make quick decisions. This speed of decision making is obviously vital for the successful prosecution of warfighting where the decision cycle is time competitive. Any decisions made by intuition are the products of an individual and are subject to that individual's rationality. There is thus a need for some kind of safety check in the process."

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[10] Whyte G. and A. S. Levi. "The origins and function of the reference point in risky group decision making the case of the Cuban missile crisis," Journal of Behavioral Decision Making, 7 (1994) pp. 243-260.

"The context in which a decision is made may influence judgment and ultimately choice. One such context effect is the reference level or standard of comparison. The authors use historical documentation from the Cuban missile crisis to examine the role of the reference point."

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[11] Morgan, M. G. and M. Henrion. Uncertainty: A Guide to Dealing with Uncertainty in Qualitative Risk and Policy Analysis Cambridge University Press, 1993.

"Policy analysis deals with problem situations that are ill defined and that have been termed messy (Ackoff, R. L. Redesigning the Future Wiley, New York 1974)

The following alternative Decision Criteria that may be applied in policy analysis to manage risk

Utility based criteria

Deterministic Benefit-cost

Probabilistic benefit-cost (Expected value)

Cost effectiveness

Bounded Cost

Maximize multi-attribute utility

Minimize chance of worst possible outcome

Rights based criteria

Zero Risk: Independent of the benefits and costs and of how big the risks are, eliminate the risks, or do not allow their introduction

Bounded or constrained risk

Technology based criteria

Best Available Technology

There are circumstances that involve a single clearly identified and authorized decision maker. However they are the exception. Most policy decisions involve complex political and organizational interactions with a variety of individual and institutional actors.

When process considerations are dominant and many different actors with different objective and interests are involved, it may become difficult or impossible to apply a single coherent formulation and decision criterion to a decision process.

Ten commandments for good policy analysis

1. Do your homework with literature, experts and users

2. Let the problem drive the analysis

3. Make the analysis as simple as possible, but no simpler

4. Identify all significant assumptions

5. Be explicit about decision criteria and policy strategies

6. Be explicit about uncertainties

7. Perform systematic sensitivity and uncertainty analysis

8. Iteratively refine the problem statement and the analysis

9. Document clearly and completely

10. Expose the work to peer review

People making judgements in the presence of uncertainty use heuristic procedures:

Availability: probability judgement is driven by the ease with which previous occurrences of the event have occurred, can be recalled, or can be imagined to occur

Representativeness: when worthless specific evidence is given, prior probabilities are ignored

Anchoring and adjustment: A natural starting point or anchor is selected as a first approximation to the value of the quantity being estimated and then this value is adjusted to reflected supplementary information.

The explicit treatment of uncertainty in policy analysis may be worthwhile in the following circumstances

1. The decision maker has significant risk-aversion

2. Uncertain information from several sources must be combined

3. Decisions about whether to buy additional information to reduce uncertainty must be made

4. The loss function is highly asymmetric in an uncertain quantity

5. Some important uncertain quantity has a highly asymmetric distribution

6. Thorough examination of the uncertainty about a quantity may change the "best estimate"

7. Consideration of uncertainties can be used as a guide for model refinement

8. There is a need to assess the reliability of the analysis to help decision makers know how much weight to give to it

9. The policy analysts feel an ethical responsibility to be clear about the limitations of their analysis"

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[12] Veit, C. T. and M. Callero. "Criteria for validating human judgments and developing behavioral representation models." Prepared for the Society for Computer Simulation, 1993 Summer Computer Simulation Conference, July 19-21, 1993, Boston Mass. RAND paper P-7823 RAND, Santa Monica CA, 1993.

"This paper discusses criteria for human judgment validation. The focus of this paper is on models of human judgments. The model (alternatively theory or rule) is the interpretation of the judgment data. These interpretations are often formulated into algorithms and incorporated into simulations. For example, combat simulation models contain rules for determining military war plans, target engagement, force deployment, and other commanders' decisions. The validity question is: how is it possible to know if the algorithms actually reflect the commander's or other judge's perceptions? The theme of the paper is that interpretations of human judgments should be treated as hypotheses and formulated in such a way that they can be tested and rejected if empirical evidence does not support their claims.

About ½ century ago, psychologists began developing experimental designs that made it possible to test judgment theories expressed in the form of algebraic functions. This approach included functional measurement (Anderson (1970, 1981)) and conjoint Measurement (Krantz et al. (1971); Krantz and Tversky, (1971); Veit (1978)) Extensions of this approach produced what is called modern measurement (for example Birnbaum (1974) Birnbaum and Veit (1974a)"

References:

Birnbaum, M. H. "The nonadditivity of personality impressions" J. of Experimental Psychology Monograph, 1974 102, 543.

Birnbaum, M. H., and C. T. Veit, "Scale-free tests of an averaging model for the size-weight illusion" Perception and psychophysics, 1974a, 16, 276-282.

Krantz, D. H., R. D. Luce, P. Suppes, and A. Tversky, Foundations of Measurement Academic Press New York 1971

Krantz, D. H., and A. Tversky. "Conjoint-measurement analysis of composition rules in psychology," Psychological Review, 1971 78 151-169.

Anderson, N. H. "Functional measurement and psychophysical judgment." Psychological Review, 1970, 77 pp153-170.

Anderson, N. H. Foundations of Information Integration Theory Academic Press 1981.

Veit, C. T. "Ratio and subtractive processes in psychophysical judgment" J. of Experimental Psychology 107 (1978) ,1, pp81-107.

"The conceptualization of human judgment process proposes that people transform stimulus information (S) into subjective values by the function (H) referred to as the psychophysical, psychological, or utility function. Subjective values are then combined to form a subjective response (r) by the integration function (I) (the algebraic specification of the judgment combination process); the subjective response is then transformed by the judgment function (J) into an overt response, R.

The focus in modern measurement is testing theories about subjective events that occur after a respondent is presented with information and before he produces a response. The idea is to formulate experimental designs that make it possible to discover the algebra that underlies judgments, which in turn allows knowledge of the subjective values. When an adequate experimental design is employed, different algebraic theories predict different orderings of the magnitudes of judgements to different situations. After responses to all situations are obtained, the ordering predicted by different theories can be compared with the data's order. The subjective scale values (the algebraic model's parameters) are derived from the judgment data in accord with the algebraic model; model parameters are estimated by least squares or maximum likelihood, etc.

Many modeling problems can be termed complex because there are multiple events that occur in parallel or sequentially within a system. When human judgements are used in complex system analyses to determine and measure the effects of such sequential or parallel processes on overall system outcomes, the measurement problem is not only to credibly capture how people think about what affects their ability to do their job but also to credibly interlink sequential or parallel judgments made by the same or different subject matter experts within a system. The Subjective Transfer Function (STF) Approach (Veit and Callero, 1981; Veit, et al., 1984) was developed to achieve these goals in complex system analysis"

Veit, C. T., and M. Callero, "Subjective transfer function approach to complex system analysis." The RAND Corporation, R-2719-AF, 1981.

Veit, C. T., M. Callero, and B. J. Rose, "Introduction to the subjective transfer function approach to analyzing systems." The RAND corporation, R-31021-AF, 1984

"A sketchy example involving soldiers operating a forward area air defense system (FAADS) is given. The FAADS firing decisionmakers participated in developing the structure and factor definitions. Their focus was on what they thought would happen based on their training and experience, not necessarily on what should happen based on published doctrine. The factors determined to be of

importance in determining the likelihood an aircraft is an enemy were: the last event the air defense unit experienced; the aircraft's actions; the air defense warning level; and the "enemy or "friendly" report they receive from an Advanced Identification Device (AID) that has a known validity."

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[13] Hogarth R. and H. Einhorn. "Order effects in belief updating: the belief adjustment model," <u>Cognitive Psychology</u>, 24 (1992) pp. 1-55.

"A great challenge to those interested in decision making has been the extreme sensitivity of judgment and choice to seemingly minor changes in tasks. There has been a great deal of work studying the effects that the order in which evidence is made available to a decision maker have on the updating of his belief concerning a specific proposition or hypothesis. Sometimes the first in a series of items dominates (primacy), sometimes the latter (a recency effect)"

This paper proposes mathematical models for how people update their beliefs given the numerical evidence presented to them. The basic structure of the belief updating model proposed is an anchoring-and adjustment process. This model is proposed to explain how different ordered sequences of the same information can result in different judgements. There are assumptions concerning the encoding of evidence, the mode of processing and the adjustment weight."

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[14] Shanteau, J. and T.R. Stewart. "Why study expert decision making? Some historical perspectives and comments," <u>Organizational Behavior and Human Decision Processes</u>, 53 (1992) pp. 95-106.

"The conclusion from psychometric research is that experts are lacking validity and reliability and that more information increases confidence but not accuracy.

Extensive use of multiple regression methods for modeling judgement began in the 1950s. The evidence shows that linear models of experts and nonexperts alike contain a small number of significant factors. A robust finding in research on human judgment is that relatively few cues account for virtually all of the systematic variance.

In the decision-making literature, a common explanation for the low level of performance by experts is that they rely on heuristics in making judgments. Although these heuristics are often functional, they can lead to systematic biases or errors.

There has been much debate about whether commonly accepted findings extend from student subjects to experts.

Most judgment decision making research has focused on the deficiencies of experts. Research in cognitive psychology has elicited many special ways by which experts think and solve problems;"

Chi, M. T. H., R. Gleser, and M. J. Farr. <u>The Nature of Expertise</u>. Erlbaum, Hillsdale NJ, 1988.

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[15] Pitz, G. F. and N. J Sachs. "Judgement and decision: theory and application," <u>Annual Review of Psychology</u>, 35 (1984) pp. 139-63.

"A judgment or decision making (JDM) task is characterized either by uncertainty of information or outcome or by a concern for a person's preferences or both. The prescriptions for consistent behavior are generally derived from formal probability theory and from Expected Utility (EU) theory. Bayesian decision theory is a prescriptive theory of choice based on a combination of probability theory and EU theory.

Numerous authors have demonstrated that judgments depart significantly from the prescriptions of formal decision theory. To account for the findings, investigators have explored the information processing strategies, or heuristics, that people use when making judgments. The significance of these inconsistencies and the status of judgmental heuristics has been a matter of dispute. The current paper is concerned with the degree to which prescriptive models clarify the JDM process itself.

Functional measurement methodology developed by N. H. Anderson (1970) and social judgment theory (Hammond et al 1975) use algebraic models to show how judgments are related to stimulus information. Models have also been used to test hypotheses about the details of information processing (Wallsten and Barton 1982, Wilkening and Anderson 1982).

Payne 1982 suggests that a person might use any of a number of strategies to arrive at a judgment or decision. Beach and Mitchell (1978) suggest that the choice of strategy depends on the cognitive effort that it requires. There exists, therefore, a higher level process of cost-benefit analysis (Payne 1982) that might be used to select a strategy.

The prescriptions of EU theory and its extensions can be presented in algebraic form. There are other algebraic models of judgement and decision that are not derived from normative considerations. The best known is N. H. Anderson's information integration theory (IIT: Anderson 1981), which uses algebraic formulations to describe judgments based on multiple sources of information. Hammond's social judgment theory (SJT: Hammond et al 1975) based on Brunswik's (1952) lens model, makes use of correlation and regression analysis to relate judgments to environmental variables. SJT generally uses external measurements of environmental cues. Both theoretical approaches are concerned with the process by which information from different sources is combined. Most algebraic models rely on some version of a linear combination rule, at least as a first approximation.

Many variables other than those to which a person is asked to respond to can be shown to affect the judgment."

References:

Anderson, N. H. Foundations of Information Integration Theory. Academic Press, 1981.

Anderson, N. H. "Functional measurement and psychophysical judgment," Psychol. Rev. 77 (1970) pp. 153-170.

Brunswick, E. "The conceptual framework of psychology." In International Encyclopedia of Unified Science. Univ. Chicago Press, Chicago IL, 1952.

Beach, L. R. and T. R. Mitchell. "A contingency model for the selection of decision strategies," Acad. Manage. Rev. 3 (1978) pp. 439-449.

Hammond, K. R., T. R. Stewart, B. Brehmer, and D. Steinman. "Social judgment theory." In Human Judgment and Decision Processes, ed. M. Kaplan, S. Schwartz, pp. 271-312. New York: Academic Press, 1975.

Wallsten, T. S. and C. Barton. "Processing probabilistic multidimensional information for decisions," J. Exp. Psychol.:Learn. Mem. Cognit., 8 (1982) pp.361-384.

Wilkening, F. and N. H. Anderson. "Comparison of two rule-assessment methodologies for studying cognitive development and knowledge structure," Psychol. Bull. 92 (1982) pp. 215-237.

Payne, J. W. "Contingent decision behavior," Psychol. Bull. 92 (1982) pp. 382-402.

[16] Einhorn, H. J. and R. M. Hogarth. "Behavioral decision theory: processes of judgment and choice," Annual Review of Psychology, 32 (1981) pp.53-88.

"Much work in judgment and choice involves the development and testing of algebraic models that represent strategies for evaluating and combining information (see Slovic and Lichtenstein 1971). The conflict inherent in taking action, as distinct from conflict in judgment, occurs because action implies greater commitment. Such commitment induces conflict in several ways: 1. Whereas the existence of alternatives implies freedom to choose, the act of choice restricts that very freedom. Hence keeping 'one's options open' is in direct conflict with the need to take action, 2. Given a set of nondominated alternatives, conflict arises because each alternative has both advantages and disadvantages. 3. Unlike judgments, actions are intimately tied to notions of regret and responsibility.

As with the resolution of conflict in judgment, conflict resolution in action can involve either avoidance or confrontation."

Reference:

Slovic, P. and S. Lichtenstein. "Comparison of Bayesian and regression approaches to the study of information processing in judgment," Organ. Behav. Hum. Perform. 6 (1971) pp. 649-744.

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[17] Lipshitz, R. and O. Strauss. "Coping with uncertainty: a naturalistic decision-making analysis," Organizational Behavior and Human Decision Processes, 69 (1997) pp. 149-163.

"This study is an empirical investigation of three questions: 1) How do decision makers (e.g. military officers) conceptualize the uncertainty, which they encounter in their work? 2) How do decision makers cope with their uncertainty? 3) Are there systematic relationships between different conceptualizations of uncertainty and different methods of coping?

The authors develop three related conceptual propositions

Proposition 1: Uncertainty in the context of action is a sense of doubt that blocks or delays action.

Proposition 2: The uncertainty with which decision makers must cope depends on the decision-making model, which they employ.

Proposition 3: Different types of uncertainty can be classified according to their issue (i.e. what the decision maker is uncertain about) and source (i.e. what causes this uncertainty). Three basic issues are outcomes, situation and alternatives. Three basic sources are incomplete information, inadequate understanding, and undifferentiated alternatives."

M. S. Cohen, M. A. Tolcott, and J. McIntyre (1987) Display techniques for pilot interactions with intelligent avionics: a cognitive approach, Falls Church, VA, Decision Science Consortium "found that fighter pilots combine assumption-based reasoning with preparing for potential risks:

If their sensors confirm the presence of the threat but are inconclusive regarding its classification, pilots adopt a worse case assumption [under] the rationale...that the failure to classify the threat is itself evidence that the threat is a new system, and therefore likely to be more dangerous than previously known threats. On the other hand, if available information is inadequate to confirm the existence of a threat, pilots tend to make a best case assumption until more definite information is obtained [under] ...the rationale...that actions taken to avoid the threat would almost certainly expose the aircraft to risk from other known threats. Nevertheless, even in this situation, limited action, e.g. speeding up the plan, might be taken to reduce risk from the unconfirmed threat.

Lipshitz and Strauss "conducted an experiment in which military officers in a class on decision making were asked to relate a decision making situation in which they were involved. The authors assert

that the result of the experiment support models of naturalistic decision making. Decision makers use both situation assessment coupled with serial option evaluation and concurrent choice. The heuristic assumes that decision-making begins with an attempt to understand, recognize or make sense of the situation. If this attempt is successful, decision makers initiate a process of serial option evaluation, which they complement, if time permits, by mentally simulating the selected option. When making sense of the situation fails, decision-makers experience inadequate understanding to which they respond by seeking additional information. If additional information is not available decision makers experience lack of information, to which they respond by assumption-based reasoning or by forestalling. If decision makers generate two or more good enough options they experience conflict to which they respond by weighing pros and cons or by forestalling. Finally, if decision makers either fail to identify a single good enough option, or to differentiate among several good enough options they resort to suppression, forestalling, or the generation of a new alternative."

Other references:

Cohen, M. S., J. T. Freeman, and S. Wolf. "Meta-recognition in time stressed decision-making: recognizing, critiquing, and correcting," Human Factors, 38 (1996) pp. 206-219.

Lipshitz, R. and O. Bar Ilan. "How problems are solved: reconsidering the phase theorem," Organizational Behavior and Human Decision Processes, 65 (1996) pp. 48-60.

Lipshitz, R. and O. Ben Shaul. "Schemata and mental models in recognition-primed decision-making." In C. Zsambok, and G. A. Klein (Eds.) Naturalistic Decision-Making (pp. 292-303), Erlbaum, Hillsdale NJ, 1997.

Lipshitz, R. "The road to 'Desert Storm': Escalation of commitment and the rational vs. single option paradigms in the study of decision-making," Organization Studies, 16 (1995) pp. 243-263.

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[18] Nygren, T. E. "Framing of task performance strategies: effects on performance in a multiattribute dynamic decision making environment," Human Factors, 39 (1997) pp. 425-437.

"It is well documented that the way a static choice task is "framed" can dramatically alter choice behavior, often leading to observable preference reversals. A study was conducted to examine the hypothesis that framing can introduce affective components to the decision making process and can influence, either favorably (positive frame) or adversely (negative frame) the implementation and use of decision making strategies in dynamic high workload environments. Results indicate that negative frame participants were significantly impaired in developing and employing a simple optimal decision strategy relative to a positive frame group.

Framing refers to a rather robust finding in the judgment and decision making literature that shows that individuals may exhibit reversals of preferences when the same decision making situation with identical outcomes and likelihoods is described in different ways. For example when a decision situation is framed in terms of what could be gained, people often choose options reflecting risk-averse behavior, but when a decision situation is framed in terms of what could be lost, they tend to be more risk-acceptant."

References for naturalistic decision making models:

Stokes, A. F. and Kite, K. (1994) Flight Stress: Stress, Fatigue, and performance in Aviation Avebury, England: Avebury Aviation.

Nygren, T. E. and Fischer, U. (1996) "The role of risk in pilots' perceptions of problem situations". In Proceeding of the Human Factors and Ergonomics Society 40th Annual Meeting (p. 1258) Santa Monica, CA: Human Factors and Ergonomics Society.

L. Mann (1992) "Stress, affect and risk-taking" In J.F. Yates (Ed.) Risk-taking Behavior (pp201-230). New York: Wiley.

Klein, G. (1996) "The effect of acute stressors on decision making" In J.E. Driskell and E. Salas, (Eds.) Stress and Human Performance (pp49-88) Mahwah, NJ: Erlbaum.

Schoemaker, P. J. H. (1993) "Determinants of risk-taking: behavioral and economic views" Journal of Risk and Uncertainty vol. 6 pp49-73.

"Framing refers to a different component stage of the predecision process that should occur after a problem situation has been initially defined either by or for the decision maker. In the subsequent framing stage, however, what is critical is that the decision maker must examine the relevant potential outcomes and their corresponding contingencies and place them in a psychological context relative to some personal and subjective reference point. Once this reference point has been established, it determines whether outcomes are psychologically perceived as being either positive or negative, gains or losses, or good or bad, despite their objective values."

References:

Svenson, O. and Maule, A. J. (1993) Time pressure and Stress in Human Judgment and Decision Making London: Plenum.

Edland, A. and Svenson, O. (1993) "Judgment and decision making under time pressure: studies and findings" In O. Svenson and A. J. Maule (Eds.) Time Pressure and Stress in Human Judgment and Decision Making (pp. 27-40). London: Plenum.

"Effects of time pressure include a reduced focus of attention and an over-reliance on negative information in the decision making process or an increased reliance on fewer attributes or dimensions in making choices.

Study conducted with students. Positive: win more points doing task; Negative loss fewer points doing task. One task is tracking.

Negative mood and increasingly stressful situations often lead to decisions based on evaluation of a restricted set of attributes or dimensions, particularly negative information.

Anxiety can produce a disrupting effect on the encoding of new information into long-term memory, which in turn may lead to inefficiencies in learning. People may rigidly stick with the strategy they start with."

References:

Davies, D. R. and Parasuraman, R. (1982) The Psychology of Vigilance London: Academic.

"High levels of perceived stress, negative affect, or framing-induced anticipated potential losses may have little or marginal effect on simple perceptual task performance but appear to have a potentially debilitating effect on developing and using more cognitively complex decision making strategies. Individuals experiencing these influences appear to do more than simply tunnel their focus and disproportionately weight negative information. Framing effects may do more than merely change focus; they can be so disruptive as to be detrimental to the incorporation and adoption of new information into dynamic decision making strategies."

[19] Howell, W. C. "Engineering psychology in a changing world," <u>Annual Review of Psychology</u>, 44 (1993) pp. 231-263.

Naturalistic decision making "focuses on the problem faced by real decision makers in complex, usually multiperson systems characterized by high levels of uncertainty, information load, time pressure, and decision importance (i.e. stress). The term naturalistic was coined to differentiate this general task domain and the approach advocated for studying it, from the more traditional axiomatic and heuristic paradigms used in laboratory research. The basic idea is that experienced decision makers reduce the task situation to manageable proportions by converting it into a pattern-recognition problem. Interviews and other knowledge elucidation techniques have been used."

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[20] Beach, L. R. <u>Image Theory: Decision Making in Personal and Organizational Contexts</u>. John Wiley and Sons, New York, 1990.

"A nonquantitative approach to decision making. It does not seem easy to implement in a combat model.

The value image consists of the decision maker's prescriptive and proscriptive values, standards, ideals, precepts, beliefs, moral, and ethics, which are collectively, called principle. These are imperatives that serve as rigid guides for establishing the "rightness" or "wrongness" of any particular decision.

The trajectory image consists of the decision maker's agenda for the future, the strategic outline for where he or she should be going. The constituents of the trajectory image are called goals. Goals can be concrete, specific events, such as getting a particular job. They can also be abstract states, such as being a success in one's field or being happy. In the latter case, concrete events, called markers, serve as indicators of goal attainment.

The strategic image consists of the various plans that have been adopted for attaining the various goals that the decision maker is pursuing. Each plan is a sequence of actions that begins with goal adoption and ends with goal attainment. Plans are abstract strategies. Their concrete behavior components are called tactics. Tactics are specific actions that are intended to facilitate implementation of a plan and to produce progress toward their goal. Inherent in plans is a forecast of the future that may result (1) if a particular candidate plan is adopted to attain a specific goal, or (2) if implementation of a particular plan on the strategic image is begun, or, once begun, if it is continued.

There are two kinds of decisions:

Adoption decisions which are about adoption or rejection of candidates as constituents of the value, trajectory or strategic images;

Progress decisions which are about whether a particular plan on the strategic image is producing satisfactory progress toward attainment of its goal.

In order to interpret events and to bring relevant knowledge to bear upon them, the decision maker relies upon recognition or identification of the present context to define a subset of the constituents from his or her images as relevant toe the decision at hand. This is called framing. The necessity for action arises within a framed context, and if in the past some course of action proved successful, that same course of action, called a policy, will be used again. If no policy exists, appropriate goals and plans must be adopted.

There are two tests by which adoption and progress decisions are made.

The compatibility test assesses whether the features of a candidate for adoption violate the relevant (framed) constituents of the various images and whether forecasts based upon the constituents of the strategic image violate the relevant constituents of the trajectory image.

The Profitability test which apples only to adoption decisions, assess the relative ability of competing candidates to further the implementation of ongoing plans, attain existing goals, and comply with the decision maker's principles.

The object of the compatibility test is to screen out the unacceptable. The object of the profitability test is to seek the best.

For an adoption decision about a single candidate the compatibility test dictates that if the (weighted) number of violations exceeds the 'rejection threshold', the candidate is rejected; otherwise it is accepted. Violations are all-or-nothing (compatible/incompatible), and the rejection threshold is the upper limit of the decision maker's willingness to tolerate violations for the decision at hand.

For an adoption decision involving two or more alternative candidates, the compatibility test is essentially a screening process.

For a progress decision the compatibility test dictates that if the number of violations of the trajectory image by the forecast from the strategic image exceeds the rejection threshold, the existing plan is rejected and a new plan is sought to replace it; otherwise the existing plan is retained. The profitability test does not apply to progress decisions."

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[21] Kahan, J. P., D. R. Worley, and C. Stasz. Understanding Commanders' Information Needs Rand Publication Series R-3761-A, RAND, Santa Monica CA, June 1989.

LTC McGinnis, TRAC-Monterey, supplied reference.

"Report of a study to assess command and control information needs of Echelons Above Brigade (EAB) commanders. The study takes a social psychological view of the command-post information processing that serves the information needs of commanders." The study is observational.

"Effective command is largely a process whereby men, machines, and materiel are manipulated by a skilled and experienced individual to achieve prescribed goals"; (Bloom, J.N. and A.M. Farber, Art and Requirements of Command (ARC). Volume I: Summary Report, Technical Report 1-191, The Franklin Institute Research Laboratories, Philadelphia Pennsylvania, April 1967.)

"Studies of command and control tend to focus on tasks rather than on process or on available rather than needed information or data.

Information needs of the commander:

Decisionmaking and planning process drive a commander's information-seeking behavior and his information needs.

Situational framework shapes a commander's information needs.

Different commanders have varying information needs.

A commander's information needs are rarely specific pieces of data that can be transmitted directly from outside the headquarters; instead they are information items whose development requires the explicit participation of headquarters staff and subordinate commanders. Examples of information items are:

Estimate of enemy intentions, predicated on a belief about the enemy's overall strategic objectives supported by intelligence information

Evidence that headquarters staff understand the commander's intent and can use that intent to prepare alternative courses of action and plans

Alternative courses of action and plans, with prospects and risks for each

Evidence that subordinate commanders understand and are prepared to implement the commander's concept of operations.

All of these elements appear to be necessary for the commander to maintain a coherent image of his battle. When the information is consistent with that image, then much of the information supplied to the commander can be in a standard form; the commander will 'spot check" that standard information with detailed follow-up questions to test the validity of the image. However, information indicating to the commander that his image is in need of revision generates requests for specific items that are highly dependent on the perceived anomaly.

If a subordinate takes an unexpected action (implication subordinate does not understand the commanders concept of operations), the commander may visit the subordinate to reconcile the violation of expectations or to revise the subordinate's understanding.

If an intelligence report is inconsistent with commander's image of battle field, he will ask for specific detailed information with which to refine his understanding, will assess the validity of the intelligence report, and will obtain revised estimates of enemy intent consistent with the intelligence report.

Commander receives updates about capabilities of his own forces, especially before they change objectives or postures; often visits subordinate commands to verify the accuracy of the information.

Commander is constantly looking for weaknesses in both the enemy and his own situation.

Elements of situational framework that drive commander's information needs.

The context of the command decision (e.g. stage of war, political considerations)

Organizational structure of the command post.

Specialists present

Communication among staff (which staff receive specific information and how they process information)

Commander's image is the mental representation of the situation and drives his information needs.

His identification of the nature of the problem (e.g. the center of gravity of the battle and the culminating point) determines his information needs Different commanders have different images. Differences do not necessarily predict how good a commander is or gauge the quality of his decisions.

The interaction between the commander and his immediate subordinates

If commander believes his subordinates understand him and are competent, then the commander will require less information. A subordinate who understands the commander can communicate information more efficiently."

Keegan, J. The Mask of Command, Viking, New York, 1987

"Keegan labels the essential elements of command action as knowing and seeing. By "knowing," Keegan means having a general background knowledge that provides a rich contest. By "seeing" he refers to having a dynamic image of the battle field that leads the commander to understand what needs to be done.

METT-T s the standard Army acronym for the five essential characteristics that define a battle situation: Mission (from higher headquarters), Enemy (location, strength, and disposition), Terrain (and weather), Troops (friendly available, location, strength and disposition), and Time horizon

Commanders make assessments about the personal characteristics of their subordinates and the enemy and these assessments can strongly influence their intent. A subordinate commander believed to be weak will not be entrusted with critical positions.

Commanders also want knowledge of the personal character or habits of the enemy commander in training situations. If it is known the enemy trains for night missions, then commander will expect one.

The primary cause for inappropriate information is the misunderstanding of the commander's image of the situation; this misunderstanding can lead to a mistake in the understanding of the commander's intent. This can lead to the presentation of inappropriate courses of action. The result is time lost.

A second cause of inappropriate information content is the difficulty of expressing uncertainty. Better intelligence officers present alternative estimates of enemy intention only if, in their opinion different situations might warrant different decisions.

Only so much information can be passed. If detailed information is asked for concerning one unit, information concerning other units may not get passed.

Military expertise in the command post is in many ways analogous to expertise in complex decision making within the civilian world. Experts in most fields tend to solve problems and to make decisions by recognizing existing situations as instances of things with which they are familiar on the basis of their past experience. Thus, they know what data to examine and what steps to take to achieve a goal. Expertise is difficult to study and teach.

There are three Information Modes

Pipeline: For "normal operations to ensure that staff and subordinates share the commander's image; used when the commander believes the image is valid and for the continuation of the plan; checks the validity of the image;

Alarm: For "normal" operations to alert the commander to a possible violation of image. When the commander believes the image is valid it alerts the commander to a possible transition to tree mode. It can occur between the regular information conveyance times;

Tree: When the image is broken, it is to repair and reconstruct the image. When a new plan is being constructed, to begin a new plan.

When information that is potentially an alarm reaches a subordinate, that person must decide whether to shift to alarm mode by causing a nonscheduled information transfer or to remain in pipeline mode by holding the information for the next scheduled transfer. Knowledge of the commander's image is the most important requirement for making that decision.

Information Mode and the quality of information

Mode	Timeliness	Detail	Uncertainty
Pipeline	According To Schedule (typically 6 to 24 hours)	Aggregated down 2 echelons	Moderate
Alarm	Immediate	Highly Detailed, Highly Focused	Likely to be Very high
Tree	Varies with Item and Situation	Selective use of "telescope"	Likely to concentrate on Lower uncertainty Items

When tree mode is being employed, a commander is more likely to concentrate on information that is relatively certain. This is because he is in the position of constructing or reconstructing his image of the battlefield and is ascertaining what is known. Tree mode requires an explicit demand-pull from the commander.

Information concerning image building is concentrated on two EAB command tasks:

Mission planning--i.e. searching for and selecting a plan that is expected to achieve the objectives; and

Mission effectiveness monitoring--i.e. continually reassessing the suitability of the promulgated plan.

The action element is similarly composed of two control tasks:

Resource-order generation, or the construction of resource orders that are expected to give rise to the demanded resource activity; and

Compliance monitoring, or determining how closely the demanded activities are being, and will be, achieved

Mission planning is a complex iterative process that relies heavily on the tree mode of information search and exchange. Once a plan is constructed, it is promulgated via standardized pipeline modes, and the system transits to both mission effectiveness monitoring and resource-order generation.

Mission effectiveness monitoring typically uses pipeline modes of information exchange. If monitoring reveals that the commander's image is no longer valid or that the plan is in need of revision, then an alarm is triggered that sends the system back to mission planning

The promulgated plan is translated by the staff into a set of resource orders. The resource-order generation process is, like mission planning, an iterative one that requires the use of tree mode. Information is typically passed between subordinates. The commander intervenes if it becomes apparent that his image is not understood.

The resource-order compliance-monitoring stage assesses how well subordinates (e.g. lower-echelon commands) and resources not under direct control (e.g. intelligence assets) comply with the plan. This monitoring is generally supported by pipelines, supplemented by alarms.

Although alarms are simple in concept, they can fail when the commander's image is not shared because they are not recognized as necessitating a change of plan."

[22] Pugh, G. E. and R. M. Kerchner. "Representation of C3I effects in combat simulation," <u>Proceeding 49th</u> <u>MORS</u>, June 1982, pp. 53-66.

Engineering oriented decision making

"TAC BRAWLER is a multiple aircraft simulation that utilizes artificial intelligence methods to represent the decision processes of pilots and flight leaders in many aircraft. TAC BRAWLER can be viewed as a multiple player expert system in which a major part of the expert knowledge is represented in the form of a hierarchical value structure.

The actual human decision processes take place in what appears to be a very disorderly sequence. An individual who is concerned with an important decision typically spends some of his time trying to think of alternative courses of action; he spends some of his time trying to estimate and evaluate potential outcomes; he spends some of his time trying to improve his interpretation of the situation; and he spends a considerable amount of time in apparently non-productive "worry" as his thought seen to recycle through essentially the same thought processes. Moreover, he does not go through these different parts of the process in any standard sequence such as might be dictated by the logical structure of the problem. Instead he is always trying to direct his thoughts to whatever part of the problem he perceives as most likely to yield a quick solution.

Structure of the decision process: logical flow of information in terms of the required input and output information for each of the processing steps—without regard for the actual time sequence in which the steps maybe performed.

Situation perception: all aspects of awareness and understanding of the current state of the environment.

Situation assessment: risks and opportunities within the perception have been identified and assessed in terms of the goals and objectives of the system.

There are three hierarchical levels of a military command and control system: strategic, tactical and operational decisions. The strategic level operates with the longest time horizon and the operational level with the shortest.

The highest levels of the decision process are the selection of the decision criteria and priorities that will govern the lower level decision processes.

Decision process steps:

> Feature Recognition
>
> Inference
>
> Situation Perception
>
> (Recognition of) Valuative features
>
> Situation Assessment
>
> React
>
> Decide

Simplifications to be employed:

> Avoid the complexity of real optimization
>
> Avoid long term projection of outcomes
>
> Judgmental value criteria for intermediate outcomes

Reevaluate and revise planned courses of action

Heuristic application of value concepts:

Decompose complex decisions into simpler decision components that can be linked by value considerations (tool: Lagrange multipliers)

Structure the considerations bearing on a decision so that they can be represented by approximately additive components

Plan to adjust weights assigned to the value components so as to reflect current tactical priorities

Utilize value priorities that are communicated between decision makers to control and coordinate distributed decision processes.

To capture surprise the model must accurately portray the information available to each pilot and base simulated pilot decisions only on this information.

When a pilot makes a decision along value-driven lines an alternative generator produces a candidate alternative, the mental model predicts what the situation will be if the alternative is implemented and an evaluation model places a numerical score on the resulting situation. When all promising alternative actions have been considered in this way, the highest scoring one is implemented. Projection times for the decision are relatively short. Each decision is reevaluated at various times and can be changed."

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[23] Janis, J. L. and L. Mann. Decision Making. The Free Press, New York NY, 1977.

"H. A. Simon. "Motivational and emotional controls of cognition," Psychological Review, vol. 74 (1976) pp29-39: the decision maker satisfices rather than maximizes; that is, he looks for a course of action that is "good enough" and that meets a minimal set of requirements

Executives gravitate to a more conventional "second best" choice that will cause little immediate disturbance or disapproval because it will be seen as "acceptable by superiors and peers who will implement it and by subordinates who will implement it: Johnson, R. J. "Conflict avoidance though acceptable decisions," Human Relations, 1974, vol. 27, pp71-82

Cyert, R. M. and J. G. March. A Behavioral Theory of the Firm. Englewood Cliffs, NJ: Prentice-Hall, 1963 suggest the more uncertainty there is about a long-term outcome, the greater the tendency to make a policy decision on the basis of its short-term acceptability within the organization.

The use of a satisficing strategy does not preclude contemplating a fairly large number of alternatives, but they are examined sequentially with no attempt to work out a comparative balance sheet of pros and cons. The alternatives are thought about until you find one that is OK

Variables of a Satisficing Strategy

1. Number of requirements to be met (need only a few)

2. Number of alternatives generated

3. Decision maker (DM) typically tests alternatives only once and in a haphazard order

4. Type of testing model used: usually above or below minimal cutoffs"

(Elimination by aspects rule (A. Tversky "Elimination by aspects: a theory of choice" Psychological Review 1972 Vol. 79 pp281-99):

"Combination of simple decision rules to select rapidly from a number of salient alternatives one that meets a set of minimal requirements")

"People can not be expected to use the same strategy for all types of decisions

Two strategies: vigilant when the decision is expensive to change; satisficing when decision is not expensive to change

Symptoms of stress are often observed at the time of decision making. The intensity of the symptoms appears to depend upon the perceived magnitude of the losses the decision-maker anticipates from whatever choice he makes.

Conflict-Theory Model: Assumptions

1. Degree of stress is a function of the goal that the DM expects to remain unsatisfied.

2. When DM is motivated to consider a new COA (course of action) the stress is a function of the degree to which he is committed to adhere to his present COA

3. When each alternative poses a threat of serious risk the decision maker may use defensive avoidance of threat cues

4. When the DM anticipates having insufficient time to find an adequate means of escaping serious losses, DM's stress level remains high and the likelihood increases that his dominant pattern of response will be hypervigilance (in its extreme form panic). In hypervigilance the DM's thought processes are disrupted.

5. A moderate degree of stress induces a vigilant effort.

In hot cognitive situations (emergencies) or in all consequential decisions the prerequisites for a thought pattern of vigilance (good strategy) are:

1. Awareness of serious threat

2. Awareness of serious risks if most salient change to a new COA is taken

3. Moderate or high degree of hope that a search for information and advice will lead to better solution

4. Belief there is sufficient time to search and deliberate before any serious threat will materialize

Prior training can foster each of the above conditions in emergency conditions.

Consequential decisions include those that evoke some degree of concern or anxiety in the decision maker about the possibility he may not gain the objectives he is seeking or that he may become saddled with costs that are higher than he can afford. Uncertain risk also adds to anxiety.

Stressful situation: encounters a challenge that represents a threat or an opportunity to attain an unfulfilled goal that requires changing to a new course of action whose outcome is uncertain.

Pattern of defensive avoidance involves errors in assimilation of new information as well as failure to meet all the other requirements of vigilant decision making.

Hypervigilance: impaired cognitive efficiency that characterizes frantic search and appraisal in an emotional state.

The decision maker can bolster the least objectionable alternative by exaggerating the positive consequences or minimizing the negative consequences:

Defensive avoidance in the form of procrastination, buck passing and bolstering is a common occurrence when a difficult policy decision is to be made. When neither buck passing nor procrastination is possible, an ill-considered decision is bolstered by shared rationalizations. Wishful thinking is also part of defensive avoidance.

Many historical fiascoes can be traced to defective policy making on the part of government leaders who receive social support from their in-group of advisors. Policy advisors can be dominated by concurrence seeking or groupthink and display symptoms of defensive avoidance. The policy maker receives social support from advisors who concur with his judgements and share in developing rationalizations that bolster the least objectionable choice. Ambiguous events that could suggest to a vigilant decision maker the urgent necessity to reconsider his current policy can readily be interpreted in a reassuring way when he or she is motivated to avoid awareness of the defects of the chosen course of action. The decision maker entertains only those hypotheses that are consistent with his inclination to explain away any potentially ominous events; he fails to formulate or pursue alternative hypotheses that might represent a strong challenge to his decision.

Symptoms of group think are:

1. An illusion of invulnerability, shared by most or all members, which creates excessive optimism and encourages taking extreme risks;

2. Collective efforts to rationalize in order to discount warnings which might lead the members to reconsider their assumptions before they recommit themselves to their past policy decisions

3. An unquestioned belief in the group's inherent morality

4. Stereotyped views of rivals and enemies as too evil to warrant genuine attempts to negotiate, or as too weak or stupid to counter whatever risky attempts are made to defeat their purposes

5. Direct pressure on any member who expresses strong arguments against any of the group's stereotypes, illusions, or commitments, making clear that such dissent is contrary to what is expected of all loyal members.

6. Self-censorship of deviations from the apparent group consensus, reflecting each member's inclination n to minimize to himself the importance of his doubts and counter-arguments;

7. A shared illusion of unanimity, partly resulting from this self-censorship and augmented by the false assumption that silence implies consent.

8. The emergence of self-appointed "mind-guards"–members who protect the group from adverse information that might shatter their shared complacency about the effectiveness and morality of their decisions.

Conditions under which group think can arise:

1. High cohesiveness

2. Insulation of the group

3. Lack of methodical procedures for search and appraisal

4. Directive leadership

5. High stress with a low degree of hope for finding a better solution than the one favored by the leader or other influential persons

Major Kinds of consideration that enter into decisional conflicts:

1. Utilitarian gains and losses for self

2. Utilitarian gains and losses for significant others

3. Self-approval or -disapproval;

4. Approval or disapproval from significant others

Five stage schema in arriving at a stable decision

1. Appraising the challenge

2. Surveying alternatives

3. Weighing alternatives

4. Deliberating about commitment

5. Adhering despite negative feedback: will only change if encounters an effective challenge that is so powerful as to provoke dissatisfaction with his chosen course of action"

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[24] Dupuy, COL T. N. Numbers, Predictions, and War, Revised Edition, Hero Books, Fairfax VA, 1985.

"Book describes the Quantified Judgment Method of Analysis of Historical Combat Data (QJMA). A major component of the methodology is a long but simple mathematical equation, which is called the Quantified Judgement Model or QJM.

It is difficult to analyze trends in ground combat from historical data. The author and his associates use data to form a coherent, consistent quantitative theory of combat.

There is a chapter on the historical analysis of weapons lethality. (HERO is the Historical Evaluation and Research Organization.) Weapon lethality is "the inherent capability of a given weapon to kill personnel, or to make materiel ineffective in a given period of time, where capability includes the factors of weapon range, rate of fire, accuracy, radius of effects, and battlefield mobility"

Environmental parameters are those which affect the effectiveness of weapons; e.g. terrain, weather etc. Operational parameters are those which influence the employment of weapons and forces; e.g. posture, mobility.

Intangible variables are those such as leadership training and morale. They can be assigned values on the basis of professional military experience; the values can be highly subjective. Intelligence is reflected to some extent in surprise; it is an aspect of leadership and is also related to training and experience.

Leadership factor, training and/or experience factor and morale factor appear as part of the combat power potential

One of the three principal problems encountered in evaluating the preliminary QJM analyses of WWII data was the perturbation in the data created by combat surprise. The authors incorporated the effects of surprise into their calculations.

There are two major behavioral factors used: surprise and combat effectiveness. Combat effectiveness includes leadership, training/experience, morale, and logistics. Authors calculate a measure of combat effectiveness called casualty-inflicting capability for each side in historical battles; in WWII German vs. French, etc.

In those battles in which the record indicates that effective tactical surprise has been achieved, the effect of Surprise is captured by a judgmental decision to the category of surprise achieved. Based on the category of surprise, values for factors modifying the comparative mobility characteristics and the vulnerability characteristics of the two sides are determined from a table. The effect of surprise over subsequent days of the battle is assumed to be of a specific form.

Only when the record provides clear evidence that a degradation factor is appropriate for leadership, training and/or experience, morale, or logistical capability is a judgmental factor entered into the formulas. States of morale are expressed as categories.

There are rules for exhaustion rates of combat units."

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[25] Halbert, G. A. "The impact of soft factors on intelligence analysis." Presentation slides, Modernization Trends Division, National Ground Intelligence Center, Charlottesville VA, 1998.

NGIC rates factors such as leadership, training, readiness morale, cohesion and ability to execute logistics for foreign ground forces; can a country assimilate new equipment and tactics. Rating scale from 1 to 10. Minimum of three people score the factors for each country.

Mention of Russian work (F.I. Markovskiy) on relation between morale and the level of losses at which combat effectiveness is lost. Mention of Dupuy's view of effect of morale. Mention of Chinese work on integrating morale into Lanchester equations.

Cognitive skills degenerate when very thirsty or tired or in excessive heat

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[26] Bradshaw, D. M. "Combat stress casualties: a commander's influence," Military Review, (July-August 1995) pp. 20-22.

"Combat stress causes battle casualties. A combat stress casualty is a soldier rendered combat ineffective due to the psychological strain of battle. Esprit is pride in a unit especially in a large unit where face-to face encounters are rare among some members. Cohesion is the feeling of belonging to a specific group, a solidarity marked by trust, loyalty, and mutual affection. Morale is the mental attitude of the individual characterized by confidence in self and in the primary group.

A commander can directly decrease a unit's combat stress casualties though his personal activities, proper treatment of casualties and leading by example. To be an effective leader, he must be healthy. In other words, the commander must practice physical and mental hygiene. This hygiene includes physical fitness, determining and using effective personal stress reduction techniques and sleep discipline. Being fit allows one to use less available physical energy per action and decreases recovery time, thereby reducing fatigue and physical stress. A knowledge of effective personal stress reduction techniques will decrease the mental stress experienced.

Sleep discipline is especially important. During sleep deprivation, mental ability is impaired first and affects the information processing and decision making faculty to the greatest extent. A commander cannot afford to lose cognitive abilities when rapid decision making is required.

Training under realistic conditions builds necessary soldier trust in themselves and the organization. Confidence is essential in reducing combat stress. Commanders influence cohesion by providing opportunities for common tasks and by increasing job stability within the unit."

Ingraham, L. H. and F. J. Manning. "Psychiatric battle casualties," Military Review, (August 1980) pp. 18-29.

Ingraham, L. H. and F. J. Manning. "Cohesion: who needs it, what is it and how do we get it," Military Review, (June 1981) pp. 2-20.

Noy, S. "Combat psychiatry: the American and Israeli Experience." In Contemporary Studies in Combat Psychiatry, G. Belenky (Ed), Greenwood Press, New York, 1987, pp. 69-86.

Haslam, A. P. "Sleep loss and military performance." In Contemporary Studies in Combat Psychiatry, G. Belenky (Ed) Greenwood Press, New York, 1987, pp. 167-184.

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[27] Fishburne, F.J. "Neuropsychological applications in military settings." In Reuven Gal and A. David Mangelsdorff (Eds.) Handbook of Military Psychology, John Wiley and Sons, New York, 1991.

Belenky, G. L., G. P. Krueger, T. J. Balkin, D. B. Headley, and R. E. Solick. "Effects of continuous operations (CONOPS) on soldier and unit performance: review of the literature and strategies for sustaining the soldier in CONOPS," (WRAIR Report No. BB-87-1) Walter Reed Army Institute of Research, Washington DC, 1987.

"Literature review pertaining to sleep deprivation which shows that physical strength and endurance are less impaired by limited or no sleep than are cognitive abilities. If soldiers get regular sleep of six to eight hours per 24 period, cognitive performance is unaffected. If soldiers get only 3 to 4 hours sleep per day, effective cognitive performance can only be maintained for five or six days. With less than 3 hours sleep per day there is a rapid decline in cognitive ability within 72 hours from the time the mission begins."

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[28] Van Fleet, D. D. and G. A. Yukl. Military Leadership: An Organizational Behavior Perspective. JAI Press Inc. London, England 1986.

"Business and industrial organizations tend to be heavily utilitarian (members perform for money) in terms of the modes of compliance obtained within them.

Military organizations are normative (members perform out of duty) and to a lessor extent coercive (members perform out of fear). Normative organizations stress values more than utilitarian organizations would.

A study of traits and skills of leaders in military organizations found the following

Ethical conduct, personal integrity

Leadership effectiveness and achievement

Willingness to assume responsibility

Courage, daring

Maintaining coordination and team work

Ascendance, dominance and team work

Emotional balance and control

Intellectual skills

Social and interpersonal skills

Technical skills

Group task supportiveness

Effective mangers and administrators in large hierarchical organizations tend to have a strong need for power, a moderately strong need for achievement, and a somewhat weaker need for affiliation. Effective leaders tend to have high self-esteem, energy, maturity, stress tolerance, and a favorable attitude toward authority figures. They are inclined to be pragmatic and results-oriented, rather than introspective, philosophical or idealistic.

Effective leaders are more likely to develop subordinate loyalty and dedication to the organization through power tempered by emotional maturity and inhibition. The dominant leader characteristics that have been shown to be important are managerial motivation and task relevant expertise.

The most effective forms of leader's personal power appear to be the leader's expertise based on demonstrated competence, the leader attractiveness based on personal qualities, and loyalty to the leader developed through a history of satisfactory exchange relationships wherein the leader provided benefits to subordinates and treated them in a fair and considerate manner.

A study of World War I veterans suggested that the presence of hunger, thirst, fatigue, ignorance of plans and idleness increases the danger from fear. The most important factors in controlling fear are: devotion to cause, leadership, training and materiel.

Leaders in combat situations must plan for enemy actions, effectively organize and schedule unit activities, and take decisive action in dealing with immediate crises. Planning and problem solving are important for leadership effectiveness in combat situations. Interpersonal relations are less important both to leaders and to subordinates in crisis situations. In such situations the only aspect of consideration that remains important to subordinates is the extent to which the leader is really concerned about their welfare and survival."

There are autobiographies and biographies of military leaders who achieved some degree of fame and recognition for their successful leadership.

"Behavior categories that are important in leaders are inspiration, performance emphasis, clarifying work roles, planning and problem solving."

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[29] Heslegrave, R. J. and C. Colvin. "An exploration of psychological and psychophysical measures as predictors of successful performance under stress," Technical Report 1035, United States Army Research Institute for the Behavioral and Social Sciences, January 1996.

"In an earlier report the authors concluded that stress was best characterized as the dynamic relationship between situational demands, the cognitive appraisal of those demands, and an individual's response to these demands. Effective coping occurs when there is a balance between environmental demands and the individual's perceived available resources. Based on the literature, a personality profile emerged that successful copers tended to be more introverted, task-oriented, and self confident. It was concluded that cardiovascular measures such as heart rate and vagal tone were potentially sensitive discriminators and predictors of successful performance in stressful occupations.

In one study it was found that individuals who rated situations as less stressful tended to rate their ability to change the situations as high and that those individuals who perceived their abilities to change stressful situations engaged in more problem-focused coping strategies as planning, suppressing competing activities, restraint coping, and reinterpretation and growth.

In a second investigation, individuals with better performance under stress showed higher heart rates and blood pressures under stress as well as lower vagal tone and greater suppression of vagal tone from baseline levels. Personality predictor variables were less consistent. The data suggest that those

individuals who perceive themselves as having more ability to cope with stress and those individuals who more actively cope with stressful situations are more successful performers when they encounter the need to perform under stress."

References:

Appley, M. H. and Trumbull, R. (1986) "Development of the stress concept" In M. H. Appley and R. Trumbull (Eds.) Dynamics of stress: physiological, psychological, and social perspectives. New York: Plenum, pp. 2-18.

Baumeister, R. F. (1984) "Choking under pressure: self-consciousness and paradoxical effects of incentives on skilled performance" Journal of Personality and Social Psychology 46 610-620.

Beutler, L. E. (1985). "Parameters in the prediction of police officer performance" Professional Psychology: Research and Practice vol. 16 pp324-335.

Rachman, S. J. (1991) Psychological analyses of courageous performance in military personnel (ARI Research Note 91-86). Alexandria, VA: U. S. Army Research Institute for the Behavioral and Social Sciences. (AD A241 226)

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[30] Payne, J. W., J. R. Bettman, and E. J. Johnson. "Behavioral decision research: a constructive processing perspective," Annual Review of Psychology, 43 (1992) pp. 87-131.

"Behavioral decision research (BDR) is interdisciplinary, employing concepts and models from economics, social and cognitive psychology, statistics, and other fields. This chapter reviews behavioral decision research for the period 1983-1991 with a focus on the constructive nature of judgment and choice. A theme of decision research is that preferences for and beliefs about objects or events of any complexity are often constructed-not merely revealed-in the generation of a response to a judgment or choice task.

Framing involves the determination of the effective acts, contingencies, and outcomes of a decision. Framing is influenced by how the decision problem is presented and by the norms, habits, and expectations of the decision maker. A complete theory of framing has proven difficult to formalize.

The apparent completeness of a display can blind a decision-maker to the possibility that important information is missing from a problem description.

A hypothesis is that the more complex a decision problem, the more people will use simplifying decision heuristics. Gaeth and Shanteau (1984) found that judgments were adversely influenced by irrelevant factors, although that influence could be reduced with training. People respond in several ways when faced with decision problems varying in time pressure. These coping mechanisms include the acceleration of processing, selectivity in processing, and shifts in decision strategies. Under time stress, processing is focused on the more important and/or more negative information about alternatives. Under more severe time pressure, people accelerated processing, focussed on a subset of information, and changed processing strategies.

Decisions under risk are seen as being sensitive to the same types of context and task variables described above for preferences among multi-attribute alternatives and for the assessment of uncertainties.

The most frequently used approach to explaining contingent decision behavior assumes that people have available or can generate a repertoire of strategies or heuristics for solving decision problems. It is also assumed that the strategies have differing advantages (benefits) and disadvantages (costs). The emphasis of Beach's image theory (Beach 1990) is on noncompensatory tests of the acceptability or

compatibility of a single alternative (candidate option) with the decision-maker's values of goals (images).

Hammond et al. 1987 argue that the cognitive processes (modes of thought) available to a decision-maker can be seen as falling on a continuum from intuition (characterized by rapid data processing, low cognitive control, and low awareness of processing) to analysis (characterized by slow data processing, high cognitive control, and high awareness of processing).

There is evidence that people scan alternatives in a more nonsystematic fashion under stress, and therefore may be more data driven is provided by Keinan (1987)

As noted by Tversky and Kahneman (1986) incentives do not work by magic. Generally what incentives do is prolong deliberation or attention to a problem; people generally work harder on more important problems. More effort is generally believed to lead to better performance. However, as reported in Paese and Sniezek (1991), increased effort may lead to increased confidence in judgment without accompanying increases in accuracy.

The process of combining information in the head is often called clinical judgment.

Decision processes are not invariant across task environments complicates the search for a small set of underlying principles (models) that can describe behavior. Hogarth and Einhorn (1991) noted that the importance and pervasiveness of task and context effects may create a view of decision research as a fragmented and chaotic field.

Well established are the effects of task complexity on decision strategy use, the importance of gain vs. loss distinction in both risky and riskless preference, and the prevalence of the anchoring and adjustment process in judgment."

References:

Gaeth, G. J. and J. Shanteau. "Reducing the influence of irrelevant information in experienced decision makers<" Organizational Behavior and Human Performance, 33 (1984) pp. 263-282.

Beach. L. R. Image Theory: Decision Making in Personal and Organizational Contexts, 2nd edition. John Wiley and Sons, New York, 1990.

Hammond, K. R., R. M. Hamm, J. Grassia, and T. Pearson. "Direct comparison of efficacy of intuitive and analytical cognition in expert judgment," IEEE Trans. System Man, Cyber, 17 (1987) pp.753-770.

Tversky, A. and D. Kahneman. "Rational choice and the framing of decisions," J. Bus. 59 (1986) pp. S251-278.

Keinan, G. "Decision making under stress: scanning of alternatives under controllable and uncontrollable threats," J. Pers. Soc. Psychol. 52 (1987) pp.639-644.

Paese, P. W. and J. A. Sniezek. "Influences on the appropriateness of confidence in judgment: practice, effort, information, and decision-making," Organ. Behav. Hum. Decis. Process. 48 (1991) pp.100-130.

Hogarth R. and H. Einhorn. "Order effects in belief updating: the belief adjustment model," Cognitive Psychology, 24 (1992) pp. 1-55.

[31] Janis, I. L. Crucial Decisions. The Free Press, New York, NY, 1989.

"A main goal of book is to address the following questions: When and why do leaders of large organizations make avoidable errors that result in faulty policy decisions? How can such errors be prevented or at least kept to a minimum.

The steps of vigilant problem solving to make decisions:

Formulate the problem: what are the requirements; direction of solution?

Use informational resources: prior information and new information

Analyse and reformulate the problem: additions or changes to requirements? Additional alternatives? Additional information needed?

Evaluate and select an alternative

Decide after adequate search, appraisal, and planning

Bolster the decision by playing up the advantages and playing down the disadvantages; solicit supportive information; announce decision to interested parties; promote the decision.

Assumptions

The quality of the procedures use to arrive at a fundamental policy decision is one of the major determinants of a successful outcome.

Most leaders are capable of carrying out procedures needed for high quality decision making.

Policy makers make no effort to use high quality procedures to make decisions they regard as unimportant.

In important policy decisions a few constraints will dominate the thinking.

Factors influencing policymakers judgments on the importance of a potential problem

It is important if there is a large discrepancy between the existing and desired state of affairs.

It is important if the new problem is viewed as linked to a problem already being worked on.

The total number of important problems already being worked on.

General tendency to ignore threats that develop gradually rather than precipitately.

An unambiguous threat that arises without any prior warning requires more than standard operating procedures and decision rules.

How serious a decision maker becomes about an emerging threat depends on how familiar the policymaker is with the type of danger to which a valid warning refers.

When managers believe that the complexities of the issues exceed their capabilities or the organization lacks adequate resources for working out a high-quality solution to a problem they judge to be very important, they will make a crucial policy decision by "the seat-of-their-pants" without bothering to examine carefully the pertinent information that is readily available.

Cognitive Decision rule:

Satisficing: Accept the first alternative that comes to mind that is "good enough" to meet the minimal requirements without bothering to compare it with other viable alternatives.

Role of personality in leadership:

50

At present the role of personality in leadership is in the doldrums because few generalizations about the interaction of personality and situational factors have as yet emerged.

Five potential factors to describe major features of personality

Conscientiousness–well organized versus disorganized; careful versus careless; self-disciplined versus lax.

Openness–imaginative versus down to earth; independent versus conforming; preference for variety versus preference for routine.

Neuroticism–worrying versus calm; insecure versus secure; self-pitying versus self-satisfied.

Agreeableness–considerate versus ruthless; trusting versus suspicious; helpful versus uncooperative.

Extraversion–sociable versus retiring; active versus passive.

Hypotheses concerning factors associated with poor decision making:

Minimize importance of major challenging threats:

Chronic lack of conscientiousness

Chronic lack of openness: lack of imagination, failure to think and act independently and preference for routine

Calm, cool detached coping style in response to fear-arousing events or communications; high stress tolerance tends to make people relatively unresponsive to serious warnings

Chronic optimism concerning the organization's stability and vulnerability

Overreaction to information:

Low self confidence, including chronic sense of low self-efficacy.

Chronic pessimism concerning organization's ability to supply the resources essential for solving complicated policy problems, with supporting beliefs about internal weaknesses that preclude adaptive changes.

Overreaction to social pressures:

Chronically strong need for social approval

Strong need for power and status

Chronic apprehensiveness about ruthlessness of other powerholders in the organization with supporting beliefs about their readiness to inflict retaliations

High dependency upon a cohesive group of fellow executives for social support

Egocentric constraints by arousing strong personal motives:

Chronic lack of conscientiousness

Persistent negativism or hostility toward the organization with supporting beliefs about undesirable features that make it undeserving of loyalty.

Overreaction to information by arousing anxiety or other emotional reactions:

Low stress tolerance–manifested by relatively high level of anxiety with feelings of helplessness and vulnerability

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Lack of perceived control over outcomes and other components of a low level of personality hardiness

Persistent ambivalence toward the organization such that it is seen as having positive features that make it deserving of loyalty but is also seen as having negative features that make it weak and vulnerable

Habitual externalized anger-coping style

Persistent hostility toward major opponents, with supporting beliefs about their evil and hostile intentions."

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[32] Decision Science Applications. "Digital simulation of pilot performance: a feasibility study for a model to address workload issues in the night, all-weather, low-level ground attack mission." DSA Report, No. 469 Decision-Science Applications, Arlington VA 22209, 1982.

"Proposal for the development of a computer simulation of pilot workload capabilities and limitations to assist in workload evaluation and other problems relating to the night, low-level ground attack (NILLGA) mission. Human Factors emphasis on evaluating changes to cockpit.

TAC BRAWLER simulates pilots and has pilot tasking decision algorithms.

Time compression phenomenon: occurs when there is the requirement to perform many tasks together.

The self tasking algorithm chooses the set of compatible tasks that maximizes a value function based on short-term considerations. Each task has a value associated with its performance and each time a self-tasking decision is made the model tries to pick a set of feasible tasks for which the sum of the individual task values is (approximately) maximized. The value function is heuristically motivated by viewing each task that a pilot might perform as an activity that reduces the probability per unit time that something undesirable happens. Since different tasks take different time units use return per unit time; more generally, the ratio of the remaining benefit to the remaining time needed. Mental resources of a pilot consist of a single consciousness unit and several peripheral processors (which process in the background). The task is done more efficiently by the consciousness unit. The algorithm schedules tasks.

Each simulated decision-maker has a personal mental status array, which mirrors the central status. There is a mental model. Information arrives to the mental model via sensor events. Incoming information is processed by the pilot's mental model and is then deposited in his mental status array. There are tasks that have an information-gathering intent.

Tactical decisions are any decisions that are not self-tasking decisions; for example: flight path selection, target selection and ordnance release; how to use a piece of equipment (radar selection mode); reattack an area."

TAC BRAWLER decision making appears to be very complex form of engineering decision making.

Greenstein, J. S. and W. B. Rouse. "A model of human decisionmaking in multiple process monitoring situations," IEEE Transactions on Systems, Man, and Cybernetics Vol. SMC-12, No. 2, Mar/Apr 82.

[33] Reisweber, D. "Battle command: will we have it when we need it," <u>Military Review</u>, (Sept-Oct 1997) pp. 49-52 and 56-58.

"The US Army has embraced battle command, a concept which involves expertise in understanding the current state of the battlefield, visualizing a desired future end state, communicating intent and making the desired end state a reality. In simpler terms, it is the ability to create a vision for success (to know) and see it applied on the battlefield (to do). To know encompasses the visualization tasks involved in battle command. A battle command master is able to see both friendly and enemy forces in time and space and the results of their contacts. ` To do is the skill in taking this vision, successfully communicating it to subordinates, constructing a plan that will achieve success and providing leadership which can carry the operation to a successful end state.

There is ample evidence to suggest that battle command skills are a function of not only raw talent, but years of practice, experience and maturation. The Army has already begun identifying the battle command skills and traits that are involved in thought and action processes. These initial insights support the concept that knowledge is fundamental. There is no substitute for technical domain knowledge in proficient battle command. Recent studies also suggest that similar trait clusters are associated with successful battle commanders. These traits include cognitive complexity and behavioral complexity among others.

Cognitive processes consist of many types of mental processes such as learning, memory, concept formation, problem solving and decision making. Cognitive complexity involves a broad range of skills that include integration of information, abstraction, independent thought and use of broad and complex frames of reference. Those with high levels of cognitive complexity are able to think in metaphors and seek related patterns in unrelated objects, situations and events. Cognitive complexity is a measure of how an individual constructs meaning and organization to incoming information.

Those most gifted in cognitive complexity skills are better able to understand and identify what is critical or key given the same amount of information available to others.

An officer Personnel Management System study conducted by the Department of History at the United States Military Academy, West Point, New York, found that successful leaders are able to assess rapidly changing situations and continually assimilate large quantities of conflicting information.

A technique that appears to better develop battle command thinking skills is practical thinking. It is based on reasoning in which premises are often implicit, problems are not well bounded, several possible answers to a problem may exist and uncertainty is always present.

Another cognitive approach in developing battle command skills is situation assessment. This skill involves the ability to know or find the essence of a situation.

Key to successful battlefield assessment is recognizing and taking into account classic human biases that often blind one's decision making. These biases include placing greater importance on initial information than on later-arriving information and ignoring information that conflicts with one's initial assessment. Other assessment skills that will help develop battle commander skills include mental simulation, visualization, prediction, and anticipation.

Information technology cannot guarantee success on future battlefields. The key to success will not lie solely in the information the commander receives, but how his knowledge base, experience and cognitive skills shape and interpret the information received.

Those with the most sophisticated thinking processes will not be able to implement their vision without finely tuned interpersonal and technical skills. Behavioral complexity involves the ability to execute a complex strategy by playing multiple, even competing roles in a highly integrated and

complementary way. These roles include those of mentor, facilitator, innovator, producer, and director. Individuals high in behavioral complexity are able to motivate their subordinates to make their vision happen. They are high in self efficacy, a belief that they have control and a direct impact on their environment by what they do. Their behavioral skills allow them to use the social influence process to guide members in organizations to achieve the commanders' goals."

Reference:

S. M. Halpin "The human dimensions of battle command: a behavioral science perspective on the art of battle command" (Fort Leavenworth, KS: Army Research Institute (ARI) Battle Command Task Force Report. 1995)

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[34] Cohen, M. S. and J. T. Freeman. "Metarecognition in time-stressed decision making: recognizing, critiquing, and correcting," Human Factors, 38 (1996) pp. 206-219.

"Describes a framework for decision making, called the recognition/metacognition (R/M) model to explain how decision makers handle uncertainty and novelty while exploiting their experience in real-world domains. The study used a military scenario. The decision was whether or not to engage an incoming gunboat. The study was empirical. A conclusion is that the decision makers developed a set of situation models together with an understanding of their strength and weaknesses. Metacognition are processes that monitor and regulate other thought processes such as memory, attention, and comprehension. The authors discuss evidence for a set of specific metacognitive skills in proficient decision making. These skill include going beyond pattern matching in order to create plausible stories for novel situations; noticing conflicts between observations and a conclusion; elaborating on a story to explain a conflicting cue rather than simply disregarding or discounting the cue; having sensitivity to problems in explaining away too much conflicting data; attempting to generate alternative coherent stories to account for data; and having a refined ability to estimate the time available for decision making. Expert physicians spent more time verifying their diagnoses than did less experienced physicians.

More experienced decision makers buy themselves more time for resolving uncertainty by a) explicitly asking how much time they have before they must commit to a decision and b) estimating the available time more precisely. Less experienced decision makers are more likely to consider an alternative hypothesis at the start of their thinking and then to prematurely reject it in the face of any conflict. More experienced decision makers adopt more sophisticated critiquing strategies. They start by focusing on what is wrong with the current model especially incompleteness. Experienced decision makers adopt more sophisticated correcting strategies. They try to modify a story in order to explain conflicting evidence rather than ignore or discount the story. They evaluate the assumptions required by alternative stories rather than compare the data with fixed patterns or checklists. They try to construct a more plausible story by revising the most unreliable assumptions in the current stories. The R/M model needs to be tested and refined in research that spans several domains and that involves a variety of converging methods."

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[35] Cohen, M. S., J. T. Freeman, J.J. Fallesen, F.F. Marvin, and T. A. Bresnick. "Training critical thinking skills for battlefield situation assessment: an experimental test," Technical Report 1050, United States Army Research Institute for the Behavioral and Social Sciences, October 1996.

"A cognitive framework for battlefield situation assessment was developed and documented in earlier research. This framework is referred to as the recognition/metarecognition (R/M) model. Battlefield situation assessment is a key component to tactical decision making."

Reference:

Cohen, M. S., L. Adelman, M. A. Tolcott, T. A. Bresnick, and F. F. Marvin. "A cognitive framework for battlefield commander's situation assessment" (ARI Technical report 1002), US Army Research Institute for the Behavioral and Social Sciences, Alexandria VA, 1994.

Using this model, midgrade Army officers were examined while they conducted battlefield planning. An interesting tendency was identified: proficient decision makers appear to construct complete and coherent situation models by collecting or retrieving information and resolving any apparent conflicts.

This report assesses the merit of training methods based on the model. The training is intended to improve officer's critiquing and correcting skills.

The following is a summary of the R/M model. Meta-recognition is a cluster of skills that support and go beyond the recognitional processes in situation assessment. Situation assessment begins as recognition but continues if there is cause and opportunity to do so with one or more cycles of critical thinking. In a process called critiquing, the decision maker looks for sources of uncertainty, such as: 1) incomplete information; 2) unreliable assumptions; or 3) data that support conflicting conclusions. When problems are found, they are the targets of a correctional process, in which the decision maker collects more information, retrieves more information from long-term memory, or adjusts assumptions that stand in for missing information. The decision maker's newly elaborated understanding of the problem is re-evaluated as situation assessment continues in further cycles of recognition and metacognition. A process called the Quick Test regulates critiquing and correcting. They continue only as long as time is available, the cost of an error is high, and the situation remains unfamiliar or problematic.

Critiquing can result in the discovery of three kinds of problems with an assessment: incompleteness, unreliability, or conflict. An assessment is incomplete if key elements of a situation model or plan based on the assessment are missing. In identifying incompleteness, the recognitional meanings of the cues are embedded within a structure of some kind. In particular, story structures depict causal and intentional relations among events and have characteristics sets of components."

Reference:

Pennington, N. and R. Hastie. "A theory of explanation-based decision making." In G. A. Klein, J. Orasanu, R. Calderwood, and C. E. Zsambok (Eds.), Decision Making in Action: Models and Methods, Ablex, Norwood NJ, 1993.

"In particular, the main components of stories concerned with assessments of enemy intent are goals, capabilities and opportunities (which elicit) the intent to attack at a particular place and time (which leads to) actions (which result in) consequences. Understanding and planning are unreliable if the argument from evidence to conclusion, or from goals to action, is conditioned on doubtful assumptions.

Proficient decision makers first try to fill gaps and explain conflict, and only then assess the reliability of assumptions. They try to construct complete and coherent situation models. They do this if possible by means of newly collected or retrieved information, but if necessary by adopting assumptions. Success in filling gaps and resolving conflict does not mean that decision makers accept the resulting situation model. However, it does tell them what they must believe if they were to accept it. This process facilitates evaluation of a model by reducing all considerations to a single common currency: the reliability of its assumptions. If unreliability is too great, a new cycle of critiquing will hopefully expose it and trigger efforts to construct a new story.

The R/M model describes a set of skills that supplement pattern recognition in novel situations. These skills include identifying key assessments and the recognitional support for them, checking stories

and plans based on those assessments for completeness, noticing conflicts among the recognitional meanings of cues, elaborating stories to explain a conflicting cue rather than simply disregarding it, sensitivity to problems of unreliability in explaining away too much conflicting data, attempting to generate alternative coherent stories to account for data, and a sensitivity to available time, stakes, and novelty that regulates the use of these techniques."

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[36] Rabbitt, P. M.A. and E. A. Maylor. " Investigating models of human performance," British Journal of Psychology, 82 (1991) pp. 25 9-290.

"Reviews studies of ways in which performance in choice reaction time, visual search, and simple memory tasks is affected by individual differences in age and intelligence, by alcohol and by practice. The results are discussed in terms of the successes and limitations of 5 types of models: 'box-and-arrow in formation flow models; 'control-process' models; algebraic models of decision latencies; 'single-factor' models derived from psychometrics; and connectionist-network models."

"Broadbent (1971) attempts to set out a complete methodology for studying the effects of stress and individual differences on human performance."

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

"The review of the current paper considers Broadbent's exploration of how detailed functional models of performance of particular tasks can be broadened to help us understand the functional aetiology of brief fluctuations in efficiency, of steady improvement with practice and of stable individual differences of performance practice. The authors consider how easy serial choice reaction time (CRT) tasks and simple laboratory memory tasks are effected by individual differences in old age, by differences in individual IQ scores (IQTSs), by a particular drug, alcohol, and by a state variable, degree of practice."

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[37] Foss, J. W. "Command," Military Review, (Jan-Feb 1997) pp. 66-70.

"The future battlefield will be less forgiving of slow decisions than ever before. Good commanders anticipate. Not only do they anticipate the enemy, they anticipate their subordinates' needs and provide help and support to facilitate overall mission accomplishment. In this regard, the staff plays a key role. They must be forward-looking, helping the commander anticipate. Successful commanders also have a vision of the task. They "see" the task in its proper perspective; they understand the conditions necessary for success. Further, they articulate those points to others. The commander who centralizes everything in an attempt to be strong everywhere is, in fact, strong nowhere. His chain of command and his junior leaders will never develop responsibility and initiative. Commanders must be provided the maximum freedom to command and have imposed on them only those control measures necessary to synchronize mission accomplishment."

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[38] Hunt, J. G. and R. L. Phillips. "Leadership in battle and military performance." In Handbook of Military Psychology, John Wiley and Sons, New York, 1991.

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

Quinn, R. "Applying the competing values approach to leadership: toward an integrative framework." In J. G. Hunt, D. M. Hoskings, C. A. Schriesheim, and R. Stewart (Eds.) Leaders and Managers: International Perspectives on Managerial Behavior and Leadership, Pergamon, Elmford NY, 1984.

"Training can modify behavior: skill development techniques under high stress situations involve overlearning through extended practice to produce automatic responses and overlearning for improvisation" (Weick, K. E. "A stress analysis of future battlefields." In J. G. Hunt and J. D. Blair (Eds.), Leadership on the Future Battlefield, pp. 32-46, Pergamon Press-Brassey's, Washington DC, 1985).

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[39] Van Fleet, D. D. and G. A. Yukl. Military Leadership: An Organizational Behavior Perspective. JAI Press Inc. London, England 1986.

"Business and industrial organizations tend to be heavily utilitarian (members perform for money) in terms of the modes of compliance obtained within them.

Military organizations are normative (members perform out of duty) and to a lessor extent coercive (members perform out of fear). Normative organizations stress values more than utilitarian organizations would.

A study of traits and skills of leaders in military organizations found the following

Ethical conduct, personal integrity

Leadership effectiveness and achievement

Willingness to assume responsibility

Courage, daring

Maintaining coordination and team work

Ascendance, dominance and team work

Emotional balance and control

Intellectual skills

Social and interpersonal skills

Technical skills

Group task supportiveness

Effective mangers and administrators in large hierarchical organizations tend to have a strong need for power, a moderately strong need for achievement, and a somewhat weaker need for affiliation. Effective leaders tend to have high self-esteem, energy, maturity, stress tolerance, and a favorable attitude toward authority figures. They are inclined to be pragmatic and results-oriented, rather than introspective, philosophical or idealistic

Effective leaders are more likely to develop subordinate loyalty and dedication to the organization through power tempered by emotional maturity and inhibition. The dominant leader characteristics, which have been shown to be important, are managerial motivation and task relevant expertise.

The most effective forms of leader's personal power appear to be the leader's expertise based on demonstrated competence, the leader attractiveness based on personal qualities, and loyalty to the leader developed through a history of satisfactory exchange relationships wherein the leader provided benefits to subordinates and treated them in a fair and considerate manner.

A study of World War I veterans suggested that the presence of hunger, thirst, fatigue, ignorance of plans and idleness increases the danger from fear. The most important factors in controlling fear are: devotion to cause, leadership, training and materiel.

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There are autobiographies and biographies of military leaders who achieved some degree of fame and recognition for their successful leadership.

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[40] ARI Newsletter. "Transformational leadership and follower development," ARI Newsletter (Fall 1996) p. 12.

"Transactional leadership involves exchanges between leaders and followers that reflect more traditional forms of "management by objectives." In transactional exchanges, leaders specify requirements and the conditions and rewards for fulfilling those requirements. Transformational leadership achieves levels of effects over and above those produced by transactional exchanges. These augmenting effects are achieved through the following types of transformational behaviors: behaving so as to become a role model which followers want to emulate; providing meaning and challenge so as to inspire commitment to goals beyond self interest and to a shared vision; encouraging new ways of thinking, new approaches to problems, and learning from mistakes; and paying attention to each individual's particular needs, desires and capabilities. Bernard M. Bass and his fellow researchers have developed questionnaire measures of transformational and transactional leadership behavior.

The Center for Leadership and Organizations Research (CLOR), jointly operated at West Point by the United States Military Academy and the Army research Institute is administering the measures of transformational and transactional leadership for inclusion in the Baseline Officer Longitudinal Data Set (BOLDS)"

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[41] Okechuku, C. "The relationship of six managerial characteristics to the assessment of managerial effectiveness in Canada, Hong Kong and People's Republic of China," Journal of Occupational and Organizational Psychology, 67 (1994) pp. 79-86.

"The purpose of this study is to provide a descriptive comparison of the relative influence of certain Western-conceptualized managerial abilities, traits and motivations in assessing managerial effectiveness in the PRC and Hong Kong relative to a Western society such as Canada. Six characteristics considered to be critical to managerial success are supervisory ability, achievement motivation, intellectual ability, self-actualization, self-assurance, and decisiveness. In the West people tend to see themselves as individuals while in Chinese culture people tend to see themselves as part of a collective."

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[42] Smith, P. B., J. Misumi, M. Tayeb, M. Peterson, and M. Bond. "On the generality of leadership style measures across cultures," Journal of Occupational Psychology, 62 (1989) pp. 97-109.

"Study using shop-floor work teams and their immediate supervisors in Britain, the United States, Hong Kong and Japan. Where individualistic values prevail a leader's options may be expected to include the option of exerting direct pressure towards a goal. Where collectivist values prevail, leadership is more likely to emphasize reciprocal influence processes."

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[43] Van Fleet, D. D. and G. A. Yukl. Military Leadership: An Organizational Behavior Perspective. JAI Press Inc. London, England 1986.

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Effective mangers and administrators in large hierarchical organizations tend to have a strong need for power, a moderately strong need for achievement, and a somewhat weaker need for affiliation. Effective leaders tend to have high self-esteem, energy, maturity, stress tolerance, and a favorable attitude toward authority figures. They are inclined to be pragmatic and results-oriented, rather than introspective, philosophical or idealistic

Effective leaders are more likely to develop subordinate loyalty and dedication to the organization through power tempered by emotional maturity and inhibition. The dominant leader characteristics that have been shown to be important are managerial motivation and task relevant expertise.

The most effective forms of leader's personal power appear to be the leader's expertise based on demonstrated competence, the leader attractiveness based on personal qualities, and loyalty to the leader developed through a history of satisfactory exchange relationships wherein the leader provided benefits to subordinates and treated them in a fair and considerate manner.

A study of World War I veterans suggested that the presence of hunger, thirst, fatigue, ignorance of plans and idleness increases the danger from fear. The most important factors in controlling fear are: devotion to cause, leadership, training and materiel.

Leaders in combat situations must plan for enemy actions, effectively organize and schedule unit activities, and take decisive action in dealing with immediate crises. Planning and problem solving are important for leadership effectiveness in combat situations. Interpersonal relations are less important both to leaders and to subordinates in crisis situations. In such situations the only aspect of consideration that remains important to subordinates is the extent to which the leader is really concerned about their welfare and survival."

There are autobiographies and biographies of military leaders who achieved some degree of fame and recognition for their successful leadership.

"Behavior categories that are important in leaders are inspiration, performance emphasis, clarifying work roles, planning and problem solving."

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[44] Yukl, G. A. and D. D. Van Fleet. "Cross-situational, multimethod research on military leader effectiveness," Organizational Behavior and Human Performance, 30 (1982) pp. 87-108.

"Aspects of leadership found effective: performance emphasis; inspiration; role clarification; provide clear directions; criticism-discipline; planning and problem solving was important in combat situations. Friendly interpersonal relations become less important both to leaders and to subordinates in crisis situations."

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[45] Johnson, J. E. V. and A. C. Bruce. "Risk strategy under task complexity: a multivariate analysis of behaviour in a naturalistic setting," Journal of Behavioral Decision Making, 11 (1998) pp. 1-17.

"Study analyzes a large sample of decisions made by individuals in UK offcourse betting markets. The investigation focuses on the comparative impacts of complexity defined in terms respectively of alternatives and attributes. The results suggest that the risk strategy employed is affected by task complexity. Complexity does not affect the size of risk accepted but alternative- and attribute-based complexity together influence the propensity to accept greater degrees of risk. In addition, the effect of attribute-based complexity on risk taking appears to be modified by the use of risk-hedging strategies.

A widely employed framework (see, for example Timmermans, 1993) relates complexity to the number of alternatives between which an individual must discriminate in making a decision. Since information load, the amount one needs to know in order to make effective decisions, and hence complexity, are expected to increase with the number of alternatives, this is referred to as alternative-based complexity. The concept of discriminability is the ease with which alternatives can be distinguished by their attributes. This may be affected by complicated relationships between attributes that confound analysis of a set of alternatives. (Klein and Yadov 1989) In addition, lack of knowledge on the part of the decision maker or the nature of the problem may result in perceived ambiguity in the value of attributes or a lesser degree of relative attractiveness of alternatives; each of these may hinder discriminability since fewer alternatives can easily be eliminated. Since discriminability is largely a function of the attribute set, the associated complexity is referred to as attribute-based complexity."

References:

Timmermans, D. "The impact of task complexity on information use in multi-attribute decision making" Journal of Behavioural Decision Making vol. 6 (1993) pp. 95-111.

Klein, N. M. and M. S. Yadov. "Context effects on effort and accuracy in choice: an enquiry into adaptive decision making," Journal of Consumer Research, 15 (1989) pp. 411-421.

"Johnson and Bruce (1997a) explore the extent to which complexity inhibits risky decision making and their results suggest that attribute-based complexity exerts a greater deterrent effect than alternative-based complexity."

References:

Johnson, J. E. V. and A. C. Bruce. "An empirical study of the impact of complexity on participation in horserace betting" Journal of Gambling Studies 1997a (forthcoming)

Johnson and Bruce, 1997b "suggests that risk taking decreases as both alternative-and attribute-based complexity increases."

Johnson, J. E. V. and A. C. Bruce. "A probit model for estimating the effect of complexity on risk taking" Psychological Reports 1997b (forthcoming)

The results of the current study are as follows. "The results suggest that the size of risk, measured by stake is not influenced by either attribute-or alternative-based complexity. Generally the results support the notion of a propensity to accept greater degrees of risk as complexity increases. However the results suggest that the size of risk accepted is not affected by complexity but that attribute- and alternative- based complexity influence the absolute and relative risk accepted in an interactive manner. In addition, the propensity to accept absolute or relative risk is affected jointly by the level of attribute-based complexity and whether a risk-hedging mechanism is employed."

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[46] Chris Blood

Naval Health Research Center in San Diego

(619) 553 8386

Telephone interview by Jacobs

Name suggested by J Halbert. Dr. Blood is leader of working group 23 at MORS to be held in Monterey. His organization has done work on battlefield attrition of US forces in combat. As part of this they have tried to make some estimates of soft factors in combat outcomes. They assembled a subject matter panel. Attempting to assess horizontal bonding in the organization. Under the assumption the a homogeneous force is more cohesive, they used United Nations books to assess religious homogeneity in societies; ethnic homogeneity in societies; technical sophistication; and percent of GNP spent on defense. These assessments went into a model called FORCAZ to project battlefield attrition for US forces.

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[47] Soft Factors in Combat

Jerry Halbert (804) 980 7560

National Ground Intelligence Center

Address:

220 Seventh Street

N. E. Charlottesville VA 22902

NGIC

Attn: IANG-RAS (Halbert)

Telephone Interview 4/20/1998 by P. Jacobs

The National Ground Intelligence Center analyses intelligence of foreign countries; technical intelligence and military intelligence.

Some time ago there was a study of the of weapon acquisition potential by countries for the next 20 years. More recently there have been studies to evaluate factors that bear on the ability of countries to use the equipment; e.g. If a country purchased a long-range gun, did they also purchase the targeting equipment that would allow them to use the long range?

Each soft factor has a description that is a rating on a scale from 1 to 10. The author of the study plus 2 other people form a consensus rating score for each factor. The scales are not consistent over different studies; e.g. a score of 5 is not midway on the scale of 1 to 10.

One of the factors is the "wild card" battlefield performance; this factor reflects attributes not reflected by the other factors; e.g. the country has recently had 30 years of civil war.

Another factor is leadership.

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[48] Janet Morrow. Head of Modeling and Simulation at the National Ground Intelligence Center (NGIC). Telephone interview, (804) 980 7393, on 4/21/98 by Jacobs.

Have experts assess soft factors of combat; e.g. the level of training; morale. There is a reference scale from 1 to 10. Each number has criteria associated it. Some of the criteria are measurable. They keep refining the criteria. She does not know of anyone that is working on representing soft factors in combat models.

She recommends the book by Janis and Mann and the work by Tversky and his colleagues. A case study of bad decision making is a book about Pearl Harbor.

Prange, G. W., D. M. Goldstein, and K. V. Dillon. At Dawn We Slept: The Untold Story of Pearl Harbor. McGraw-Hill, New York, 1981.

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[49] Blood, C. G., D. Rotblatt, and J. S. Marks. "Incorporating adversary-specific adjustments into the FORECAS ground casualty projection model," Technical Document 96-10J, Naval Health Research Center, P.O. Box 85122, San Diego, CA 92186-5122.

"The FORECAS ground casualty projection system is an interactive tool designed to provide medical requirements specialists with estimates of the number of casualties that may be incurred during various combat scenarios. The projections provided by the system include wounded in action, killed in action, and disease and non-battle injury incidence for US Marine forces. Estimates are needed for medical resource planning.

The present report describes efforts to refine casualty rate projections by examining societal/cultural factors and weapons inventories.

Subject Matter Experts (SME) with backgrounds in casualty rate estimation were recruited to participate on a panel quantifying human factors adjustments to the baseline casualty estimates. The panel reached consensus on nine variables that would impact battlefield performance. The factors generally fall into the categories of 1) Technical Sophistication, 2) Group Cohesion, and 3) Armed Forces wide Esprit de Corps

Technical Sophistication is measured by electrical consumption per capita. Electrical consumption per capita was computed as thousand metric tons of coal equivalent/population.

Group cohesion is measured by overall societal homogeneity. Ethnic homogeneity and religious homogeneity measured societal homogeneity.

Battlefield experience, military tradition, and troop commitment influence armed forces-wide esprit de corps. Number of engagements within the last 10 years and number of engagements in the last 25 years measured battlefield experience. In the military tradition subcategory, the variables of combat success percentage and combat history were judged to have varying influences on the fighting spirit of a force. Two variables that measure troop commitment were the length of conscription and national defense spending priority.

Each member of the SME panel ranked each factor's importance, overall and relative to other factors by assigning each factor a number between 1 and 7 denoting it contribution to battlefield performance. The panel also agreed to weightings to combine information between countries. A composite factor for each country was determined."

Some details of the forecasting system are given in C. G. Blood, J. M. Zouris, and D. Rotblatt "Using the ground forces casualty forecasting system (FORECAS) to project casualty sustainment" Report No. 97-39, Naval Health Research Center, P.O. Box 85122, San Diego, CA 92186-5122.

The model is a time series model that appears to be specified by looking at casualty data from previous conflicts.

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[50] Bond, M. H. and P. B. Smith. "Cross-cultural social and organizational psychology," Annual Review of Psychology, 47 (1996) pp. 205-35.

"Leadership: The general functions that effective leaders must carry out appear to be universal. The specific ways in which these functions are expressed differs.

Managerial Decision Making: Managers in individualistic societies tend to handle events based more on their own experience than managers in collectivist societies.

Negotiation: Members in collectivist societies are more competitive with out-groups than are members of individualist cultures. Negotiating behavior is influenced both by variations in individualism-collectivism and by specific situational demands. Collectivists may regard long term links as a more important success criterion than short-term payoff."

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[51] Yates, J. F., J-W. Lee, and H. Shinotsuka. "Beliefs about overconfidence, including its cross-national variation," Organizational Behavior and Human Decision Processes, 65 (1996) pp. 138-147.

"A commonly used judgment research task requires the subject to choose among alternative answers to a general knowledge question and then state a probability that the selected response is correct. People often exhibit overconfidence in this task; (the subjects' average probability judgments exceed the proportion of items they answer correctly). Such overconfidence is stronger in most Asian countries than in Western countries. An empirical study demonstrated that subjects in both Taiwan and the United States typically expect cross-national variations to be the opposite of those that actually occur. It also showed that dominant lay theories for overconfidence rest exclusively on factors such as inflated self-appraisals.

Research has shown that overconfidence in one's general knowledge is subject to a number of factors. The most commonly discussed is item difficulty. Overconfidence is most pronounced for difficult questions, ones that are answered correctly by relatively few people. In contrast, overconfidence

typically diminishes, and even turns into underconfidence for very easy items; questions that almost everyone answers correctly.

The results of an experiment indicated that Mainland Chinese were far more overconfident than Americans. Another study indicated that Japanese subjects' judgments were virtually indistinguishable from Americans.

The current paper used student subjects in Taiwan (Chinese) and the United States and asked in what country they would expect overconfidence. Students in both countries expected overconfidence in the United States. The Taiwanese Chinese subjects were about twice as likely as the Americans to expect Taiwanese to display overconfidence.

There is a fair amount of cross-cultural personality research indicating that personal modesty—even self-effacement–is more common in Asia than in the US. Such modesty manifests itself in practical situations, too. In the US, self appraisals of job performance are almost always more lenient than those of the employee's supervisors. A study found exactly the opposite among Chinese workers and supervisors in Taiwan.

There are important reasons why we should expect more modesty among Asians. Many Asian societies place a premium on interpersonal harmony, which is enhanced by self-effacement. Considerable data indicate that self esteem in an individualistic society is enhanced when one sees him or herself as distinct–in particular, better than others. In contrast, in a collectivistic society, self esteem is facilitated by adherence to the norm that one should "fit in".

There are growing indications from other directions that intuitively appealing self-esteem explanations of overconfidence in general knowledge are deficient. It appears that although self esteem mechanisms might underlie many self-appraisals, they do not explain overconfidence in general knowledge. Explanations of general knowledge overconfidence are the topic of active debate."

[52] Kaplan, M. "Cultural ergonomics: an evolving focus for military human factors." In Reuven Gal and A. David Mangelsdorff (Eds.) Handbook of Military Psychology, John Wiley and Sons, New York, 1991.

Shouksmith, G. and S. Burrough. "Job stress factors for New Zealand and Canadian air traffic controllers," Applied Psychology: an International Review, 37 (1988) pp. 263-270.

Breznitz, S. and Y. Eshel. "Life events: stressful ordeal or valuable experience?" In S. Breznitz (Ed), Stress in Israel, Van Nostrand Reinhold, New York, 1983.

Shalit, B. The Psychology of Conflict and Combat, Praeger, New York, 1988.

Rachman, S. J. "Fear and courage in bomb disposal operators," Advances in Behavior Research and Therapy, 4 (1983) pp. 99-164.

Rachman, S. J. "Psychological analysis of courageous performance in military personnel," Contract DAJA 45-83-C-0028 (in progress). European Science Coordination Office US Army Research Institute, 1989.

Stewart, N. K. "South Atlantic conflict of 1982: a case study in military cohesion," (draft report), US Army Research Institute, Alexandria VA, 1987.

Braun, P., D. Wiegand, and H. Aschenbrenner. "The assessment of complex skills and of personality characteristics in military services." In Reuven Gal and A. David Mangelsdorff (Eds.) Handbook of Military Psychology, John Wiley and Sons, New York, 1991.

Lord, R. G., C. De Vader, and G. M. Alliger. "A meta-analysis of the relation between personality traits and leadership perceptions," J. of Applied Psychology, 71 (1986) pp. 402-410.

[53] Winter, D. G., A. J. Stewart, L. E Duncan, O. P. John, and E. C. Klohnen. "Traits and motives: toward an integration of two traditions in personality research," Psychological Review, 105 (1998) pp. 230-250.

"After reviewing classic and current conceptions of trait (as measured by questionnaires) and motive (as measured by the Thematic Apperception Test [TAT] or other imaginative verbal behavior), the authors suggest that these 2 concepts reflect 2 fundamentally different elements of personality-conceptually distinct and empirically unrelated. The authors propose that traits and motives interact in the prediction of behavior: Traits channel the behavioral expression of motives throughout the life course. The authors illustrate this interactive hypothesis in 2 longitudinal studies, focusing on the broad trait of extraversion and the 2 social motives of affiliation and power. Extraversion facilitates unconflicted motive expression, whereas introversion deflects social motives away from their characteristic goals and creates difficulties in goal attainment."

[54] Ackerman, P. L. and E. D. Heggestad. "Intelligence, personality, and interests: evidence for overlapping traits," Psychological Bulletin, 121 (1997) pp. 219-245.

The authors review theories of intelligence, personality and interest as a means to establish potential overlap. "Evaluations of relations among personality construct, vocational interests and intellectual abilities lead them to propose that the development of personality-interest-intelligence traits proceeds along mutually causal lines; that is abilities, interests, and personality develop in tandem.

Gf: fluid intelligence: sequential reasoning, inductive reasoning, quantitative reasoning,...

Gc: crystallized intelligence: verbal comprehension, lexical knowledge, foreign language,...

Five factors of personality traits:

Extroversion

Agreeableness

Conscientiousness

Neuroticism

Intellect

TIE: Typical intellectual engagement is a self report measure of personality developed by Goff and Ackerman. The measure shows association with openness to experience. It does not show association with Gf"

[55] Ghosh, D. and M. R. Ray. "Risk, ambiguity and decision choice: some additional evidence," Decision Sciences, 28 (1997) pp. 81-104.

Reports results of experiments using MBA students. "Both risk attitude and ambiguity intolerance determine choice behavior The presence of ambiguity may often be interpreted/perceived as risk. Decision makers who are less risk averse and have more tolerance for ambiguity display greater confidence in their choice. Individuals with a low tolerance for ambiguity may interpret lack of information or lack of precise information as risk and take action that incurs cost without yielding benefit. Risk seeking and ambiguity tolerant individuals may take no action where such action may be necessary."

Ghosh, D. and Ray, M. R. (1992) "Risk attitude, ambiguity intolerance, and decision making: an exploratory investigation" Decision Sciences vol. 23 pp431-444.

Hogarth, R. M. (1989) "Ambiguity in competitive decision making: some implications and tests" In P.C. Fishburn and I. Lavelle (Eds.) <u>Annals of Operations Research</u> vol. 19 pp31-50.

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[56] Atwater, L. E., S. D. Dionne, B. J. Avolio, J. F. Camobreco, and A. W. Lau. "Leader attributes and behaviors predicting emergence of leader effectiveness," Technical report 1044, United States Army Research Institute for the Behavioral and Social Sciences, July 1996.

"Data was gathered concerning a sample of cadets/students over the course of their education and military training at a state military college (Virginia Military Institute). The primary purpose was to track longitudinally leader development and emergence and to identify individual characteristic and leadership behaviors that differentiated the leadership position and leadership effectiveness attained by the cadets. The study sought to identify the individual characteristics and leadership behaviors that differentiated the leadership positions and leadership effectiveness achieved by the students as college seniors.

The Center for Leadership and organizations Research (CLOR), jointly established by the US Military Academy (USMA) and the US Army Institute for the Behavioral and Social Sciences conduct programmatic research on Army-wide priorities in the areas of organizational leadership and leader education, training an development. The CLOR's major research effort is known as Leadership Education and Development for the 21st Century (LEAD21). The overall goal of LEAD21 is development of a longitudinal database as a capability for understanding the leadership development process. LEAD 21 involves the creation of a longitudinal database, begun with the USMA cadets in the Class of 1998, which will allow a description of changes in leadership behavior with organizational progression, as well as identification of experiences contributing to progressive leader development.

Early studies of leadership emergence and effectiveness concentrated on linking leader personality traits to various leader effectiveness or performance measures"

References:

Bass, B. M. <u>Bass & Stogdill's Handbook of Leadership</u>. Free Press, New York, 1990.

Yukl, G. A. <u>Leadership in Organizations</u>. Prentice-Hall, Englewood Cliffs NJ, 1994.

"Generally, clusters of characteristics seemed to differentiate effective from ineffective leaders, though no specific trait or characteristic could be deemed essential. Among the characteristics found to be of clear consequence to leadership were cognitive ability, conscientiousness, self-confidence, energy/activity level, values, and tolerance for stress. (Bass (1990)) Lord, Devader and Alliger (1986) in their meta-analysis review of the leader trait literature concluded that traits did account for appreciable variance in leadership perceptions. They found that aggregate correlation between intelligence and leadership was 0.50. Lord and Hall (1992) argued that cognitive ability levels determine the extent to which leaders are more successful at anticipating and recognizing problems, thus improving their ability to influence others."

References:

Lord, R. G., C. De Vader, and G. M. Alliger. "A meta-analysis of the relation between personality traits and leadership perceptions," <u>J. of Applied Psychology</u>, 71 (1986) pp. 402-410.

Lord, R. G. and R. J. Hall. "Contemporary views of leadership and individual differences," <u>Leadership Quarterly</u>, 3 (1992) pp. 137-157.

"The report contains a literature review of various individual characteristics and leader effectiveness. It also talks about assessment of traits and interpersonal behaviors. For example the

California Psychological Inventory (CPI) was developed to assess traits and interpersonal behaviors that arise from and operate in the domain of the social environment.

The report uses analysis of variance to assess associations between individual characteristics and the final military rank of the students graduating from VMI. Standard errors of means are never reported. The most important individual difference characteristics were physical fitness, self-esteem, cognitive ability, prior influence experiences and conscientiousness."

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[57] Avolio, B. J., S. Dionne, L. Atwater, A. Lau, J. Camobreco, N. Whitmore, and B. Bass. "Antecedent predictors of a 'full range' of leadership and management styles," Technical Report 1040, United States Army Research Institute for the Behavioral and Social Sciences, March 1996.

"Report provides the results of research examining the relationship between antecedent measures of focal cadet personality, ability, temperament, interpersonal style, experience, and physical fitness with rating of leadership collected from multiple sources (subordinate and superior) over two time periods. The primary purpose of the research reported is to assess the characteristics that differentiate cadets rated as transformational versus those who are rated as exhibiting less active and/or passive corrective styles of leadership and management." Data were collected at Virginia Military Institute (VMI).

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[58] Spector, P. E. and B. J. O'Connell. "The contribution of personality traits, negative affectivity, locus of control and type A to the subsequent reports of job stressors and job strains," Journal of Occupational and Organizational Psychology, 67 (1994) pp. 1-11.

"Negative affectivity locus of control and type A personality have all been suggested as playing an important role in the job stress domain. Negative affectivity (NA) is defined as the tendency for an individual to experience a variety of negative emotions across time and situations. Locus of control is a personality variable that concerns people's generalized expectancies that they can or cannot control reinforcements in their lives. People who hold expectancies that they control reinforcements are considered to be internals, and people who hold expectancies that outside forces or luck controls reinforcements are considered to be externals. There are two aspects to type A personality: impatience-irritability and achievement striving."

Paper reports results of a study assessing a cohort of graduating college seniors while in school and again after graduating and beginning a job. The results show that personality relates to incumbent reports of job stressors and strains.

Reference:

Ganster, D.C. (1986). "Type A behavior and occupational stress" Journal of Organizational Behavior Management vol. 8 pp61-84.

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[59] Robertson, I. T. and A. Kinder. "Personality and job competencies: the criterion-related validity of some personality variables," Journal of Occupational and Organizational Psychology, 66 (1993) pp. 225-244.

Results of a study to assess the criterion-related validity of some personality variables are reported.

The study uses the Occupational Personality Questionnaire (OPQ; Saville and Holdsworth 1990). The instrument is the result of efforts to produce self-report personality inventories focused on occupationally-relevant (as opposed to clinically-relevant) factors.

References:

Barrick, M. R. and Mount, M. K. (1991) "The big five personality dimensions and job performance: a meta-analysis" Personnel Psychology vol. 44 pp1-26

Saville, P. and Holdsworth (1990) Occupational Personality Questionnaire Manual. Echer, Surrey: Saville &Holdsworth.

Tett, R. P., Jackson. D. N. and Rothstein, M. (1991) "Personality measures as predictors of job performance: a meta-analytic review" Personnel Psychology vol. 44 pp703-742.

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[60] Lord, R. G. and R. J. Hall. "Contemporary views of leadership and individual differences," Leadership Quarterly, 3 (1992) pp. 137-157.

"There is a need for an effective method for measuring leadership behavior. This report considers the Cadet Performance Report (CPR). CPR is a 12-dimensional leadership behavior rating system currently used to develop and evaluate the leadership performance of USMA cadets. The report examines the use of CPR to measure cadet leadership behavior.

The US Army has conducted research on defining and measuring leadership effectiveness. Three classification systems are particularly relevant for understanding leadership in the Army context. The Center for Army Leadership (CAL) has identified nine leadership competencies representing the performance requirements of leaders throughout the US Army. Two other systems were developed to classify the leadership behaviors involved in precommissioning education and training. They are the leadership Assessment Program (LAP), a sixteen-dimensional taxonomy used in the reserve Officer Training Corps (ROTC) and the Cadet Performance Report (CPR), a twelve-dimensional leadership behavior rating system employed by the US Military Academy at West Point, NY

This study evaluates the reasonableness CPR as a measure."

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[61] Driskell, J. E. and E. Salas. "Overcoming the effects of stress on military performance: human factors, training, and selection strategies." In Reuven Gal and A. David Mangelsdorff (Eds.) Handbook of Military Psychology, John Wiley and Sons, New York, 1991.

Kahan, J. P., N. Webb, R. J. Shavelson, and R. M. Stolzenberg. "Individual characteristics and unit performance," The RAND Corporation, Santa Monica CA, 1985.

"It does not appear promising to use personality measures to predict unit effectiveness."

Hogan, J., R. Hogan, and S. Briggs. "Psychological and physical performance factors associated with attrition in explosive ordinance disposal training," (Report No. UY-100), Office of Naval Research, Arlington VA, 1984.

"It is difficult to discover consistent relationships between personality variables and stress resistance given the scarcity of reliable measures of stress proneness or stress vulnerability."

Driskell, J. E., Hogan, R. and Salas, E.. "Personality and group performance," Review of Personality and Social Psychology, 9 (1987) pp. 91-112.

"There are many different definitions of personality."

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[62] Jacobs, T. O. and E. Jaques. "Executive leadership." In Reuven Gal and A. David Mangelsdorff (Eds.) Handbook of Military Psychology, John Wiley and Sons, New York, 1991.

"The scientific study of leadership at senior levels arguably dates from the initial work of Mintzberg (1973)"

H. Mintzberg (1973) The Nature of Managerial Work. New York: Harper and Row.

"The US Army Research institute has done systematic research on leadership at the senior levels."

Isenberg, D. J. "Some hows and whats of managerial thinking: implications for future army leaders." In J. G. Hunt and J. D. Blair (Eds.), Leadership on the Future Battlefield, Pergamon Press-Brassey's, Washington, 1985.

"The Meyers-Briggs Temperment Indicator (MBTI) has been used at both the Army's Command and General Staff College and War College and the National Defense University. Individual preferences about information processing can be categorized into 4 types

S: (sensing) orientation toward extracting meaning from events

N: (intuiting) preference for constructing an internal meaning structure

T: (thinking) preference for orientation to make judgements through logical, analytical processes.

F (feeling) orientation toward basing judgments on value positions

Nutt, P.C. "Decision style and strategic decisions of top executive," Technical Forecasting and Social Change, 30 (1986) pp. 39-62.

ST executives were highly risk adverse; SF executives generally perceived lower risk and made riskier decisions. ST executives were impacted by "incompatible information, seeing higher risk in projects when informed about them through means not compatible with their 'style'

The peacetime environment may give high survival value to risk aversion (thereby increasing survival value of ST type)

Executive effectiveness is dependent on successful execution of a complex set of role behaviors, which extend beyond what is conventionally termed leadership. The acquisition of skill in these role behaviors is strongly dependent on the incumbent's conceptual ability i.e. capacity to develop a representation (cognitive map) which encompasses the complexity of the cause and effect dynamics, that he/she must influence."

Campbell, D. "The psychological test profiles of brigadier generals: warmongers or decisive warriors." Invited address at American Psychological Association Convention, 1987.

Blair J. D. and J. G. Hunt. "A Research Agenda." In J. G Hunt and J. D. Blair (Eds.) Leadership on the Future Battlefield, Pergamon Press, New York, 1985.

Dixon, N. On the Psychology of Military Incompetence. Basic Books, New York, 1976.

Jaques, E., S. Clement, C. Rigby, and T. O. Jacobs. Senior leadership performance requirements at the executive level. US Army Research Institute for the Behavioral and Social Sciences, Alexandria VA, 1986.

"Findings based on interviews of 41 general officers. Single skill most often mentioned was consensus building (convince subordinates from other services; convince others to provide necessary assets; ensures that successors will continue the effort); make decisions without full information; have to deal with complexity and uncertainty"

Isenberg (1985) (D. J. Isenberg (1985) "Some hows and whats of managerial thinking: implications for future army leaders" in J. G. Hunt and J. D. Blair (Eds.), Leadership on the future battlefield. Washington: Pergamon Press)" describes observation of six senior managers. They create new alternatives, keep options open, delay decision points, search for more information, and include more people in the decision-making function. They do not solve problems; they focus on defining them so solutions could be found. Have a high tolerance for ambiguity and perceived and understood novelty."

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[63] McGregor, L., M. Eveleigh, J. C. Syler, and S. F. Davis. "Self-perception of personality characteristics and the type A behavior pattern," Bulletin of the Psychonomic Society, 29 (1991) pp. 320-322.

"The type A behavior pattern has been characterized by the following traits:

A sense of time urgency

Competitive achievement striving

High levels of aggressiveness and/or free-floating hostility

In contrast, Type B individuals are defined by the relative absence of these Type A characteristics.

All Type A characteristics are seen as mechanisms by which the individual attempts to maintain control over the surrounding environment. Any situation that is perceived as a threat to the individual's control results in an intensification of these mechanisms. Glass (1977) demonstrated that Type A individuals displayed greater reactions than did Type Bs to uncontrollable events that were very salient, whereas the opposite was true for events of low salience."

Reference:

Glass, D. (1977) Behavior patterns, stress, and coronary disease Hillsdale, NJ: Erlbaum

"Type A individuals displayed greater impairment on a task requiring a response delay than did Type Bs. The type A subjects consistently overestimated the passage of time and responded before the delay interval had timed out."

Reference:

Glass, D., Snyder, M., and Hollis, J. (1974) "Time urgency and the Type A coronary-prone behavior pattern" Journal of Experimental Social Psychology vol. 10 pp284-300.

"Type A adults were shown to be significantly more aggressive than Type Bs when provoked by an annoying confederate or by a frustrating task":

Reference:

Carver, C. S. and Glass, D. C. (1978) "Coronary-prone behavior pattern and interpersonal aggression" Journal of Personality and Social Psychology Vol. 36 pp. 361-366.

"To continue a tiring but challenging task, Type A individuals have repeatedly suppressed fatigue and performed closer to their endurance levels than Type B":

Reference:

Carver, C. S., Coleman, A. E., and Glass D. C. (1976) "Coronary-prone behavior pattern and the suppression of fatigue on a treadmill test" Journal of Personality and Social Psychology Vol. 33 pp. 460-466.

"Extreme Type A individuals display higher death anxiety and manifest anxiety scores than did type B individuals":

Reference:

Tramill, J. L., Kleinhammer-Tramill, P. J., Davis, S. F. and Parks, C. S. (1985)"The relationship between Type A and Type B behaviors and level of self-esteem" Psychological Record vol. 35 pp323-327.

    The authors studied undergraduate college students.

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[64] Byrne D. G. and M. I. Reinhart. "Work characteristics, occupational achievement and the type A behavior pattern," Journal of Occupational Psychology, 62 (1989) pp. 123-134.

"Study of people in Australian Public Service. Type A behavior pattern is associated with more working weeks/year, more discretionary work hours/week and more days/ year spent on occupation-related travel. This time commitment is instrumental in facilitating occupational achievement among those with a type A behavior pattern."

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[65] Hunt, R G., F. J. Krzystofiak, J. R. Meindl, and A. M. Yousry. "Cognitive style and decision making," Organizational Behavior and Human Decision Processes, 44 (1989) pp. 436-453.

"Field independence is the ability to separate an object or phenomenon from its environment. Individuals showing high field independence were thought to prefer problem solving approaches which emphasize detail and basic relationships. The field dependent person shows less ability (or perhaps less inclination) to separate objects from their environment. Field dependent individuals would prefer more global, perhaps intuitive, approaches to problem solving."

Above quote from

Henderson, J. C. and P. C. Nutt. "The influence of decision style on decision-making behavior," Management Science, 26 (1980) pp. 371-386.

"A related set of categories contrast "analytic" and "intuitive" individuals. The analytic individual is seen as concentrating on detail and thus as breaking that which is observed into component parts. In contrast the intuitive individual comprehends the field as an integrated whole."

"McKenny and Keen (1974) have both an information-gathering and an information-evaluation dimension of style. The information-gathering dimension differentiates receptive, data-sensitive (i.e. analytic) individuals from perceptive data-filtering (i.e. intuitive) individuals. The information-evaluation dimension differentiates systematic structured decision makers (i.e. analytic) from holistic, trial and error (i.e. intuitive) problem solvers. Combination of the two dimensions results in four cognitive styles: systematic-perceptives, systematic-receptives, intuitive-perceptives and intuitive-receptives."

References:

McKenny, J. and P. Keen. "How managers' minds work," Harvard Business Review, 52 (1974) pp. 79-90.

Mitroff, I. I. "Archetypal social systems analysis: on the deeper structure of human systems," Academy of Management Review, 8 (1983) pp. 387-397.

"Based on a Jungian scheme Mitroff (1983) utilized a similar classification scheme which recognized that individuals differ in the way that they acquire information and in the methods that they use to process data. The information-acquisition dimension differentiates individuals who are sensation-oriented (S) from those who are intuition-oriented (I). The sensation-oriented information acquirer prefers structured problems which involve routine and detail while the intuitive prefers structured problems which involve routine and detail while the intuitive prefers structured problems which involve routine and detail while the intuitive prefers unstructured problems. The information-evaluation dimension differentiates those individuals who adopt a thinking(T) approach when evaluating information from those who adopt a feeling (F) approach. Again these dimensions are seen as being independent and thus, combine to produce four basic composite styles: Sensation-Thinking (ST), Sensation-Feeling (SF), Intuition-Thinking (NT), and Intuition-Feeling (NF). Each individual is thought to be predominantly of one type.

The research reported in Hunt et al. (1989) concentrates on sharply contrasting "analytics" and "intuitives". Analytics are people who, for example when gathering information tend to be attentive to detail whereas Intuitives focus on patterns; and when evaluating information, analytics define the quality of a solution largely in terms of the method whereas Intuitives defend a solution in terms of "fit"" (cf.

Keen, P. G. W. (1973) The Implications of cognitive style for Individual Decision Making Unpublished doctoral dissertation, Harvard University Graduate School of Business Administration.

"Behling, Gifford and Tolliver (1980) found intuitives to be more risk prone than sensers in a betting situation. Henderson and Nutt (1980) found that Sensation-Thinking (ST) styles were associated with a greater degree of risk aversion than were Sensation-Feeling (SF) styles. Second, Keen (1973) provided evidence that the dimensions of cognitive style are not empirically independent. Systematic subjects were more likely to be thinking information evaluators and intuitives were more likely to be feeling."

References:

Behling, O., W. E. Gifford, and J. M. Tolliver. "Effects of grouping information on decision making under risk," Decision Sciences, 11 (1980) pp. 272-283.

"A simple schematic model of decision making would conceive of it in terms of three interacting components: the decision maker, the task, and the decision context or situation.

Hypothesis: Expressed or preferred decision strategies will vary as a function of the decision maker's cognitive style.

Procedure: The short form of the Myers-Briggs Type Indicator (MBTI) was used to determine the cognitive style. A standardized decision task was simulated in the form of a case designed in accord with a specific model of decision processes. In it different pairs of specialists, differing in style, gave advice to a company's head about how to handle a strategic issue confronting the firm. Subjects were asked to choose one from each pair of advisors, in each of three consecutive meetings, representing stages of the decision process. It was expected that a subject having a particular style would choose advisors expressive of the same style.

Authors use analytic (both dimensions analytic) intuitive (both dimensions intuitive) mixed in type (intuitive in one dimension and analytic in the other)

The Bahl-Hunt model divides decision making into four distinct features: 1) a definition of the situation in the form of a cognitive "model"; 2) a set of alternatives; 3) the selection of a choice; and 4) an overt action."

The authors found some associations of the type they were expecting

Reference:

Bahl, H. C. and Hunt, R. G. (1984) "A framework for systems analysis for decision support systems" Information and Management vol. 7 pp121-131.

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[66] Janis, I. L. Crucial Decisions. The Free Press, New York, NY, 1989.

"A main goal of book is to address the following questions: When and why do leaders of large organizations make avoidable errors that result in faulty policy decisions? How can such errors be prevented or at least kept to a minimum.

The steps of vigilant problem solving to make decisions:

Formulate the problem: what are the requirements; direction of solution?

Use informational resources: prior information and new information;

Analyse and reformulate the problem: additions or changes to requirements? Additional alternatives? Additional information needed?

Evaluate and select an alternative;

Decide after adequate search, appraisal, and planning;

Bolster the decision by playing up the advantages and playing down the disadvantages; solicit supportive information; announce decision to interested parties; promote the decision.

Assumptions:

The quality of the procedures used to arrive at a fundamental policy decision is one of the major determinants of a successful outcome.

Most leaders are capable of carrying out procedures needed for high quality decision making.

Policy makers make no effort to use high quality procedures to make decisions they regard as unimportant

In important policy decisions a few constraints will dominate the thinking.

Factors influencing policymakers judgments on the importance of a potential problem:

It is important if there is a large discrepancy between the existing and desired state of affairs.

It is important if the new problem is viewed as linked to a problem already being worked on.

The total number of important problems already being worked on.

General tendency to ignore threats that develop gradually rather than precipitately.

An unambiguous threat that arises without any prior warning requires more than standard operating procedures and decision rules.

How serious a decision maker becomes about an emerging threat depends on how familiar the policymaker is with the type of danger to which a valid warning refers.

When managers believe that the complexities of the issues exceed their capabilities or the organization lacks adequate resources for working out a high-quality solution to a problem they judge to be very important, they will make a crucial policy decision by "the seat-of-their pants" without bothering to examine carefully the pertinent information that is readily available.

Cognitive Decision rule:

Satisficing: Accept the first alternative that comes to mind that is "good enough" to meet the minimal requirements without bothering to compare it with other viable alternatives.

Role of personality in leadership:

At present the role of personality in leadership is in the doldrums because few generalizations about the interaction of personality and situational factors have as yet emerged.

Five potential factors to describe major features of personality

Conscientiousness-well organized versus disorganized; careful versus careless; self-disciplined versus lax.

Openness-imaginative versus down to earth; independent versus conforming, preference for variety versus preference for routine.

Neuroticism-worrying versus calm; insecure versus secure; self-pitying versus self-satisfied.

Agreeableness-considerate versus ruthless; trusting versus suspicious; helpful versus uncooperative.

Extraversion-sociable versus retiring; active versus passive.

Hypotheses concerning factors associated with poor decision making

Minimize importance of major challenging threats:

Chronic lack of conscientiousness;

Chronic lack of openness: lack of imagination, failure to think and act independently and preference for routine;

Calm, cool detached coping style in response to fear-arousing events or communications; high stress tolerance tends to make people relatively unresponsive to serious warnings;

Chronic optimism concerning the organization's stability and vulnerability;

Overreaction to information:

Low self confidence, including chronic sense of low self-efficacy;

Chronic pessimism concerning organization's ability to supply the resources essential for solving complicated policy problems, with supporting beliefs about internal weaknesses that preclude adaptive changes;

Overreaction to social Pressures:

Chronically strong need for social approval;

Strong need for power and status;

Chronic apprehensiveness about ruthlessness of other powerholders in the organization with supporting beliefs about their readiness to inflict retaliations;

High dependency upon a cohesive group of fellow executives for social support;

Egocentric constraints by arousing strong personal motives:

Chronic lack of conscientiousness;

Persistent negativism or hostility toward the organization with supporting beliefs about undesirable features that make it undeserving of loyalty;
Overreaction to information by arousing anxiety or other emotional reactions:

Low stress tolerance-manifested by relatively high level of anxiety with feelings of helplessness and vulnerability;

Lack of perceived control over outcomes and other components of a low level of personality hardiness;

Persistent ambivalence toward the organization such that it is seen as having positive features that make it deserving of loyalty but is also seen as having negative features that make it weak and vulnerable;

Habitual externalized anger-coping style;

Persistent hostility toward major opponents, with supporting beliefs about their evil and hostile intentions."

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[67] Ajzen, I. <u>Attitudes, Personality, and Behavior</u>. The Dorsey Press, Chicago IL, 1988.

"We cannot construct a broad personality inventory or attitude scale and hope to use it as a basis for the prediction and explanation of any conceivable behavioral criterion. Too many factors unique to a given occasion prevent emergence of a clear behavior consistency. Broad response dispositions are poor predictors of specific actions. Both theory and empirical findings negate the possibility of using measures of general attitudes or personality traits to predict behavior."

Generally, observations of single actions on individual occasions do not correlate well with each other. However, aggregating observations of a given behavior across occasions can provide a measure of the disposition to perform the behavior in question.

Both theory and empirical findings negate the possibility of measuring general attitudes or personality traits and using the resulting scores to predict any single behavior under a set of circumstances.

The author describes a theory of planned behavior: Attitude toward the behavior, subjective norms, and perceived behavioral control are the three primary determinants of intentions. Intentions are influenced by beliefs about the behavior's likely outcomes; beliefs about the expectations of important others; beliefs about the factors that may facilitate or hinder performance of the behavior. The theory of planned behavior is designed to permit prediction and explanation of behavioral achievement by taking into account motivational antecedents, reflected in intentions, as well as other factors that are only partly under volitional control that are reflected in perceived behavioral control.

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[68] Streufert, S. "Individual differences in risk taking," <u>J. of Applied Social Psychology</u>, 16 (1986) pp. 482-497.

"Investigated personality traits that resulted in the likelihood to adopt risky actions with highly adverse consequences: attributes are type

A (success driven, time driven competitive); high tolerance for incongruity between past experience and contemplated risks; and low cognitive complexity (less integrative multidimensional information processing)

Personality characteristics of great leaders is sparse."

Suedfield, P., R. S. Corteen, and C. McCormick. "The role of integrative complexity in military leadership: Robert E. Lee and his opponents," J. of Applied Social Psychology, 16 (1986) pp. 498-507.

Huntford, R. Scott and Amundsen. Putnam, New York, 1980.

"There is a mistrust reluctance and objections of higher ranks of military leadership to the formal introduction of personality factors in selection, advancement and placement at these ranks."

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[69] Sanders, G. S. and F. S. Malkis. "Type A behavior, need for control, and reactions to group participation," Organizational Behavior and Human Performance, 30 (1982) pp. 71-86.

"Type A behavior is characterized primarily by the combination of a highly competitive achievement orientation, a sense of time urgency, and excessive hostility in response to frustration. Type As seem to have a strong investment in demonstrating that they can deliberately cause desired consequences–that is, they have a high need for control. The desire to master their environment is presumed to underlie Type As concern with competition, their strong reaction to being thwarted by frustration, and their fear of missing deadlines or wasting time. Type A syndrome is not chronic but emerges primarily when the environment poses some threat to these individuals' sense of control."

Experiment with student subjects.

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