DECISION MAKING:
AN ANNOTATED BIBLIOGRAPHY OF SELECTED RECENT LITERATURE

Ellen S. Decker and Sharon L. Riedel
U.S. Army Research Institute

ARI Field Unit at Fort Leavenworth, Kansas
Stanley M. Halpin, Chief

SYSTEMS RESEARCH LABORATORY
Robin L. Keesee, Director

U. S. Army
Research Institute for the Behavioral and Social Sciences
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**Title:** Decision Making: An Annotated Bibliography of Selected Literature

**Authors:** Ellen S. Decker and Sharon L. Riedel

**Abstract:**
This annotated bibliography of selected readings in decision making is designed to serve as a guide for researchers and military personnel by providing them with a current bibliography on decision making/aiding in man/computer systems. **Keywords:**
- Military Decision Making
- Decision Making
- Evaluation of Information
- Decision Aids
- Heuristics and Biases
- Uncertainty
- Human Factors
- Computer Interface
- Decision Models
- Authors

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# DECISION MAKING: AN ANNOTATED BIBLIOGRAPHY OF SELECTED LITERATURE

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EXECUTIVE SUMMARY

Requirement:

To provide a guide for research and military personnel interested in current literature on decision making.

Procedure:

The literature collected was selective in nature, but has wide applicability in the area of decision making pertaining to basic research, decision aids, evaluation, and literature reviews/bibliographies.

The annotated bibliography consists of papers chosen from technical reports, published scientific studies, presented papers, and unpublished reports in progress. A categorical index is included.

Findings:

The literature is presented in the following manner:

a. According to categories as specified in the Table of Contents.

b. Indexed alphabetically by first author within each category.

c. Indexed alphabetically by author within year of publication.

The classification scheme is representative of the contents of the decision making material. The abstracts are designed to allow the reader an objective preview of each article. When a reference applies to more than one category, it is repeated.

Utilization of Findings:

This bibliography can be used by system analysts, system developers, and researchers doing work in decision making as an aid in identifying relevant issues and in locating related research findings. As such, it will facilitate the conduct of research, building on the past work of others, and contributing to the efficient use of resources.
INTRODUCTION

Decision aiding was identified by the 1983 Army Command and Control Master Plan as an area requiring increased attention. Interest in decision aiding and in the development of tactical decision aids has increased significantly over the past several years, and decision aiding is now a major concern in the research and development community. This research is critical to the design, evaluation, and implementation of decision support systems. Those from the many disciplines working in the area of decision making need to make efficient use of past research findings. Using this bibliography researchers can survey potentially relevant topics and identify articles for more detailed examination.

The body of literature relating to decision making is enormous, totaling in the thousands of articles. This bibliography contains articles that have been collected in the course of the ARI Fort Leavenworth Field Unit's continuing research program in decision aiding. Literature selection was neither comprehensive nor completely representative, however, it did include a wide variety of articles relating to the most important issues facing decision aid designers and evaluators.

The report has been divided into four main categories: basic research, decision aids, evaluation, and reviews and bibliographies. Subheadings are identified under each category except the fourth. In addition to the annotated entries, a topic and author index is included at the back of this report.
General Decision Making


Argues that interactive, conversational decision support systems do not represent their true identities in many cases. The author believes that better man-computer interfaces are needed, but not necessarily by managers themselves. Suggests that the focus should be on experts who understand the details underlying a support system; if managers do not learn the correct usage of decision support systems, then usage should be discouraged without the aid of an intermediary.


A "false recognition effect" is described, whereby a subject incorrectly "remembers" items which remain consistent with his "schema" of something. The authors concur with previous research results that a diagnosis functions as a schema. Three experiments were conducted to observe the effect of the possession of a diagnosis on consequent recognition of symptoms that were conceptually related/unrelated to the diagnosis. Memory distortion may be attributed to overconfidence in the validity of one's hypothesis, false recognition of unpresented inferences or features of a schema, or a long retention interval.


Classifies literature pertaining to organizational decision making into three areas: management science, classical, and behavioral science. Stresses that there is a problem in measuring information value. The author aims to provide insight into the broad area of organizational decisionmaking.


This report investigates the consistency with which subjective probabilities are revised. Four experiments were performed in which models of probabilistic concept formation studies and Bayesian subjective probability revision studies were combined. Results showed that subjects' revisions of their subjective probabilities can be accurately predicted with Bayes' theorem.

Interaction among group members in nineteen newly formed decision making groups (composed of five persons each) was studied to understand how social norms form. The behavior of these group members served as the foundation in constructing a model of norm development whereby uncertainty over appropriate behavior directs people to utilize their past experiences in similar social settings as scripts. By using these experiences they determine behaviors in their current situations. The results of gaining knowledge about how norms develop would grant the capability of "managing" this limitation in group decision making situations.


Debates the utility of weighting by importance in measuring job satisfaction when combining measures of satisfaction relevant to job aspects into a measure of aggregate satisfaction. Doubts the validity of information which is applied in importance weighting.


Addresses problems in the technology of decision analysis, namely structuring of the model itself. The conventional decision theory model in the form of a decision tree is referred to as "preposterior" analysis, which is faulted by the author as rarely meeting "real world" decision analyses requirements. This could possibly be a reason for the lack of success with decision analysis in information decisions as opposed to successful operating decisions which are all based on prior information. An acts-as-events model is proposed which supposedly provides an adequate framework for assessment (and involves a smaller number of total assessments) and allows events to be more readily visualized.


Addresses the question of how decisionmaking responsibilities should be allocated between humans and increasingly intelligent computers as systems become more automated. The authors maintain that with "adaptive allocation" the allocation of responsibility is contingent upon the state of the system and decisionmakers. The decisionmaker most capable of performing a task at a particular time will be subject to complete it. An experimental study involving a flight management task illustrates this general strategy.


Addresses the medical problem solving process. The two major decision making phases which characterize this process are: specification of the correct diagnosis to a level adequate for therapeutic considerations, and choice
of a therapy that positively influences the patient's problem. For effective
decision making, appropriate selectivity must be engaged in to limit the amount
of information worthy of examination or generated from the thought process.

Connolly, T., & Miklausich, V.M. (1978). Some effects of feedback error in

A laboratory study was conducted to examine the effects of varying the
levels of feedback error on performance in diagnostic tasks. Results suggest
that the comprehensive decision quality is contingent on both the quality of
information available when the decision is made and the quality of subsequent
feedback.


Models that delineate the means by which rational expectations may be de-
developed within a market are the focus of this article. Three distinct models
are unfolded which explain the interaction of Bayesian learning and the expec-
tations in achieving a market equilibrium. These dynamic models depict the
transition process toward equilibrium.

important for effective decision making? Paper presented at the Psychonomics
Meeting, San Antonio, Texas.

This study was conducted with the purpose of analyzing how decision makers
themselves define decision making competence. Thirty-five bottom-level and
twenty-four top-level managers participated in the following: (1) Rated skills
that they believed important for effective decision makers; (2) Rated the
importance of these skills in upper-level and lower-level decision makers; and,
(3) Were evaluated in regards to the effects of gender, their types of
organizations, and their levels within their organizations.

sion* (Report No. 001597-F). Los Angeles, California: Advanced Research
Projects Agency.

The technology of inference and decision is the topic of this research re-
port. The focus is on the elicitation of subjective probabilities, multi-at-
tribute utility theory, and error in decision analysis. Stressed is the
necessity of prioritizing the structuring of the problem along with processing
information and the elicitation of probabilities/utilities, respectively.

social decisionmaking. *IEEE Transactions on Systems, Man, and Cybernetics,
SMC-7*(5), 326-339.

Contends that arguments over public policy often result from dissension
over values. These disagreements are repeatedly contested in the context of
specific decisions, at tremendous social cost for each decision which must be
made. The author utilizes Multivariate Utility Measurement (MAUM) for social
decision making through three examples in applied settings, in which he illus-
trates this ten-step process to elucidate the values of each participant in the
decision making process. The fundamental idea is that every outcome of an
action may have value on a number of various dimensions. It is strongly empha-
sized that simplicity in elicitation procedures enable social policies to be
efficiently and more easily implemented. MAUM is also flexible in response to
ever-changing value systems.


This review of behavioral decision theory literature argues that the
judgmental biases exhibited in laboratory situations may be functional in natu-
ral settings. Areas reviewed include attention, memory, learning, feedback,
cognitive representation, and conflict. Assuming a broad perspective in the
research of decision making may yield the most insightful and generalized re-
sults.

Einhorn, H.J., Hogarth, R.M., & Klempner, E. (1977). Quality of group judg-
ment. Psychological Bulletin, 84, 158-172.

Deals with the accuracy of group judgment within and between different
populations of groups. The quality of group judgment is defined. Results as
well as constraints affecting judgmental quality of various strategies for
merging opinions under a diversity of circumstances are discussed. A statisti-
cal procedure is introduced that considers which baselines are suitable in the
evaluation of the quality of group judgment.

Davis, California: University of California.

Attempts to integrate current methods for evaluating single-attribute util-
ity functions. Presents various new methods of evaluation which may be benefi-
cial in furthering the research in this area, emphasizing the varied steps in
the utility assessment process, and contrasting methods of comparative risk.
Reviews approximately twenty-four utility assessment methods.

Fischer, G.W. (1979, July). Utility models for multiple objective decisions:
do they accurately represent human preferences? The Journal for the American
Institute for Decision Sciences, 10(3), 451-479.

This paper is written for those decision scientists who do not utilize
Multivariate Utility (MAU) modeling procedures because they doubt that these
procedures are reliable in providing a true representation of human prefer-
ences. The author's goal is to persuade many that the MAU approach has many
useful applications. Two approaches to MAU modeling as well as relevant psy-
chological research are examined. Covered in this article are the following
topics: assigning utility values to decision outcomes, holistic utility assess-
ment methods, an overview of MAU theory, methods for assessing decomposed MAU
functions, common objections to MAU models, and validating MAU models and as-
ssessment procedures.

Draws an analogy between decision analysis and psychotherapy. Areas discussed include evaluating the validity, effectiveness, and underlying assumptions of decision analysis, improving analysts' skills, and social, ethical, and political issues. The comparison with psychotherapy serves to delineate the important issues that should be addressed in a research program.


This study of environmental reporting focuses on the difficulty in obtaining complete, relevant, and valid environmental stories. The author cites the major problem as one of overconfidence displayed by specialists who do not realize the limits to their own understanding.


This study analyzes the effects of varying three aspects of fault tree structure on the assessment of a fault tree for the event of "a car failing to start." Results confirmed that: (a) People were insensitive to what had been omitted from the fault tree; (b) When the amount of detail was increased this did not significantly affect perceptions; and, (c) The perceived importance of a certain branch was increased by presenting it as two separate component branches.


Two training procedures were applied to assess the impact on reducing the influence of irrelevant information on agricultural expert judges. The training consisted of either a lecture or an involved interaction session with practice. The interactive training significantly lessened the incorporation of irrelevant information into the decision made by the expert decision makers. Not only did it also improve the accuracy of the judgments, it had long term effects. Application to areas other than those which are perceptually based is advocated.


Comments on paper written by Harrison and March on "Decisionmaking and Postdecision surprises" (1984). The author examines the issue and explains why there is a problem with the disappearance of post decision surprise. Believes that "hindsight bias," where an outcome of a decision may be seen by one in
hindsight as having been expected to a greater extent than it actually was, is
detrimental because it prevents individual and organizational learning about
faults in the decision system. Further research is needed on how to reduce
hindsight bias.

of procedural knowledge. *International Journal of Man-Machine Studies, 11,*
51-77.

A model of the evolution of rule-structured knowledge which is considered a
cornerstone of the development of computer-based coaches is illustrated. A
graph structure depicting the concepts of generalization, correction, and re-
finement is displayed and defined. Various genetic graph formulations pertaining
to reasoning skills used in playing an elementary mathematical game are
examined.

*Organizational Behavior and Human Decision Processes, 36,* 209-228.

Addresses the subject of group decision making by presenting evaluative
criteria, which were derived from a review of prevailing literature, for judg-
ing when a "high-quality outcome" has been reached. A major goal which is
hoped to be generated by this project is the construction of a set of empiri-
cally derived criteria against which outcome quality may be judged. The most
effective procedures for the achievement of a high quality collective judgment
are suggested as a result of six factual group problem-solving cases which
were evaluated by use of a specially developed questionnaire.

version of paper presented at the Fifth Research Conference on Subjective
Probability, Utility, and Decision Making, Darmstadt, West Germany.

Contends that there is no "one best way" to aggregate opinions. Items
discussed in this report include: (a) methods and models for aggregating opin-
ions in the way of point estimates and probability distributions; and (b)
causes of incompetency in interacting groups and how to enhance group
processes.

93-107.

An experiment was conducted in which a competitive game was played to as-

sess whether or not the costs of time and effort used to analyze a decision
outweighed the benefits. Another objective was to discover strategies to
improve decision performance. There were two kinds of uncomplicated decision rules: (1) rules were applied consistently (arbitrary-consistent), and (2) rules were subject to a random component (arbitrary-random).


Presents an assessment of decision analysis by discussing human decision making, decision analysis, the usefulness of decision analysis, ethical concerns, and the challenge that must be faced if the field is to continue its growth. The author explains that "decision making is what you do when you don't know what to do", and cites evidence that people are not good natural decision makers. It is emphasized that decision analysis is not simply a logical procedure, but also an "artistic" process.


In this thesis an algorithm for computing time delay in the operation of distributed decision making systems (DDM) is produced. Interactors in DDM organizations are investigated and asynchronous protocols that enrich performance are constructed.


Discriminates between the scale quality in a simple linear model and the scale quality of a nonlinear model through use of a distortion index. This index is tested in a simulation study, indicating that in some cases the linear model can misleadingly disconnect alternatives. The correlation approach does not take into account the changes which may occur in the scale upon which alternatives are examined, which is why the simple linear model is proposed.


In this discussion of cognitive models of medical problem solvers the principal theme is that similarities outweigh differences when comparing individual problem solvers. A diagnostic reasoning model of physician knowledge is proposed which depicts what patients with certain diseases or conditions should "look like".


This chapter from Johnson-Laird's book defines "mental models", explains how they are constructed, and interprets them. The theory itself is designed to explain the higher processes of cognition, particularly comprehension and inference.

Deals with techniques which assist people in making personal decisions. Personal decisions are defined as those where the person making the decision must face the ramifications of his actions. Even though this distinction may seem blurred between those persons making decisions for themselves versus others, the author holds the opinion that not enough attention in applied decision research is given to personal decisionmaking. Structuring the problem, assessing one's value system, and examining alternative options are addressed in helping one to arrive at a decision.


The author's interest lies with the first stage in the process of decision making, in which the problem is represented (translated cognitively into a structure that represents the situation). It is proposed that the questions one asks influence the answers one gets, i.e., various methods of posing a decision problem to a person stimulates him to "reference structure" different sets of knowledge. Examples are given of the phases of the decision making process, the structuring of knowledge, and fault trees.


Reports on some of the specific tactics and overall strategies composing the problem-solving behavior of trained clinicians as they were "taking the history of the present illness." The tape recorded behavior of this interchange between a clinician and simulated patient was analyzed. The authors suggest that the information has potential value in the field of medical education and in devising computer programs to assume the process of diagnosis.


This paper addresses questions pertaining to the modifications made in strategies in response to task complexity by decision makers. A primary goal of these simulation studies entails identifying different decision strategies on the basis of information search patterns. It is reasoned that simulation can be very useful in generating, testing, and modifying hypotheses about human decision strategies but care must be taken to insure that the design is representative of the impending specific decision task.


Proposes a comparison-guided model of decision-making, maintaining that proficient decision makers are able to recognize and subsequently place new situations parallel to ones previously experienced. The types of decisions discussed are complex, those with unusual conditions. It is asserted that a
redefinition of the problem by the expert will allow utilization of all resources which may yield a solution to the problem, rather than using a decision aid requiring "rule-following". The author believes that proficiency is not just following rules and procedures.

Klein, G.A. (1981, March). A perceptual/recognitional model of decision making. Yellow Springs, Ohio: Klein Associates. Defends the view that skilled decision making depends on perceptual learning and recognitional capacities, known as the perceptual/recognitional model. Argues that the procedural model, whereby one follows rules and procedures, is not adequate for use in making complex decisions. The author contends that decision making can be treated as a skill. The perceptual/recognitional model proposes the use of analogous experiences to form judgments and requires the evaluation of the intangible differences between experts and novices. Suggests that future decision aids should include a method by which relevant analogues may be identified.

Kunreuther, H.C., & Schoemaker, P.J.H. (1979). Decision analysis for complex systems, integrating descriptive and prescriptive components. Knowledge: Creation, Diffusion, and Utilization, 2(3), 389-412. A framework for decision analysis in complex social systems is presented. Of major concern in this article are three components: (a) descriptive analyses of organizational environments and decision models; (b) prescriptive analysis, including decision methodology and decision theory; and, (c) the relationship between descriptive and prescriptive analyses. The importance of descriptive analyses is emphasized in organizational decision making.

Lichtenstein, S., Earle, T.C., & Slovic, P. (1975). Cue utilization in a numerical prediction task. Journal of Experimental Psychology: Human Perception and Performance, 104(1), 77-85. Research results in this study were obtained from an experiment in which forty subjects were trained to make numerical predictions of a criterion from a cue. It was found that subjects regressed each cue and subsequently averaged the regressed values. It is suggested that by analyzing the heuristics utilized by subjects, we can further our knowledge of human decision making.

Morris, P.A. (1975, February). Modeling experts. Manuscript submitted for publication. Addresses the problem of expert resolution. A model is presented which allows the decision maker to arrive at a solution, whether it is from a single expert or a group of experts. The term "surrogate prior" is defined and shown to play a role in measuring the joint information contained in the probability assessments generated by a panel of experts within the case of the multi-expert. This modeling approach forms the basis for analytical thinking about the interaction between experts and the manner in which probabilities should be derived from experts.

This study describes the conditions which are appropriate for differential or simple unit weighting of predictor variables in prediction and/or decision studies. A regression model, ridge analysis (RIDGE), is proposed as a substitution for the ordinary least squares (OLS) regression analysis because of potential difficulties with OLS analysis. The RIDGE method of estimation may also be used as a substitute for cross validation.


The author outlines a system of activated schemas with a triggering mechanism which determines appropriate time for activation, which is a satisfactory framework for categorization and analysis of action slips. This theory permits slips to be categorized into three areas: (a) errors in the formation of the intention; (b) faulty activation of schemas; and, (c) faulty triggering of slips.


Discusses human processing structures by arguing for a different kind of processing mechanism than that which is most commonly referred to in Artificial Intelligence. The form of human error is of major importance in this study. A distinction is made between two major classes of errors, mistakes versus slips, and these two types are examined.


Advocated is the study of processes such as attention, encoding, and short-term memory in relation to probabilistic information processing (PIP) in order to expand our knowledge of decision making behavior. It is stressed that the information, not the processing itself, is probabilistic in nature. Two models of opinion revision are reviewed which incorporate the use of Bayes' theorem in their models, but recognize human error. Outlined is a PIP model computer program.


Covers models of human problem solving with an emphasis on those models which predict human behavior and performance to support design and evaluation. Areas which are of particular concern in this article are detection, diagnosis, and compensation of system failures. Proposed is an outline of a model which may influence the integration and progress of understanding human problem solving.

A computerized decision-support system is described which was developed by the authors as an effective replacement for decision-tree representation. They state that the approach is preferable because of the clarity and purposefulness it provides. This goal-directed method focuses on a single objective at any given time and instructs the user to ignore all side effects. An extensive amount of graphs, structures, and representations are provided.


Various empirical issues pertaining to decision analysis, specifically multiattribute utility (MAU) modeling, are investigated. The issues primarily concern the following issues: (a) the need for empirical validations in normative decision theory; (b) the examination of the intrinsic characteristics of MAU preference functions, expressly mathematical complexity; (c) the review of method bias; and, (d) analysis of the meanings of relative importance judgments.


In this report it is demonstrated that the additive functional measurement model reduces to a distinct case of additive conjoint measurement. Disputes N. Anderson's (1970) functional measurement theory.


Two combination rules, averaging and multiplying, which describe sequential inference judgments, were compared through three experiments in this study. Both of these rules depict how successive pieces of evidence are combined with previous judgments to form new judgments. Usage of the averaging rule was supported but the descriptive ability of the Bayesian approach (and other approaches which use the multiplying rule) was questioned. It may be inferred from the averaging result that judgments may incorporate processing rules differently than previously speculated.


This study investigates personal characteristics in expert decision makers, the psychological properties which the author feels are neglected in expert judgment research. Observations are made concerning these characteristics and some unexplored questions about expert decision makers are asked.

A series of research projects were performed with the goal of revealing the influence of irrelevant information on expert decision makers. Training programs to overcome this effect were discussed and the long-term effects of the training were evaluated.


This selected chapter covers some of the principal findings from research conducted on the person perception model with the information integration theory (ITT). Five research studies are alluded to which exemplify the early development and basic assumptions of ITT, which is traced to impression formation. Cases are cited which show how ITT can be utilized in the analysis of socially relevant interpersonal decisions, and also in real-world concerns.


This article provides support for the idea that economic analysis should not simply be concerned with substantive rationality, but also with the procedural aspects of decision making. The author discusses approaches to procedural rationality within the fields of operations research and management science, artificial intelligence, computational complexity, and cognitive simulation.


The author focuses on the psychological aspects of individual judgment and decision making by reviewing descriptive research and examining decision aids. A survey of publications (the majority of them dated 1971-75) on the subject of behavioral decision theory is provided and descriptive studies of judgment are evaluated. An attempt is made to enumerate the errors in decision-making that may arise from judgment biases. Some areas mentioned under the topic of descriptive research include probabilistic judgment, choice, models of risky choice, and regression approaches. An insightful discussion of decision aids, MAUT research, decision analysis, man/machine systems, and use of decision aids clarifies: (a) issues which a decision maker may face, and (b) the systems used to solve problems.


Argues that the established principle: "rational choice is comparable to logic in that a reasonable person who understands the postulates would not want to violate them" is open to doubt. An experiment is conducted which examines Savage's independence principle, a key axiom inherent in expected utility theory. Discussed is the difficulty in discriminating between rejection of a decision principle and unsuccessful "understanding" of it.

Proposed in this research report is a system which tutors students with intelligent computer aided instruction (ICAI) by diagnosing and rectifying conceptual misunderstandings. A theory based on examination of tutoring dialogs is the basis for this system. The goal structure of a tutor and types of conceptual bugs are specified.


Provides a summary of literature which may be useful in developing and implementing training programs pertaining to tactical decision making. The authors contend that a cause for concern in the military is the question of whether or not decision makers are deciding upon the best courses of action in rapidly changing situations based on the techniques utilized by them to organize, analyze, and present information. Various models of decision making, along with problems in training, are examined with the purpose of developing a methodology for preparing military leaders to make tactical decisions.


Reviews current measurement theories on utility modeling and assessment. Written particularly for decision analysts who are interested in these theories for deciphering and solving real world decision problems which are complex in nature. This paper aims to relate the present utility measurement theory with decision analytic practice. The paper tries to lessen the gap between the theory and practice of utility measurement, which may be attributed in part to the difficulty in comprehension of the mathematical language inherent in the utility theories. It is concluded that even though utility theories can be beneficial in the structuring process of evaluation, they are usually too complex for usage in real world preference assessment.

Uncertainty


This report investigates the consistency with which subjective probabilities are revised. Four experiments were performed in which models of probabilistic concept formation studies and Bayesian subjective probability revision studies were combined. Results showed that subjects' revisions of their subjective probabilities can be accurately predicted with Bayes' theorem.

A decision aid is promoted which allows one to calculate subjective expected utilities (SEUs) for having a (another) child; a value hierarchy is used. The method is intended to assist people with their birth planning decisions so that they may logically and sensibly weigh the pros and cons. Decisions are divided into "manageable chunks" and the relative utility of each chunk is evaluated. The authors affirm that through the development of this aid they developed a method applicable to other areas besides birth planning.


Cites various models of information processing which account for human thinking and attempts to cover the capabilities, as well as the inadequacies, in information processing present in the literature. The authors believe that management information systems (MIS) can be radically improved by understanding the behavioral processes by which humans process information and make choices. This will aid in eliminating the problem of "overloading" the human user.


Addresses problems in the technology of decision analysis, namely structuring of the model itself. The conventional decision theory model in the form of a decision tree is referred to as "preposterior" analysis, which is faulted by the author as rarely meeting "real world" decision analyses requirements. This could possibly be a reason for the lack of success with decision analysis in information decisions as opposed to successful operating decisions which are all based on prior information. An acts-as-events model is proposed which supposedly provides an adequate framework for assessment (and involves a smaller number of total assessments) and allows events to be more readily visualized.


The technology of inference and decision is the topic of this research report. The focus is on the elicitation of subjective probabilities, multi-attribute utility theory, and error in decision analysis. Stressed is the necessity of prioritizing the structuring of the problem along with processing information and the elicitation of probabilities/utilities, respectively.


Argues that the methods we practice to fulfill our goals depend upon unaided judgment rather than scientific methodology. The author believes that we
continually "judge our own judgment," and overconfidence in judgment is a result of the manner in which outcome feedback is utilized to evaluate and learn about judgmental accuracy. The idea of outcome irrelevant learning structures (OILS) is presented. Discusses how our ability to learn about judgment can be enhanced.


Responds to the question "Why is there a substantial difference between a person's confidence in his own judgment and research findings on the fallibility of human judgment?" by exploring the structure of judgmental tasks as it affects outcomes. The manner in which outcomes are interpreted and used is discussed, as well as the relationship between learning and experience. Presents a model in which learning and maintaining confidence in one's own judgment is developed.


This review of behavioral decision theory literature argues that the judgmental biases exhibited in laboratory situations may be functional in natural settings. Areas reviewed include attention, memory, learning, feedback, cognitive representation, and conflict. Assuming a broad perspective in the research of decision making may yield the most insightful and generalized results.


Presents a model in reference to the role of ambiguity and uncertainty in inferential judgments. The authors show how this model may be associated with Keynes' concept of the weight of evidence, the non-additivity of complementary probabilities, risky choice, and current work on cognitive heuristics. It is proposed that reaching a compromise between "what is" and "what might have been" or "what might be" is focal to inferences under ambiguity and uncertainty.


Addresses the problem of a low accuracy rate in clinical judgment. An analytical framework for dealing with questions pertaining to the validity of clinical judgment is illustrated. Some of the effects of clinical judgment on decisions that resulted because of a lack of correlation between some criterion and the judgment is also reviewed. The authors assert that their results are applicable to all situations where judgments lead to making decisions.

This study of environmental reporting focuses on the difficulty in obtaining complete, relevant, and valid environmental stories. The author cites the major problem as one of overconfidence displayed by specialists who do not realize the limits to their own understanding.


This study analyzes the effects of varying three aspects of fault tree structure on the assessment of a fault tree for the event of "a car failing to start." Results confirmed that: (a) People were insensitive to what had been omitted from the fault tree; (b) When the amount of detail was increased this did not significantly affect perceptions; and, (c) The perceived importance of a certain branch was increased by presenting it as two separate component branches.


In this study, two experiments conducted at the Four Queens Casino in Las Vegas refute prior research evidence that accounted for choices among gamblers. The Expected Value (EV) normally is highly correlated with preferences among gamblers. It may be inferred that the attraction of a gamble is not totally dependent upon the characteristics of that gamble. The results suggest that certain concepts can not be overlooked in the construction of theories that endeavor to depict human decision making; these are: anchoring, adaptation, assimilation, and contrast.


The author begins by providing the reader with various definitions of the word inconsistency and relates inconsistency to the concept of variability. The goals and steps of practical inference are discussed, and sources of consistency and inconsistency in the process of formulating hypotheses are cited.


A computer-generated task and a controlled task were used in two experiments to examine sex differences in risk-taking behavior. Male and female participants were shown a video display of simulated probabilities and took risks. The results concur with the current research that states men are more inclined to take risks than women in a diversity of situations.

Research results in this study were obtained from an experiment in which forty subjects were trained to make numerical predictions of a criterion from a cue. It was found that subjects regressed each cue and subsequently averaged the regressed values. It is suggested that by analyzing the heuristics utilized by subjects, we can further our knowledge of human decision making.


An experiment was conducted at the Four Queens Casino in Las Vegas to determine the effects of response mode upon information-processing strategies applied by subjects in gambling decisions. Different strategies were used for choosing among pairs of bets as opposed to assigning monetary values to single bets. Bias was found to occur in favorable and unfavorable gambles as a result of cue-response compatibility.


Addresses the question "Why do psychologists in general and decision experts treat gambling so differently from other probability distributions?". The author analyzes and questions the role that mathematical expectation has in affecting theories of rational choice and decision making.


Investigates a methodology for understanding how people evaluate decision making approaches involving health and safety risk factors. Three methods for making a consumer product safety decision were appraised on scales relating to their perceived acceptability, logical soundness, completeness, and sensitivity to moral and ethical concerns. An effect on judgments was not shown from having knowledge of the consequences. An implication made is that people's acceptance of risk may be greatly determined by the manner in which decision risks are made.


Addresses the problem of expert resolution. A model is presented which allows the decision maker to arrive at a solution, whether it is from a single expert or a group of experts. The term "surrogate prior" is defined and shown to play a role in measuring the joint information contained in the probability assessments generated by a panel of experts within the case of the multi-expert. This modeling approach forms the basis for analytical thinking about the interaction between experts and the manner in which probabilities should be derived from experts.

This study describes the conditions which are appropriate for differential or simple unit weighting of predictor variables in prediction and/or decision studies. A regression model, ridge analysis (RIDGE), is proposed as a substitution for the ordinary least squares (OLS) regression analysis because of potential difficulties with OLS analysis. The RIDGE method of estimation may also be used as a substitute for cross validation.


Advocated is the study of processes such as attention, encoding, and short-term memory in relation to probabilistic information processing (PIP) in order to expand our knowledge of decision making behavior. It is stressed that the information, not the processing itself, is probabilistic in nature. Two models of opinion revision are reviewed which incorporate the use of Bayes' theorem in their models, but recognize human error. Outlined is a PIP model computer program.


The goal of this research study was to utilize the theory of information integration by applying an information processing approach to risky decision judgments. The study challenges the utility theory as used in risky decision making. The multiplying model is advocated, which is supported by data resulting from two experiments.


The author senses that people are inadequately equipped to make societal decisions in our state of rapid technological development. This article deals with the determinants of perceived and acceptable risk within the context of risk assessment, which was developed as a result of society attempting to confront problems of risk.


Inter-task consistency of individual differences was ascertained in two structurally comparable risk-taking tasks. A relationship was shown between information processing and situational specificity. As a result of the experiment, it was determined that the two response modes triggered different methods of processing information pertaining to probabilities and payoffs in a way that influenced individual differences and reduced inter-task consistencies. The implication is that it is improbable to find significant correlations between risk-taking measures in structurally different settings or between risk-taking and different behaviors.

The author focuses on the psychological aspects of individual judgment and decision making by reviewing descriptive research and examining decision aids. A survey of publications (the majority of them dated 1971-75) on the subject of Behavioral Decision Theory is provided and descriptive studies of judgment are evaluated. An attempt is made to enumerate the errors in decision-making that may arise from judgment biases. Some areas mentioned under the topic of descriptive research include probabilistic judgment, choice, models of risky choice, and regression approaches. An insightful discussion of decision aids, MAUT research, decision analysis, man/machine systems, and use of decision aids clarifies: (a) issues which a decision maker may face, and (b) the systems used to solve problems.


Deals with the attempt by researchers to determine what the term "risky" means to people. Factors which affect the response to perceived risk are examined, with the goal of providing more effective communication risk information, altering people's perceptions, and enhancing management strategy. Reviewed are some results obtained from psychometric studies of risk perception.


This report examines the beliefs held by people about the relevant importance of probabilities and payoffs and their capability to act on the premise of these beliefs when processing information included in the description of a gamble. Two experiments are described which suggest that there is utility in recognizing decisions about gambling within the context of information processing.


Argues that the established principle: "rational choice is comparable to logic in that a reasonable person who understands the postulates would not want to violate them" is open to doubt. An experiment is conducted which examines Savage's independence principle, a key axiom inherent in expected utility theory. Discussed is the difficulty in discriminating between rejection of a decision principle and unsuccessful "understanding" of it.


How do people evaluate the frequency of classes or the likelihood of events? According to this article, people engage in using a limited number of heuristics, thus diminishing judgments into easier ones. A judgmental heuristic in which one assesses the frequency of classes or probability of events by availability (the quickness with which relevant instances come to mind) is
investigated. It is believed that reliance on the availability or representative heuristic leads to systematic biases. By analyzing the heuristics that one uses in judging the probability of an event, it is asserted that the occurrence of errors in human judgment under uncertainty may be decreased.

Heuristics, Biases, and Errors


This report investigates the consistency with which subjective probabilities are revised. Four experiments were performed in which models of probabilistic concept formation studies and Bayesian subjective probability revision studies were combined. Results showed that subjects' revisions of their subjective probabilities can be accurately predicted with Bayes' theorem.


Responds to the question "Why is there a substantial difference between a person's confidence in his own judgment and research findings on the fallibility of human judgment?" by exploring the structure of judgmental tasks as it affects outcomes. The manner in which outcomes are interpreted and used is discussed, as well as the relationship between learning and experience. Presents a model in which learning and maintaining confidence in one's own judgment is developed.


This review of behavioral decision theory literature argues that the judgmental biases exhibited in laboratory situations may be functional in natural settings. Areas reviewed include attention, memory, learning, feedback, cognitive representation, and conflict. Assuming a broad perspective in the research of decision making may yield the most insightful and generalized results.


Presents a model in reference to the role of ambiguity and uncertainty in inferential judgments. The authors show how this model may be associated with Keynes' concept of the weight of evidence, the non-additivity of complementary probabilities, risky choice, and current work on cognitive heuristics. It is proposed that reaching a compromise between "what is" and "what might have been" or "what might be" is focal to inferences under ambiguity and uncertainty.

Attempts to integrate current methods for evaluating single-attribute utility functions. Presents various new methods of evaluation which may be beneficial in furthering the research in this area, emphasizing the varied steps in the utility assessment process, and contrasting methods of comparative risk. Reviews approximately twenty-four utility assessment methods.


Reviews existing problems of decision making distribution when dealing with several individuals or groups. The authors propose solutions for complications which may arise as a result of using these systems, and discuss design and management of distributed decision making.Outlined are possible limitations which could affect an organization.


In this study, two experiments conducted at the Four Queens Casino in Las Vegas refute prior research evidence that accounted for choices among gambles. The Expected Value (EV) normally is highly correlated with preferences among gamblers. It may be inferred that the attraction of a gamble is not totally dependent upon the characteristics of that gamble. The results suggest that certain concepts can not be overlooked in the construction of theories that endeavor to depict human decision making; these are: anchoring, adaptation, assimilation, and contrast.


Comments on paper written by Harrison and March on "Decisionmaking and Postdecision surprises" (1984). The author examines the issue and explains why there is a problem with the disappearance of post decision surprise. Believes that "hindsight bias," where an outcome of a decision may be seen by one in hindsight as having been expected to a greater extent than it actually was, is detrimental because it prevents individual and organizational learning about faults in the decision system. Further research is needed on how to reduce hindsight bias.


Analyzes cognitive reliability in manned systems, which the authors state is an intricate function of attitudinal and structural factors, along with their interaction. Cites the types of human errors which may transpire, and discusses factors which influence the chance of these errors. Due to the changing role of man in complex systems, a broadening of prevalent approaches
to human performance reliability must be sought. In addition to describing the tasks which are becoming progressively more important in man-machine systems, the term "cognitive reliability" is defined, methods of classifying cognitive errors are identified, and an example is given which exemplifies the factors likely to affect cognitive errors.


This paper addresses questions pertaining to the modifications made in strategies in response to task complexity by decision makers. A primary goal of these simulation studies entails identifying different decision strategies on the basis of information search patterns. It is reasoned that simulation can be very useful in generating, testing, and modifying hypotheses about human decision strategies but care must be taken to insure that the design is representative of the impending specific decision task.


The present paper discusses the analysis of information gathering patterns as a tool for process tracing. Attention to complex and diverse decision approaches has underscored the necessity of developing more refined process tracing analyses (analyzing information gathering patterns). Two major methods of improving search analysis are examined. An experimental example using these techniques is given, and applications are submitted in three areas.


Research results in this study were obtained from an experiment in which forty subjects were trained to make numerical predictions of a criterion from a cue. It was found that subjects regressed each cue and subsequently averaged the regressed values. It is suggested that by analyzing the heuristics utilized by subjects, we can further our knowledge of human decision making.


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Addresses the question "Why do psychologists in general and decision experts treat gambling so differently from other probability distributions?". The author analyzes and questions the role that mathematical expectation has in affecting theories of rational choice and decision making.


The goal of this study was to ascertain the extent to which the conjunction fallacy, a type of judgmental error, reflects task specific misunderstanding of specific judgment problems. Results show that: (a) Task specificity is a factor in the subjects' misunderstanding of conjunction problems, and (b) an unprejudiced approach to conjunction fallacy may lower but not eradicate the conjunctive error rate for problems which are not depictive of representative thinking.


This report's area of concentration lies in human error, particularly error made by skilled operators in complex, demanding systems. Through this analysis of human error, various applications of human information processing are delineated and a classification scheme for errors is outlined. Short-term memory and human attentional limitations are examined in the design of human-machine interfaces.


The author outlines a system of activated schemas with a triggering mechanism which determines appropriate time for activation, which is a satisfactory framework for categorization and analysis of action slips. This theory permits slips to be categorized into three areas: (a) errors in the formation of the intention; (b) faulty activation of schemas; and, (c) faulty triggering of slips.


Discusses human processing structures by arguing for a different kind of processing mechanism than that which is most commonly referred to in Artificial Intelligence. The form of human error is of major importance in this study. A distinction is made between two major classes of errors, mistakes versus slips, and these two types are examined.

Contends that current inappropriate system design does not allow optimum efficacy between the users and machines. Through the study of human error, it is discovered that human usage should be a factor warranting primary consideration by designers. The author proposes a cohesive system, a "friendly system", composed of the principles underlying both cognitive science and human factors.


Advocated is the study of processes such as attention, encoding, and short-term memory in relation to probabilistic information processing (PIP) in order to expand our knowledge of decision making behavior. It is stressed that the information, not the processing itself, is probabilistic in nature. Two models of opinion revision are reviewed which incorporate the use of Bayes' theorem in their models, but recognize human error. Outlined is a PIP model computer program.


This issue is devoted to understanding human error. It is defined through the causal approach as error that is seldom random and traceable to causes, which once identified, can be obliterated or lessened. A methodology is presented which allows one to analyze and classify human error; this is exemplified by comparing the use of checklists in aviation. The goal is to examine human error and its causes, contributing factors, and contributing events.


Various empirical issues pertaining to decision analysis, specifically multiattribute utility (MAU) modeling, are investigated. The issues primarily concern the following issues: (a) the need for empirical validations in normative decision theory; (b) the examination of the intrinsic characteristics of MAU preference functions, expressly mathematical complexity; (c) the review of method bias; and, (d) analysis of the meanings of relative importance judgments.


Two combination rules, averaging and multiplying, which describe sequential inference judgments, were compared through three experiments in this study. Both of these rules depict how successive pieces of evidence are combined with previous judgments to form new judgments. Usage of the averaging rule was supported but the descriptive ability of the Bayesian approach (and other
approaches which use the multiplying rule) was questioned. It may be inferred from the averaging result that judgments may incorporate processing rules differently than previously speculated.


The author senses that people are inadequately equipped to make societal decisions in our state of rapid technological development. This article deals with the determinants of perceived and acceptable risk within the context of risk assessment, which was developed as a result of society attempting to confront problems of risk.


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Military Decision Making


Discusses the concept of the Battlefield Management System (BMS) and advocates its role in improving the speed and effectiveness of combat operations and reducing battlefield stress. Col. (U.S. Army retired) Burke does not suggest replacing the human factor, but rather applying advanced technology to assist soldiers, leaders, and staff people in coping with the hectic movement of combat action. BMS is designed with the purpose of allowing humans to concentrate on creative decision making while it stores and processes data with great speed. BMS would be an immense asset to the battalion S2 and S3. It is argued that BMS can be used to train combat crews and entire units through battlefield simulation and will save millions of dollars, a substantial amount of time, and increase efficiency in field training.


This study applies decision analytic concepts to the problem of determining value of information in the design and evaluation of information systems. Although many current systems furnish an abundance of data, the decision maker is often unable to pick out the data essential to the problem. Necessary information is that which has a high probability of changing a decision and improving decision outcome. This study modifies standard VOI techniques in order to simplify them and encourage their usage.


Reviews existing problems of decision making distribution when dealing with several individuals or groups. The authors propose solutions for complications which may arise as a result of using these systems, and discuss design and management of distributed decision making. Outlined are possible limitations which could affect an organization.


Outlines a study in which an illustration of how incumbent generals, colonels, and lieutenant colonels define command and control performances. Five general categories which emerged were: getting and using information, planning, organizing, controlling/directing, and leadership/personnel. Reports on an experiment in which the usefulness of automating analysis and production tasks is analyzed and proves to be applicable to organizational decision making. Among the findings reported are: (a) The battalion level differs from division command level in that the descriptive model suggests a "process-oriented reactive orientation" for battalion level decision makers; (b) the time
perspective is very limited for the battalion commander in combat; and, (c) experiments in the area of tactical decision making may require the utilization of real incumbents in realistic situations.


Describes a decision support framework to be utilized by developers of decision aids to assist them in the organization and categorization of decision aiding procedures. This framework succinctly distinguishes between two categories of aids and exemplifies the development and execution of the aid system. The authors suggest that utilization of this framework could result in maximum productivity of their systems. Army Intelligence decision making examples are cited which typify the components of the framework. This decision support framework is designed to represent the decision support components, not the decision process itself.


Addresses the question: How much command and control (C^2) capability is enough? In order for one to answer this question, the cost of achieving that capability must be weighed against the potential benefits of allocating funds elsewhere. A value is assigned to the action of deciding to deploy a certain C^2 system in a precarious future. The trade-offs which must be made in order to resolve this question are analyzed. The paper is divided into four sections; discussed are: (a) the theory of assessing value for multiple attributed alternatives; (b) the use of scenarios as a solution to the problem with decision trees; (c) the application of value assessment procedures; and, (d) a specific problem: the trade-offs between cost and multiple performance measures, which illustrates the use of utility assessment procedures with the C^2 problem.


Provides a summary of literature which may be useful in developing and implementing training programs pertaining to tactical decision making. The authors contend that a cause for concern in the military is the question of whether or not decision makers are deciding upon the best courses of action in rapidly changing situations based on the techniques utilized by them to organize, analyze, and present information. Various models of decision making, along with problems in training, are examined with the purpose of developing a methodology for preparing military leaders to make tactical decisions.
Methodology


This paper addresses questions pertaining to the modifications made in strategies in response to task complexity by decision makers. A primary goal of these simulation studies entails identifying different decision strategies on the basis of information search patterns. It is reasoned that simulation can be very useful in generating, testing, and modifying hypotheses about human decision strategies but care must be taken to insure that the design is representative of the impending specific decision task.


The present paper discusses the analysis of information gathering patterns as a tool for process tracing. Attention to complex and diverse decision approaches has underscored the necessity of developing more refined process tracing analyses (analyzing information gathering patterns). Two major methods of improving search analysis are examined. An experimental example using these techniques is given, and applications are submitted in three areas.


Simultaneous verbal protocols were employed to study individual decision making processes. The authors describe the protocol analysis procedure used and present the coding scheme developed to analyze the data. Results of two experiments show that thought processes used in complex decision making are associated with subsequent performance: subjects using causal analysis performed more successfully than those who did not.

DECISION AIDS

Models


Addresses three important issues which are relevant to the design and evaluation of decision analytic aids and presents a framework which illustrates the decision making organization. The three interfaces identified are: between the decision aid and the user, between the user and the extent to which the decision aid facilitates the decision making processes of the organization, and between the decision making organization and whether or not the quality of the organization's decision making has improved the environment. Without the
smooth functioning of the three interfaces, effective integration of decision aids into organizations can not be accomplished. The author covers some ways to attract the user to the aid and to simplify its overall operation.


Argues that interactive, conversational decision support systems do not represent their true identities in many cases. The author believes that better man-computer interfaces are needed, but not necessarily by managers themselves. Suggests that the focus should be on experts who understand the details underlying a support system; if managers do not learn the correct usage of decision support systems, then usage should be discouraged without the aid of an intermediary.


Presents an approach to the design and development of personal computer-based decision aiding systems which views the human problem-solver as an active user who must be able to use the computer without the aid of a problem-solving intermediary. In order to successfully utilize a system, the author states that the design of the system should encompass the measurement and integration of cognitive, situational, and physiological variables which should inform and alter the decision-aiding process. It is suggested that without explicit user requirements, interactive systems fulfill the needs of the designer and not the target user. Problem solvers are categorized according to their experience with computer-based systems and grouped according to their "cognitive styles" in order to formulate computer-generated information and strengthen man's interaction with the computer. The user's physiological state and situational characteristics are examined as well.


Describes a general information system model, MAN, which emphasizes the importance of the user in man-machine systems. The ultimate goal is to acquire the ability to utilize the results of human information processing studies to predict the impact on system performance. The framework structure is based on the supposition that there are five central operations in the performance of an information system: screen, transform, input, assimilate, and decide.


Cites various models of information processing which account for human thinking and attempts to cover the capabilities, as well as the inadequacies, in information processing present in the literature. The authors believe that management information systems (MIS) can be radically improved by understanding the behavioral processes by which humans process information and make choices. This will aid in eliminating the problem of "overloading" the human user.

Human factors engineering is a discipline which has not had widespread application in commercial product development, but through the proposed usability laboratory, experts may incorporate this approach into their product evaluation. Describes the structure of a usability laboratory.


Interaction among group members in nineteen newly formed decision making groups (composed of five persons each) was studied to understand how social norms form. The behavior of these group members served as the foundation in constructing a model of norm development whereby uncertainty over appropriate behavior directs people to utilize their past experiences in similar social settings as scripts. By using these experiences they determine behaviors in their current situations. The results of gaining knowledge about how norms develop would grant the capability of "managing" this limitation in group decision making situations.


Addresses the question of how decisionmaking responsibilities should be allocated between humans and increasingly intelligent computers as systems become more automated. The authors maintain that with "adaptive allocation" the allocation of responsibility is contingent upon the state of the system and decisionmakers. The decisionmaker most capable of performing a task at a particular time will be subject to complete it. An experimental study involving a flight management task illustrates this general strategy.


This study applies decision analytic concepts to the problem of determining value of information in the design and evaluation of information systems. Although many current systems furnish an abundance of data, the decision maker is often unable to pick out the data essential to the problem. Necessary information is that which has a high probability of changing a decision and improving decision outcome. This study modifies standard VOI techniques in order to simplify them and encourage their usage.


Discusses a theory of human plausible reasoning which purports to exemplify how various configurations of information affect the surety of drawn conclusions. The theory is computational in nature and was constructed from an experiment in which an analysis was made of the answers people gave to routine questions.

The authors propose a theory of inquiry teaching whereby students construct theories by dealing with specifications and subsequently apply these theories to new cases. The authors feel that as a result of this teaching, reasoning skills, such as forming and testing hypotheses, making predictions, and knowing which questions to ask, to name a few, are learned and applied. It is recommended that these techniques be applied within other fields of study.


Deals with the accuracy of group judgment within and between different populations of groups. The quality of group judgment is defined. Results as well as constraints affecting judgmental quality of various strategies for merging opinions under a diversity of circumstances are discussed. A statistical procedure is introduced that considers which baselines are suitable in the evaluation of the quality of group judgment.


This paper is written for those decision scientists who do not utilize Multivariate Utility (MAU) modeling procedures because they doubt that these procedures are reliable in providing a true representation of human preferences. The author's goal is to persuade many that the MAU approach has many useful applications. Two approaches to MAU modeling as well as relevant psychological research are examined. Covered in this article are the following topics: assigning utility values to decision outcomes, holistic utility assessment methods, an overview of MAU theory, methods for assessing decomposed MAU functions, common objections to MAU models, and validating MAU models and assessment procedures.


Reviews existing problems of decision making distribution when dealing with several individuals or groups. The authors propose solutions for complications which may arise as a result of using these systems, and discuss design and management of distributed decision making. Outlined are possible limitations which could affect an organization.

Presents a problem solving model which originated from the study of computer coaches (advanced computer assisted instruction). This model depicts problem solving skills as an evolving set of rules for a domain influencing growing representation of the problem and administered by a resource-limited problem solver.


A model of the evolution of rule-structured knowledge which is considered a cornerstone of the development of computer-based coaches is illustrated. A graph structure depicting the concepts of generalization, correction, and refinement is displayed and defined. Various genetic graph formulations pertaining to reasoning skills used in playing an elementary mathematical game are examined.


Addresses the subject of group decision making by presenting evaluative criteria, which were derived from a review of prevailing literature, for judging when a "high-quality outcome" has been reached. A major goal which is hoped to be generated by this project is the construction of a set of empirically derived criteria against which outcome quality may be judged. The most effective procedures for the achievement of a high quality collective judgment are suggested as a result of six factual group problem-solving cases which were evaluated by use of a specially developed questionnaire.


Discusses the association between decision time and task complexity. A mathematical model is thoroughly explained which examines this association. The model is described as having several observable variables linked to an unobservable variable of the psychological function, i.e., cognitive strain. It is suggested that when a decision maker is faced with different alternatives, he considers two kinds of cost: the time involved in the decision procedure, and the cost of making errors.
Hogarth, R.M., & Einhorn, H.J. (1976, January, in press). Optimal strategies for personnel selection when candidates can reject offers. *Journal of Business.* Discusses personnel decision making with the inclusion of the possibility of rejection of job offers by candidates, which the authors recognize as an overlooked factor in formal models of decision making. Perfect Expected Acceptance Gain and Expected Acceptance Gain are promoted and demonstrate significant value for assessing the effects of various selection strategies. An interactive computer program is described. It is capable of being utilized for sensitivity analysis as a tool in the evaluation of important variations in subjective inputs, which affect changes in decision variables and their possible economic results.


In this thesis an algorithm for computing time delay in the operation of distributed decision making systems (DDM) is produced. Interactors in DDM organizations are investigated and asynchronous protocols that enrich performance are constructed.


In this discussion of cognitive models of medical problem solvers the principal theme is that similarities outweigh differences when comparing individual problem solvers. A diagnostic reasoning model of physician knowledge is proposed which depicts what patients with certain diseases or conditions should "look like."


This chapter from Johnson-Laird's book defines "mental models," explains how they are constructed, and interprets them. The theory itself is designed to explain the higher processes of cognition, particularly comprehension and inference.


Deals with techniques which assist people in making personal decisions. Personal decisions are defined as those where the person making the decision must face the ramifications of his actions. Even though this distinction may seem blurred between those persons making decisions for themselves versus others, the author holds the opinion that not enough attention in applied decision research is given to personal decisionmaking. Structuring the problem, assessing one's value system, and examining alternative options are addressed in helping one to arrive at a decision.

The author's interest lies with the first stage in the process of decision making, in which the problem is represented (translated cognitively into a structure that represents the situation). It is proposed that the questions one asks influence the answers one gets, i.e., various methods of posing a decision problem to a person stimulates him to "reference structure" different sets of knowledge. Examples are given of the phases of the decision making process, the structuring of knowledge, and fault trees.


Reports on some of the specific tactics and overall strategies composing the problem-solving behavior of trained clinicians as they were "taking the history of the present illness." The tape recorded behavior of this interchange between a clinician and simulated patient was analyzed. The authors suggest that the information has potential value in the field of medical education and in devising computer programs to assume the process of diagnosis.


Proposes a comparison-guided model of decision-making, maintaining that proficient decision makers are able to recognize and subsequently place new situations parallel to ones previously experienced. The types of decisions discussed are complex, those with unusual conditions. It is asserted that a redefinition of the problem by the expert will allow utilization of all resources which may yield a solution to the problem, rather than using a decision aid requiring "rule-following." The author believes that proficiency is not simply following rules and procedures.


In this report, development of an experimental approach to be used in the investigation of the advantages of adaptive aiding is recapitulated. Implications for the design of adaptive aids are examined and a conceptual framework is outlined. The task environment consists of two competing tasks which must be performed concurrently: a target spotting task and a tracking task. Results indicate that the manipulation of spotting task difficulty affects performance.


Addresses the problem of expert resolution. A model is presented which allows the decision maker to arrive at a solution, whether it is from a single expert or a group of experts. The term "surrogate prior" is defined and shown to play a role in measuring the joint information contained in the probability assessments generated by a panel of experts within the case of the multi-
expert. This modeling approach forms the basis for analytical thinking about the interaction between experts and the manner in which probabilities should be derived from experts.


This study describes the conditions which are appropriate for differential or simple unit weighting of predictor variables in prediction and/or decision studies. A regression model, ridge analysis (RIDGE), is proposed as a substitution for the ordinary least squares (OLS) regression analysis because of potential difficulties with OLS analysis. The RIDGE method of estimation may also be used as a substitute for cross validation.


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Contends that current inappropriate system design does not allow optimum efficacy between the users and machines. Through the study of human error, it is discovered that human usage should be a factor warranting primary consideration by designers. The author proposes a cohesive system, a "friendly system", composed of the principles underlying both cognitive science and human factors.


Discusses the role of the knowledge engineer, a person who builds an expert system in conjunction with an expert in the subject field. Believes that the expert should communicate directly with the computer, thus eliminating the need for a knowledge engineer. An Intelligent Support System (ISS) is presented as an ideal solution to providing sophisticated support in expert systems in three different roles: the training of novices, tactical or operational support, and strategic planning. The philosophy is that there should be only a narrow gap between the creators and operators of an intelligent support system.

An experimental evaluation is conducted on the effectiveness of decision-tree elicitation and goal-directed structuring. To analyze these two structuring procedures, a computer simulation of a hypothetical decision making environment, Goal-Directed Decision-Structuring System (GODDESS), was applied. This system promoted an objective evaluation of each decision instituted by the subjects. The main topics of discussion are the simulated model, the experimental approach, and the results. The results illuminate the strengths and weaknesses of the two decision structuring methods. The authors contend that the supremacy of the goal-directed approach would be recognized in a situation where the difference in performance between long-range and short-range planners is more strongly emphasized.


Describes a decision support framework to be utilized by developers of decision aids to assist them in the organization and categorization of decision aiding procedures. This framework succinctly distinguishes between two categories of aids and exemplifies the development and execution of the aid system. The authors suggest that utilization of this framework could result in maximum productivity of their systems. Army Intelligence decision making examples are cited which typify the components of the framework. This decision support framework is designed to represent the decision support components, not the decision process itself.


Decisionmap, published by Softstyle Inc., is decision support software (run on the Macintosh) through which one is able to design his/her own decision model. After choosing criteria on which the decision is to be based, factors are weighed according to importance and possible solutions are ranked. The author advocates its usage, emphasizing the ease of learning and minimal amount of time involved.


This report concerns computer-aided human information seeking. It is proposed that a computer-based information system can considerably reduce the frequency of human errors. Various types of information and styles of presentation are evaluated. Results are submitted which support the hypothesis that computer aiding is often more desirable than computerizing in that the goal
should be for computers to help humans overcome limitations and utilize their best skills, rather than replace human operators. The design of an onboard computer-based information system for aircraft is explained.


Covers models of human problem solving with an emphasis on those models which predict human behavior and performance to support design and evaluation. Areas which are of particular concern in this article are detection, diagnosis, and compensation of system failures. Proposed is an outline of a model which may influence the integration and progress of understanding human problem solving.


Argues that by integrating design and evaluation in computer-based decision support systems, improvements in the efficiency and effectiveness of the process will be the result. Because systems are becoming increasingly complex, decision support systems which aid humans in decision making and problem solving are essential.


Organizes current literature from various disciplines (i.e., psychology, management, systems engineering, computer science, and library science) to develop the topic of human information seeking and information systems. The nature of information seeking is defined, and through discussion, the contrast is made between information seeking and information processing. The difficulty in defining and measuring the value of information affects the progress which may be made in developing frameworks and formulating methods to evaluate this area of concern. Human information seeking is shown to be a integral part of decision making and problem solving.


A computerized decision support system is described which was developed by the authors as an effective replacement for decision-tree representation. They state that the approach is preferable because of the clarity and purposefulness it provides. This goal-directed method focuses on a single objective at any given time and instructs the user to ignore all side effects. An extensive amount of graphs, structures, and representations are provided.

Simultaneous verbal protocols were employed to study individual decision making processes. The authors describe the protocol analysis procedure used and present the coding scheme developed to analyze the data. Results of two experiments show that thought processes used in complex decision making are associated with subsequent performance: subjects using causal analysis performed more successfully than those who did not.


Two combination rules, averaging and multiplying, which describe sequential inference judgments, were compared through three experiments in this study. Both of these rules depict how successive pieces of evidence are combined with previous judgments to form new judgments. Usage of the averaging rule was supported but the descriptive ability of the Bayesian approach (and other approaches which use the multiplying rule) was questioned. It may be inferred from the averaging result that judgments may incorporate processing rules differently than previously speculated.


Evaluated are the effects of synergisms on nonorthogonal designs. It is determined that multiplicative synergisms have an influence on nonorthogonal designs. Methodology currently in use in the analysis of these designs is questioned. Incongruity is found in the stimulus cue sets; some reveal the presence of synergisms better than others.


Discusses the utilization of job performance aids (JPAs), which are defined as plans that allow the human component of a system to perform some function he could not otherwise accomplish without extensive training or complex information processing. Through the employment of computer simulation (as opposed to laboratory experimentation) different combinations of job performance aid formats and the effect of stress on task performance with a JPA is analyzed. The use of computer simulation allows one to estimate and evaluate JPA combinations under varying conditions.


Provides guidelines for the design of user interface software to aid designers, system analysts, teachers, students, human factors practitioners, and researchers in making this process more efficient. The focus is on six functional areas: data entry, data display, sequence control, user guidance, data transmission, and data protection.

Proposed in this research report is a system which tutors students with intelligent computer-aided instruction (ICAI) by diagnosing and rectifying conceptual misunderstandings. A theory based on examination of tutoring dialogs is the basis for this system. The goal structure of a tutor and types of conceptual bugs are specified.


The focus of this paper is on two issues originating from computer-based instruction (CBI) research and development analysis in support of the CBI data base design. The two points of concern deal with: (a) the importance of specific attention to the characteristics and requirements of potential users (of CBI and of the data base), and (b) the necessity of having a well-formulated classification schema for description of the features of CBI systems in the form of data storage and retrieval cues. The goal of this technology analysis and synthesis is to describe current and near future capabilities of CBI in the Department of Defense (DOD) environment.


Supports usage of an Adaptive Dynamic Decision Aiding Mechanism (ADDA) system to aid decision makers in their administration of dynamic decision tasks. The effectiveness of the decision aiding system was examined through an experimental study which used a realistic decision task. ADDA allows the operator to organize his own in-context behavior into a methodical mathematical framework. The purpose of this strategy is not simply to present a model for decision making behavior, but also to furnish a foundation for decision aiding.


Proposes steps and guidelines which will enable airborne decision makers to enhance their performance. This methodological approach is intended to allow designers to effectively convert system performance objectives into full system designs. Cites some difficulties with decision augmentation systems and outlines steps to design and organize these systems.


Provides support for the notion that the implementation of Decision Augmentation Systems (DASs) is an additional requirement for properly assessing and developing situations in order to make optimal decisions. The introduction of computer-based systems which support managerial decision making (Decision
Support Systems, DSSs) are not sufficient in augmenting human decision making performance to its fullest degree. The overall structure of a functional and computational DAS is presented in six stages.

User/Computer Interface


Argues that interactive, conversational decision support systems do not represent their true identities in many cases. The author believes that better man-computer interfaces are needed, but not necessarily by managers themselves. Suggests that the focus should be on experts who understand the details underlying a support system; if managers do not learn the correct usage of decision support systems, then usage should be discouraged without the aid of an intermediary.


Presents an approach to the design and development of personal computer-based decision aiding systems which views the human problem-solver as an active user who must be able to use the computer without the aid of a problem-solving intermediary. In order to successfully utilize a system, the author states that the design of the system should encompass the measurement and integration of cognitive, situational, and physiological variables which should inform and alter the decision-aiding process. It is suggested that without explicit user requirements, interactive systems fulfill the needs of the designer and not the target user. Problem solvers are categorized according to their experience with computer-based systems and grouped according to their "cognitive styles" in order to formulate computer-generated information and strengthen man's interaction with the computer. The user's physiological state and situational characteristics are examined as well.


A method is presented for designing computer-assisted instructional (CAI) systems, Unobtrusive Problem Solving Monitors (UPSM's). These systems are aimed at monitoring students solving multi-step problems and provide valuable guidance to students based on prior students' input history. Students may solve problems in an unguided fashion with easily accessible help if needed. A typical example of a UPSM system that has been employed in plane geometry instruction is summarized.


Cites various models of information processing which account for human thinking and attempts to cover the capabilities, as well as the inadequacies, in information processing present in the literature. The authors believe that
management information systems (MIS) can be radically improved by understanding the behavioral processes by which humans process information and make choices. This will aid in eliminating the problem of "overloading" the human user.


Human factors engineering is a discipline which has not had widespread application in commercial product development, but through the proposed usability laboratory, experts may incorporate this approach into their product evaluation. Describes the structure of a usability laboratory.


This study reviews a training program which furnishes supplementary information pertaining to the relationship between remaining faults and the realizable indicators during fault diagnosis. An interactive computer system provides problem solving process information to trainees as they learn to diagnose faults. A flow chart is given which displays the procedure followed by computer programmers in controlling a fault diagnosis problem.


Discusses the concept of the Battlefield Management System (BMS) and advocates its role in improving the speed and effectiveness of combat operations and reducing battlefield stress. Col. (U.S. Army retired) Burke does not suggest replacing the human factor, but rather applying advanced technology to assist soldiers, leaders, and staff people in coping with the hectic movement of combat action. BMS is designed with the purpose of allowing humans to concentrate on creative decision making while it stores and processes data with great speed. BMS would be an immense asset to the battalion S2 and S3. It is argued that BMS can be used to train combat crews and entire units through battlefield simulation and will save millions of dollars, a substantial amount of time, and increase efficiency in field training.


Addresses the problem of computer-based coaching by presenting a coaching system named WEST, structured upon the game "How the West was Won." Analyzes this system in order to discover possible limitations and to yield tutorial strategies which should be an integral part of a successful coaching system. As a result of the increase in use of personal computers, computer-based games are widely played and may provide a beneficial environment for learning which is informal. A limitation is that a certain amount of tutoring is necessary to facilitate proper learning.

Discusses the need for an increase of Computer-Aided Instruction (CAI) programs in on-line computer systems. Interactive on-line computer programs are shown to allow the user use of computer services, and facilitate meaningful contact with the computer. Three examples of this type of system are given which were developed by the author and have varying user-training characteristics. The author purports to show that self-teaching systems can create a skilled user population.


Addresses the question of how decisionmaking responsibilities should be allocated between humans and increasingly intelligent computers as systems become more automated. The authors maintain that with "adaptive allocation" the allocation of responsibility is contingent upon the state of the system and decisionmakers. The decisionmaker most capable of performing a task at a particular time will be subject to complete it. An experimental study involving a flight management task illustrates this general strategy.


In three experiments comparing a method of teaching developed from analysis of human tutors (Tutorial Mode) versus a method developed from programmed instruction (Block-Test Mode) a SCHOLAR Computer Assisted Instruction (CAI) is employed. The goal was to determine which facets of teaching strategy affected student learning. The results yield the conclusion that the major factor affecting student learning is tutorial strategy. Because CAI has the capacity to provide a mode analogous to human tutors, it is said to be beneficial in the evaluation and implementation of different teaching strategies.


The authors propose a theory of inquiry teaching whereby students construct theories by dealing with specifications and subsequently apply these theories to new cases. The authors feel that as a result of this teaching, reasoning skills, such as forming and testing hypotheses, making predictions, and knowing which questions to ask, to name a few, are learned and applied. It is recommended that these techniques be applied within other fields of study.

A definite interaction between type of dialogue and type of data is evident in an experiment which evaluated four fundamental types of data entry dialogue concerning speed. It was found that subjects in this experiment preferred an interaction mode which maximized speed at the cost of less feedback and less opportunity for error control in the command dialogues. There were no significant differences between the number of errors within each type of dialogue. Authors contend that an adaptable man-computer dialogue is necessary with an irregular data structure in performing data entry.


Attempts to integrate current methods for evaluating single-attribute utility functions. Presents various new methods of evaluation which may be beneficial in furthering the research in this area, emphasizing the varied steps in the utility assessment process, and contrasting methods of comparative risk. Reviews approximately twenty-four utility assessment methods.


Presents a problem solving model which originated from the study of computer coaches (advanced computer assisted instruction). This model depicts problem solving skills as an evolving set of rules for a domain influencing growing representation of the problem and administered by a resource-limited problem solver.


A model of the evolution of rule-structured knowledge which is considered a cornerstone of the development of computer-based coaches is illustrated. A graph structure depicting the concepts of generalization, correction, and refinement is displayed and defined. Various genetic graph formulations pertaining to reasoning skills used in playing an elementary mathematical game are examined.


Analyzes cognitive reliability in manned systems, which the authors state is an intricate function of attitudinal and structural factors, along with their interaction. Cites the types of human errors which may transpire, and discusses factors which influence the chance of these errors. Due to the changing role of man in complex systems, a broadening of prevalent approaches to human performance reliability must be sought. In addition to describing the
tasks which are becoming progressively more important in man-machine systems, the term "cognitive reliability" is defined, methods of classifying cognitive errors are identified, and an example is given which exemplifies the factors likely to affect cognitive errors.


Discusses personnel decision making with the inclusion of the possibility of rejection of job offers by candidates, which the authors recognize as an overlooked factor in formal models of decision making. Perfect Expected Acceptance Gain and Expected Acceptance Gain are promoted and demonstrate significant value for assessing the effects of various selection strategies. An interactive computer program is described. It is capable of being utilized for sensitivity analysis as a tool in the evaluation of important variations in subjective inputs, which affect changes in decision variables and their possible economic results.


Argues that the current literature on cognitive styles is inadequate for determining operational Management Information Systems and Decision Support Systems (DSS) guidelines. He further states that cognitive style research is unlikely to produce valuable guidelines.


Investigates a methodology for understanding how people evaluate decision making approaches involving health and safety risk factors. Three methods for making a consumer product safety decision were appraised on scales relating to their perceived acceptability, logical soundness, completeness, and sensitivity to moral and ethical concerns. An effect on judgments was not shown from having knowledge of the consequences. An implication made is that people's acceptance of risk may be greatly determined by the manner in which decision risks are made.


In this report, the authors utilize a simplified information seeking environment, DBASE (Data Base Access and Search Environment), in an experiment to study human machine interaction. Included in this topic are computer aiding, availability of citation lists, data base structure, and type of search tasks. It is indicated from the results of this experiment that data base structure and type of search task may be combined to create diversified search environments, which greatly influence the user's search performance.
In this report, development of an experimental approach to be used in the investigation of the advantages of adaptive aiding is recapitulated. Implications for the design of adaptive aids are examined and a conceptual framework is outlined. The task environment consists of two competing tasks which must be performed concurrently: a target spotting task and a tracking task. Results indicate that the manipulation of spotting task difficulty affects performance.


Presents a computer-based technique, An Interactive Decision System (AIDS), with the goal of assisting typical managers in making strategic decisions dealing with qualitative issues by allowing them optimal usage of their available information and resources. This system is based on Kepner and Tregoe's information processing techniques utilized in their decision training agendas. A thorough illustration of the nine steps in AIDS and a discussion of the program and its effectiveness describe this approach.


This report's area of concentration lies in human error, particularly error made by skilled operators in complex, demanding systems. Through this analysis of human error, various applications of human information processing are delineated and a classification scheme for errors is outlined. Short-term memory and human attentional limitations are examined in the design of human-machine interfaces.


Contends that current inappropriate system design does not allow optimum efficacy between the users and machines. Through the study of human error, it is discovered that human usage should be a factor warranting primary consideration by designers. The author proposes a cohesive system, a "friendly system", composed of the principles underlying both cognitive science and human factors.


The lack of learning capability in Computer Assisted Instruction (CAI) programs is the issue addressed in this research report. The author's goal is to present an alternative teaching strategy for instructing students on ways to solve quadratic equations. Introduced is a self-improving quadratic tutor which teaches the solution to quadratic equations through the discovery method. The two major components of the tutor are explained. One of the components is an adaptive teaching program where the teaching strategy is described as a set
of production rules, and the second component executes the self-improving function of the system by making experimental changes to the set of production rules.


This report concerns computer-aided human information seeking. It is proposed that a computer-based information system can considerably reduce the frequency of human errors. Various types of information and styles of presentation are evaluated. Results are submitted which support the hypothesis that computer aiding is often more desirable than computerizing in that the goal should be for computers to help humans overcome limitations and utilize their best skills, rather than replace human operators. The design of an onboard computer-based information system for aircraft is explained.


Argues that by integrating design and evaluation in computer-based decision support systems, improvements in the efficiency and effectiveness of the process will be the result. Because systems are becoming increasingly complex, decision support systems which aid humans in decision making and problem solving are essential.


Six experiments evaluating the effects of computer aiding on performance are described. The practicality of utilizing context-free computer-based simulations to instruct troubleshooting skills is also examined. A goal of this research study is to increase understanding of human fault diagnosis abilities. Computer aiding significantly lessened the number of tests required to diagnose simple problems and improved consequent unaided performance.


Inter-task consistency of individual differences was ascertained in two structurally comparable risk-taking tasks. A relationship was shown between information processing and situational specificity. As a result of the experiment, it was determined that the two response modes triggered different methods of processing information pertaining to probabilities and payoffs in a way that influenced individual differences and reduced inter-task consistencies. The implication is that it is improbable to find significant correlations between risk-taking measures in structurally different settings or between risk-taking and different behaviors.

The author focuses on the psychological aspects of individual judgment and decision making by reviewing descriptive research and examining decision aids. A survey of publications (the majority of them dated 1971-75) on the subject of behavioral decision theory is provided and descriptive studies of judgment are evaluated. An attempt is made to enumerate the errors in decision-making that may arise from judgment biases. Some areas mentioned under the topic of descriptive research include probabilistic judgment, choice, models of risky choice, and regression approaches. An insightful discussion of decision aids, MAUT research, decision analysis, man/machine systems, and use of decision aids clarifies: (a) issues which a decision maker may face, and (b) the systems used to solve problems.


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Specific Aids


A decision aid is promoted which allows one to calculate subjective expected utilities (SEUs) for having a (another) child; a value hierarchy is used. The method is intended to assist people with their birth planning decisions so that they may logically and sensibly weigh the pros and cons. Decisions are divided into "manageable chunks" and the relative utility of each chunk is evaluated. The authors affirm that through the development of this aid they developed a method applicable to other areas besides birth planning.


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Discusses the role of the knowledge engineer, a person who builds an expert system in conjunction with an expert in the subject field. Believes that the expert should communicate directly with the computer, thus eliminating the need for a knowledge engineer. An Intelligent Support System (ISS) is presented as an ideal solution to providing sophisticated support in expert systems in three different roles: the training of novices, tactical or operational support, and strategic planning. The philosophy is that there should be only a narrow gap between the creators and operators of an intelligent support system.


Decisionmap, published by Softstyle Inc., is decision support software (run on the Macintosh) through which one is able to design his/her own decision model. After choosing criteria on which the decision is to be based, factors are weighed according to importance and possible solutions are ranked. The author advocates its usage, emphasizing the ease of learning and minimal amount of time involved.


This report concerns computer-aided human information seeking. It is proposed that a computer-based information system can considerably reduce the frequency of human errors. Various types of information and styles of presentation are evaluated. Results are submitted which support the hypothesis that computer aiding is often more desirable than computerizing in that the goal should be for computers to help humans overcome limitations and utilize their best skills, rather than replace human operators. The design of an onboard computer-based information system for aircraft is explained.

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EVALUATION

Human Factors


Presents an approach to the design and development of personal computer-based decision aiding systems which views the human problem-solver as an active user who must be able to use the computer without the aid of a problem-solving intermediary. In order to successfully utilize a system, the author states that the design of the system should encompass the measurement and integration of cognitive, situational, and physiological variables which should inform and alter the decision-aiding process. It is suggested that without explicit user requirements, interactive systems fulfill the needs of the designer and not the target user. Problem solvers are categorized according to their experience with computer-based systems and grouped according to their "cognitive styles" in order to formulate computer-generated information and strengthen man's interaction with the computer. The user's physiological state and situational characteristics are examined as well.

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A definite interaction between type of dialogue and type of data is evident in an experiment which evaluated four fundamental types of data entry dialogue concerning speed. It was found that subjects in this experiment preferred an interaction mode which maximized speed at the cost of less feedback and less opportunity for error control in the command dialogues. There were no significant differences between the number of errors within each type of dialogue. Authors contend that an adaptable man-computer dialogue is necessary with an irregular data structure in performing data entry.


In this report, the authors utilize a simplified information seeking environment, DBASE (Data Base Access and Search Environment), in an experiment to study human machine interaction. Included in this topic are computer aiding, availability of citation lists, data base structure, and type of search tasks. It is indicated from the results of this experiment that data base structure and type of search task may be combined to create diversified search environments, which greatly influence the user's search performance.


Classifies literature pertaining to organizational decision making into three areas: management science, classical, and behavioral science. Stresses that there is a problem in measuring information value. The author aims to provide insight into the broad area of organizational decisionmaking.

Cites various models of information processing which account for human thinking and attempts to cover the capabilities, as well as the inadequacies, in information processing present in the literature. The authors believe that management information systems (MIS) can be radically improved by understanding the behavioral processes by which humans process information and make choices. This will aid in eliminating the problem of "overloading" the human user.


This study applies decision analytic concepts to the problem of determining value of information in the design and evaluation of information systems. Although many current systems furnish an abundance of data, the decision maker is often unable to pick out the data essential to the problem. Necessary information is that which has a high probability of changing a decision and improving decision outcome. This study modifies standard VOI techniques in order to simplify them and encourage their usage.


A laboratory study was conducted to examine the effects of varying the levels of feedback error on performance in diagnostic tasks. Results suggest that the comprehensive decision quality is contingent on both the quality of information available when the decision is made and the quality of subsequent feedback.


This paper addresses questions pertaining to the modifications made in strategies in response to task complexity by decision makers. A primary goal of these simulation studies entails identifying different decision strategies on the basis of information search patterns. It is reasoned that simulation can be very useful in generating, testing, and modifying hypotheses about human decision strategies but care must be taken to insure that the design is representative of the impending specific decision task.


The present paper discusses the analysis of information gathering patterns as a tool for process tracing. Attention to complex and diverse decision approaches has underscored the necessity of developing more refined process tracing analyses (analyzing information gathering patterns). Two major methods of improving search analysis are examined. An experimental example using these techniques is given, and applications are submitted in three areas.

Proposes a comparison-guided model of decision-making, maintaining that proficient decision makers are able to recognize and subsequently place new situations parallel to ones previously experienced. The types of decisions discussed are complex, those with unusual conditions. It is asserted that a redefinition of the problem by the expert will allow utilization of all resources which may yield a solution to the problem, rather than using a decision aid requiring "rule-following." The author believes that proficiency is not simply following rules and procedures.


An experiment was conducted at the Four Queens Casino in Las Vegas to determine the effects of response mode upon information-processing strategies applied by subjects in gambling decisions. Different strategies were used for choosing among pairs of bets as opposed to assigning monetary values to single bets. Bias was found to occur in favorable and unfavorable gambles as a result of cue-response compatibility.


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Discusses human processing structures by arguing for a different kind of processing mechanism than that which is most commonly referred to in Artificial Intelligence. The form of human error is of major importance in this study. A distinction is made between two major classes of errors, mistakes versus slips, and these two types are examined.


Advocated is the study of processes such as attention, encoding, and short-term memory in relation to probabilistic information processing (PIP) in order to expand our knowledge of decision making behavior. It is stressed that the information, not the processing itself, is probabilistic in nature. Two models of opinion revision are reviewed which incorporate the use of Bayes' theorem in their models, but recognize human error. Outlined is a PIP model computer program.


This report concerns computer-aided human information seeking. It is proposed that a computer-based information system can considerably reduce the frequency of human errors. Various types of information and styles of presentation are evaluated. Results are submitted which support the hypothesis that computer aiding is often more desirable than computerizing in that the goal should be for computers to help humans overcome limitations and utilize their best skills, rather than replace human operators. The design of an onboard computer-based information system for aircraft is explained.


Organizes current literature from various disciplines (i.e., psychology, management, systems engineering, computer science, and library science) to develop the topic of human information seeking and information systems. The nature of information seeking is defined, and through discussion, the contrast is made between information seeking and information processing. The difficulty in defining and measuring the value of information affects the progress which may be made in developing frameworks and formulating methods to evaluate this area of concern. Human information seeking is shown to be an integral part of decision making and problem solving.
Simultaneous verbal protocols were employed to study individual decision making processes. The authors describe the protocol analysis procedure used and present the coding scheme developed to analyze the data. Results of two experiments show that thought processes used in complex decision making are associated with subsequent performance: subjects using causal analysis performed more successfully than those who did not.


The goal of this research study was to utilize the theory of information integration by applying an information processing approach to risky decision judgments. The study challenges the utility theory as used in risky decision making. The multiplying model is advocated, which is supported by data resulting from two experiments.


Two combination rules, averaging and multiplying, which describe sequential inference judgments, were compared through three experiments in this study. Both of these rules depict how successive pieces of evidence are combined with previous judgments to form new judgments. Usage of the averaging rule was supported but the descriptive ability of the Bayesian approach (and other approaches which use the multiplying rule) was questioned. It may be inferred from the averaging result that judgments may incorporate processing rules differently than previously speculated.


A series of research projects were performed with the goal of revealing the influence of irrelevant information on expert decision makers. Training programs to overcome this effect were discussed and the long-term effects of the training were evaluated.


This selected chapter covers some of the principal findings from research conducted on the person perception model with the information integration theory (ITT). Five research studies are alluded to which exemplify the early development and basic assumptions of ITT, which is traced to impression formation. Cases are cited which show how ITT can be utilized in the analysis of socially relevant interpersonal decisions, and also in real-world concerns.

Inter-task consistency of individual differences was ascertained in two structurally comparable risk-taking tasks. A relationship was shown between information processing and situational specificity. As a result of the experiment, it was determined that the two response modes triggered different methods of processing information pertaining to probabilities and payoffs in a way that influenced individual differences and reduced inter-task consistencies. The implication is that it is improbable to find significant correlations between risk-taking measures in structurally different settings or between risk-taking and different behaviors.


This report examines the beliefs held by people about the relevant importance of probabilities and payoffs and their capability to act on the premise of these beliefs when processing information included in the description of a gamble. Two experiments are described which suggest that there is utility in recognizing decisions about gambling within the context of information processing.

General


Addresses three important issues which are relevant to the design and evaluation of decision analytic aids and presents a framework which illustrates the decision making organization. The three interfaces identified are: between the decision aid and the user, between the user and the extent to which the decision aid facilitates the decision making processes of the organization, and between the decision making organization and whether or not the quality of the organization's decision making has improved the environment. Without the smooth functioning of the three interfaces, effective integration of decision aids into organizations can not be accomplished. The author covers some ways to attract the user to the aid and to simplify its overall operation.


A decision aid is promoted which allows one to calculate subjective expected utilities (SEUs) for having a (another) child; a value hierarchy is used. The method is intended to assist people with their birth planning decisions so that they may logically and sensibly weigh the pros and cons. Decisions are divided into "manageable chunks" and the relative utility of each chunk is evaluated. The authors affirm that through the development of this aid they developed a method applicable to other areas besides birth planning.

In this study behavioral analysis is applied in the field test environment. Used simultaneously with other evaluation tools, behavior changes can be fully evaluated. In the example provided, behavior analysis was used to document and assess instances of behavioral divergence in the field test of a military system.


This study applies decision analytic concepts to the problem of determining value of information in the design and evaluation of information systems. Although many current systems furnish an abundance of data, the decision maker is often unable to pick out the data essential to the problem. Necessary information is that which has a high probability of changing a decision and improving decision outcome. This study modifies standard VOI techniques in order to simplify them and encourage their usage.


This study was conducted with the purpose of analyzing how decision makers themselves define decision making competence. Thirty-five bottom-level and twenty-four top-level managers participated in the following: (1) Rated skills that they believed important for effective decision makers; (2) Rated the importance of these skills in upper-level and lower-level decision makers; and, (3) Were evaluated in regards to the effects of gender, their types of organizations, and their levels within their organizations.


Deals with the accuracy of group judgment within and between different populations of groups. The quality of group judgment is defined. Results as well as constraints affecting judgmental quality of various strategies for merging opinions under a diversity of circumstances are discussed. A statistical procedure is introduced that considers which baselines are suitable in the evaluation of the quality of group judgment.


A definite interaction between type of dialogue and type of data is evident in an experiment which evaluated four fundamental types of data entry dialogue concerning speed. It was found that subjects in this experiment preferred an interaction mode which maximized speed at the cost of less feedback and less
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Fischhoff, B. (1977, May). Decision analysis: clinical art or clinical sci-
ence? (Technical Report PTR-1042-77-5). Eugene, Oregon: Decision Research, A
Branch of Perceptronics.

Draws an analogy between decision analysis and psychotherapy. Areas dis-
cussed include evaluating the validity, effectiveness, and underlying assump-
tions of decision analysis, improving analysts' skills, and social, ethical,
and political issues. The comparison with psychotherapy serves to delineate
the important issues that should be addressed in a research program.


Addresses the subject of group decision making by presenting evaluative
criteria, which were derived from a review of prevailing literature, for judg-
ing when a "high-quality outcome" has been reached. A major goal which is
hoped to be generated by this project is the construction of a set of empiri-
cally derived criteria against which outcome quality may be judged. The most
effective procedures for the achievement of a high quality collective judgment
are suggested as a result of six factual group problem-solving cases which
were evaluated by use of a specially developed questionnaire.

Hogarth, R.M. (1975). Decision time as a function of task complexity. In
Wendt/Velk (Eds.). Utility Probability, and Human Decision Making (pp. 321-

Discusses the association between decision time and task complexity. A
mathematical model is thoroughly explained which examines this association.
The model is described as having several observable variables linked to an
unobservable variable of the psychological function, i.e., cognitive strain.
It is suggested that when a decision maker is faced with different alter-
 natives, he considers two kinds of cost: the time involved in the decision pro-
 cedure, and the cost of making errors.

complex environment: an experimental approach. Management Science, 27,
93-107.

An experiment was conducted in which a competitive game was played to
assess whether or not the costs of time and effort used to analyze a decision
outweighed the benefits. Another objective was to discover strategies to
improve decision performance. There were two kinds of uncomplicated decision
rules: (1) rules were applied consistently (arbitrary-consistent), and (2)
rules were subject to a random component (arbitrary-random).

Presents an assessment of decision analysis by discussing human decision making, decision analysis, the usefulness of decision analysis, ethical concerns, and the challenge that must be faced if the field is to continue its growth. The author explains that "decision making is what you do when you don't know what to do", and cites evidence that people are not good natural decision makers. It is emphasized that decision analysis is not simply a logical procedure, but also an "artistic" process.


Outlines a study in which an illustration of how incumbent generals, colonels, and lieutenant colonels define command and control performances. Five general categories which emerged were: getting and using information, planning, organizing, controlling/directing, and leadership/personnel. Reports on an experiment in which the usefulness of automating analysis and production tasks is analyzed and proves to be applicable to organizational decision making. Among the findings reported are: (a) The battalion level differs from division command level in that the descriptive model suggests a "process-oriented reactive orientation" for battalion level decision makers; (b) the time perspective is very limited for the battalion commander in combat; and, (c) experiments in the area of tactical decision making may require the utilization of real incumbents in realistic situations.


Examines the issue of the evaluation problem with computer-based decision aids. The author proposes that a diagnostic approach be implemented which considers all benefits, "soft" and "hard," since it is not always feasible that benefits can be quantified. Evaluation should be initiated prior to the design of the system, when all interested parties reach an understanding as to what the system should ultimately accomplish. A case study is given which exemplifies the necessity of employing the process of evaluation during implementation.


Addresses the question: How much command and control ($C^2$) capability is enough? In order for one to answer this question, the cost of achieving that capability must be weighed against the potential benefits of allocating funds elsewhere. A value is assigned to the action of deciding to deploy a certain $C^2$ system in a precarious future. The trade-offs which must be made in order to resolve this question are analyzed. The paper is divided into four sections; discussed are: (a) the theory of assessing value for multiple attributed alternatives; (b) the use of scenarios as a solution to the problem with
decision trees; (c) the application of value assessment procedures; and, (d) a specific problem: the trade-offs between cost and multiple performance measures, which illustrates the use of utility assessment procedures with the C² problem.


An experimental evaluation is conducted on the effectiveness of decision-tree elicitation and goal-directed structuring. To analyze these two structuring procedures, a computer simulation of a hypothetical decision making environment, Goal-Directed Decision-Structuring System (GODDESS), was applied. This system promoted an objective evaluation of each decision instituted by the subjects. The main topics of discussion are the simulated model, the experimental approach, and the results. The results illuminate the strengths and weaknesses of the two decision structuring methods. The authors contend that the supremacy of the goal-directed approach would be recognized in a situation where the difference in performance between long-range and short-range planners is more strongly emphasized.


This report concerns computer-aided human information seeking. It is proposed that a computer-based information system can considerably reduce the frequency of human errors. Various types of information and styles of presentation are evaluated. Results are submitted which support the hypothesis that computer aiding is often more desirable than computerizing in that the goal should be for computers to help humans overcome limitations and utilize their best skills, rather than replace human operators. The design of an onboard computer-based information system for aircraft is explained.


Organizes current literature from various disciplines (i.e., psychology, management, systems engineering, computer science, and library science) to develop the topic of human information seeking and information systems. The nature of information seeking is defined, and through discussion, the contrast is made between information seeking and information processing. The difficulty in defining and measuring the value of information affects the progress which may be made in developing frameworks and formulating methods to evaluate this area of concern. Human information seeking is shown to be a integral part of decision making and problem solving.


Discusses the utilization of job performance aids (JPAs), which are defined as plans that allow the human component of a system to perform some function he
could not otherwise accomplish without extensive training or complex information processing. Through the employment of computer simulation (as opposed to laboratory experimentation) different combinations of job performance aid formats and the effect of stress on task performance with a JPA is analyzed. The use of computer simulation allows one to estimate and evaluate JPA combinations under varying conditions.


Provides guidelines for the design of user interface software to aid designers, system analysts, teachers, students, human factors practitioners, and researchers in making this process more efficient. The focus is on six functional areas: data entry, data display, sequence control, user guidance, data transmission, and data protection.


Reviews current measurement theories on utility modeling and assessment. Written particularly for decision analysts who are interested in these theories for deciphering and solving real world decision problems which are complex in nature. This paper aims to relate the present utility measurement theory with decision analytic practice. The paper tries to lessen the gap between the theory and practice of utility measurement, which may be attributed in part to the difficulty in comprehension of the mathematical language inherent in the utility theories. It is concluded that even though utility theories can be beneficial in the structuring process of evaluation, they are usually too complex for usage in real world preference assessment.


Supports usage of an Adaptive Dynamic Decision Aiding Mechanism (ADDAM) system to aid decision makers in their administration of dynamic decision tasks. The effectiveness of the decision aiding system was examined through an experimental study which used a realistic decision task. ADDAM allows the operator to organize his own in-context behavior into a methodical mathematical framework. The purpose of this strategy is not simply to present a model for decision making behavior, but also to furnish a foundation for decision aiding.

Classifies literature pertaining to organizational decision making into three areas: management science, classical, and behavioral science. Stresses that there is a problem in measuring information value. The author aims to provide insight into the broad area of organizational decisionmaking.


Briefly makes reference to selected authors and their findings in the area of management decision making, including the topics of normative analyses, descriptive analyses, and bounded rationality.


This review of behavioral decision theory literature argues that the judgmental biases exhibited in laboratory situations may be functional in natural settings. Areas reviewed include attention, memory, learning, feedback, cognitive representation, and conflict. Assuming a broad perspective in the research of decision making may yield the most insightful and generalized results.


This research memorandum serves as an aid for researchers interested in decision aiding and decision making related to man/computer systems. The bibliographic listings are classified in terms of first author, year, by keyword, or by topical classification.


Attempts to integrate current methods for evaluating single-attribute utility functions. Present various new methods of evaluation which may be beneficial in furthering the research in this area, emphasizing the varied steps in the utility assessment process, and contrasting methods of comparative risk. Reviews approximately twenty-four utility assessment methods.


Covers models of human problem solving with an emphasis on those models which predict human behavior and performance to support design and evaluation. Areas which are of particular concern in this article are detection, diagnosis,
and compensation of system failures. Proposed is an outline of a model which may influence the integration and progress of understanding human problem solving.


Organizes current literature from various disciplines (i.e., psychology, management, systems engineering, computer science, and library science) to develop the topic of human information seeking and information systems. The nature of information seeking is defined, and through discussion, the contrast is made between information seeking and information processing. The difficulty in defining and measuring the value of information affects the progress which may be made in developing frameworks and formulating methods to evaluate this area of concern. Human information seeking is shown to be an integral part of decision making and problem solving.

Shanteau, J. (1985a, August). List of available reprints, preprints, working reports, etc., on judgment and decision making. (Available from James Shanteau, Department of Psychology, Bluemont Hall, Kansas State University, Manhattan, Kansas 66506.

Includes published papers and other papers in their final form, new papers or working papers, and theses and dissertations by students at KSU which are relevant to judgment/decision making.


The author focuses on the psychological aspects of individual judgment and decision making by reviewing descriptive research and examining decision aids. A survey of publications (the majority of them dated 1971-75) on the subject of behavioral decision theory is provided and descriptive studies of judgment are evaluated. An attempt is made to enumerate the errors in decision-making that may arise from judgment biases. Some areas mentioned under the topic of descriptive research include probabilistic judgment, choice, models of risky choice, and regression approaches. An insightful discussion of decision aids, MAUT research, decision analysis, man/machine systems, and use of decision aids clarifies: (a) issues which a decision maker may face, and (b) the systems used to solve problems.


Provides a summary of literature which may be useful in developing and implementing training programs pertaining to tactical decision making. The authors contend that a cause for concern in the military is the question of whether or not decision makers are deciding upon the best courses of action in rapidly changing situations based on the techniques utilized by them to organize, analyze, and present information. Various models of decision making, along with problems in training, are examined with the purpose of developing a methodology for preparing military leaders to make tactical decisions.

Reviews current measurement theories on utility modeling and assessment. Written particularly for decision analysts who are interested in these theories for deciphering and solving real world decision problems which are complex in nature. This paper aims to relate the present utility measurement theory with decision analytic practice. The paper tries to lessen the gap between the theory and practice of utility measurement, which may be attributed in part to the difficulty in comprehension of the mathematical language inherent in the utility theories. It is concluded that even though utility theories can be beneficial in the structuring process of evaluation, they are usually too complex for usage in real world preference assessment.
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