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Descriptive Models of Military Decision Making

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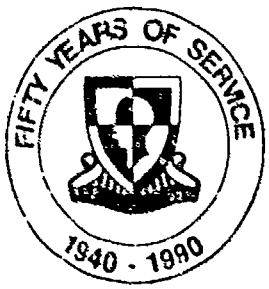

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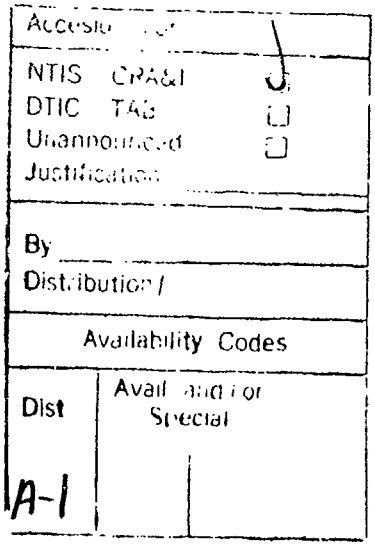

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It is important to understand the nature of military decision-making strategies in order to plan for those systems dependent on their effectiveness. This paper reports the results of three studies examining team decision making in the Army. The data suggest that recognitional decision making is much more common than analytical decision making. The strengths and weaknesses of recognitional and analytical decision strategies are viewed and compared, and we describe factors affecting the type of strategy used. Finally, the use of recognitional strategies has implications for planning, and the paper examines the conditions under which different planning approaches are most effective.

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1. Introduction

Traditional models of decision making do not take into account many critical aspects of operational settings, both military and commercial. These factors include: time pressure, realistic consequences of poor decisions, highly experienced personnel, requirements for team coordination, contextual complexity, dynamic (constantly changing) conditions, ambiguous cues, incomplete and potentially unreliable information, and ill-defined goals. In this paper we will first examine some of the assumptions of behavioral decision theory that limit the utility of models generated within this tradition. An alternative decision model will then be described that we believe is more descriptive of decision making as it is actually carried out in real world settings. Finally, some implications of this model will be presented related to team decision making, training, decision support systems, and planning.

2. Normative Decision Making Approaches

Normative decision models are the primary tools for operations research. Decision Analysis and Multi-Attribute Utility Analysis, along with Bayesian statistics and related analytical tools, have been imported from economics, game theory, and statistics for the purpose of improving the quality of decision making.

Normative decision models have a number of clear strengths. They are generic models that can be widely applied, so there is less need to be concerned with any one specific domain. The techniques ensure that all participants in a decision task will be speaking the same language, and using the same metrics. The techniques also lend themselves to incorporation into Decision Aids as a way of framing and guiding the decision making. Therefore, if it is feasible to apply normative models we will have a set of powerful techniques for overcoming biases and improving decision quality. In short, when the assumptions underlying the models are met, then the techniques can ensure optimal selection between options.

Unfortunately, normative decision models depend on a number of problematic assumptions: that goals can be isolated, that utilities can be assessed independent of context, that probabilities can be accurately estimated, that choices, goal, and evidence are carefully defined, and that the utilities of outcomes are independent of other outcomes. Each of these assumptions seems difficult to meet in an operational environment.

(a) Can goals be isolated? For example, a normative analysis might take as a starting point the goal of slowing down an enemy advance by denying the enemy the use of key roads. In actuality, this goal is linked to parallel and higher-order goals such as using the same resources in other ways, or planning for an eventual counter-attack a few days later over those same roads. Obviously, it is risky to segment goals out of the larger context, and to ignore that context in order to make the analysis work. On the other hand, it can be overwhelming for a battle manager to try to deal with the larger picture in analytical terms.

(b) Can utilities be assessed independent of context? The utility of mining key roads and calling in artillery is a function of how desperate the need is at that time to slow the enemy advance, the cost at that time of maintaining forward observers to direct the artillery, and so on. It is risky to ignore factors such as these in order to estimate the abstract utility of blocking a given road.

(c) Can probabilities be accurately estimated? Decision analyses require people to estimate the probability of occurrence for different branches of an option tree. We know how difficult it is to assign probability estimates even without time pressure and personal stress. Experienced decision analysts recognize this as a limitation of the technique--that operators will not be able to provide reliable data as inputs into the analyses.

(d) Will choices, goals, and evidence be clearly defined? Decision analysis models work best with simple decisions such as which car to buy, or whether to proceed with a surgical operation. In contrast, for many military decisions the end states are not finite and discrete. For example, there are many ways of configuring platoons in order to set up a defense, too many options to contrast with each other. Furthermore, the goals are ill-defined. Victory is a goal, but we do not seek victory at all costs in any given battle. Finally, the evidence for making the decisions will be incomplete and of uncertain validity.

(e) Normative models assume that the utilities of outcomes are independent of other outcomes. This condition is hard to satisfy without a fair amount of effort since so many facets of military operations are interrelated and since the military works so hard to sensitize soldiers to these relationships.

There are a number of serious disadvantages to misapplying normative decision models. If the assumptions are not met, then the models cannot be trusted to provide useful inputs. And it seems clear that military environments will rarely meet most of the assumptions listed above. Worse yet, by trying to force military personnel to adjust to the needs of the normative models we run the risk of degrading their ability to make use of their own experience. We can interfere with their proficiency. That is why it is important to understand the basis of their expertise in order to determine how to enhance their abilities.

3. Recognitional Decision Models

As an alternative to normative modeling, we have proposed a descriptive model of naturalistic decision making which emphasizes recognitional rather than analytical processes. The Recognition-Primed Decision (RPD) model also blends aspects of problem solving with the decision task of committing to one option when faced with several alternatives.

The RPD model grew out of research with a number of different populations, including urban Fireground Commanders (Klein, Calderwood, & Clinton-Cirocco, 1986; Calderwood, Crandall, & Klein, 1987; Calderwood, Crandall, & Baynes, 1988), wildland fire incident command teams (Taynor, Klein, & Thordsen, 1986), U.S. Army Armored Division personnel (Brezovic, Klein, & Thordsen, 1986), and U.S. Army battle planners (Thordsen, Galushka, Klein, Young, & Brezovic, 1987). These studies reflect a broad range of task constraints. For example, decisions made over several days to decisions made in less than one minute; decisions involving primarily a single individual to teams of 5-9 people; highly expert personnel with more than 20 years of command experience to newly promoted officers. Both qualitative and quantitative methods of investigation were employed in these studies, including semi-structured interviews, on-sight observations, and protocol analysis. The tasks performed ranged in the level of realism from the very real (a wildland fire requiring coordination of 4,000 crew members), to force-on-force exercises and computer simulations at the platoon, battalion, brigade, and company levels, to classroom battle planning exercises at the division and corps level.

Under all of these conditions, we found little evidence for the analytic process of identifying several options and then systematically evaluating and contrasting these options on specified dimensions. What we did find is summarized in Figure 1. The decision begins with an understanding of the situation. It must be remembered that situations will vary in their degrees of familiarity. Our decision makers had a great deal of experience, sometimes more than 20 years, and their decisions were often made under extreme time pressure, e.g., in less than one minute.

There seem to be four important aspects of situation assessment here--understanding the types of goals that can be reasonably accomplished in the situation, increasing the salience of cues that are important within the context of the situation, forming expectations which can serve as a check on the accuracy of the situation assessment (i.e., if the expectancies are violated it suggests that the situation has been misunderstood), and recognizing the typical actions to take in that type of situation. Thus, recognizing the situation carries with it a sense of how to respond. If there is enough time, the decision maker will evaluate the dominant response option by imagining it, conducting a mental simulation to see if it will work. If it does, it will be implemented. If it runs into problems, it will be modified. If it can't be fixed then, it will be rejected and the next likely option will be considered.

There are a number of features that distinguish the RPD model from decision analytical approaches.

--The RPD model focuses on situation assessment rather than judging one option to be superior to others.

--The RPD model asserts that experienced decision makers can identify a reasonably good option as the first one they consider, rather than treating option generation as a semi-random process.

--The RPD model relies on satisficing (Simon, 1955) rather than optimizing--finding th first option that works, not necessarily the best option.

--The RPD model asserts that experienced decision makers are capable of effective use of imagery to conduct mental simulations, rather than having to be skilled at multi-attribute utility analyses.

--The RPD model views evaluation as occurring through mental simulation of a single option, rather than the determination of strengths and weaknesses of several options.

--The RPD model incorporates problem solving to describe how options become improved during the process of mental simulation.

--Finally, the RPD model views the decision maker as being almost continually prepared to initiate action by committing to the option being evaluated, rather than having to wait until the analyses are completed before finding out which option was rated the highest.

We also want to acknowledge the work of a number of researchers who have been working on related ideas for the past several years. Hammond, Hamm, Grassia, and Pearson (1984), studying highway engineers, have contrasted analytical and intuitive decision strategies, showing that under different conditions each is advantageous. Noble, Boehm-Davis, and Grosz (1986), working with Navy planners, proposed a schema-based model of recognitional decision making. Lipshitz (1988) collected data from soldiers in the Israeli Defense Forces and described their decision making largely in terms of recognitional processes. Beach and Mitchell (1987), working with decision makers in industry, have developed Image Theory as a way of incorporating pattern matching processes into decision models. Thus, in recent years, several versions of recognitional decision theory have emerged.

4. Strengths and Weaknesses of Recognitional Decision Models

We are <u>not</u> proposing that there is a best decision strategy. Both recognitional and analytical approaches have their place, and both often need to be applied within the same decision task. Our claim is that recognitional strategies can be adaptive, can allow experienced decision makers to respond effectively, and should be acknowledged as a potential source of strength.

If analytical decision strategies are used in the wrong conditions, they can leave the decision maker unable to react quickly and effectively. Conversely, the danger of misapplying recognitional decision strategies is that personnel will lack the experience needed to identify effective courses of action as the first ones considered, or will lack the ability to mentally simulate the option to find the pitfalls, or will fail to optimize when necessary. For example, the task of generating an operational order of battle calls for speed and satisficing, and can be compromised by excessive use of analytical decision strategies. However, the task of anticipating the enemy's course of action requires optimizing to identify the worst thing that the enemy might do, and here recognitional processes can lead to trouble.

Research suggests that there are a number of factors affecting the use of analytical vs. recognitional decision "strategies." Hammond et al. (1984) have identified a number of these factors in contrasting analytical and intuitive decision making. Our own research has shown that recognitional decision making is more likely when the decision maker is experienced, when time pressure is greater, and when conditions are less stable. In contrast, analytical decision making seems to prevail when the available data are abstract and alphanumeric rather than perceptual, when the problems are very combinatorial, when there is a dispute between different constituencies, and when there is a strong requirement to justify the course of action chosen.

Care must be taken in interpreting and generalizing research findings on decision biases, because this literature encourages an emphasis on analytical decision making, and fosters distrust of the untrained judgments of decision makers. Many of the heuristics studied by decision researchers (e.g., availability, representativeness) enable experienced decision makers to take advantage of their training to identify likely courses of action. Unfortunately, the way these heuristics have been studied has resulted in their being labelled as "biases." Any heuristic can be made to appear counterproductive under the wrong conditions; we must be careful to consider whether the laboratory conditions will generalize to naturalistic settings before judging the strengths and weaknesses of heuristics.

5. Team Decision Making

Because so many of the naturalistic decisions we have studied involve coordination among different people, we have a special interest in team decision making. Three studies have been conducted to examine whether team decision making would increase the use of analysis, to facilitate communication. This hypothesis was not supported--we saw as much recognitional decision making among teams as we did in studying individuals.

The first study was conducted at Ft. Hood, during a simulated battalion exercise (Thordsen et al., 1987). A 5-hour planning session was observed, during which 27 different decision points were identified. In only one of these did the decision makers compare one option to another. The team showed the same RPD strategies as individuals had. They identified likely courses of action and together simulated what would happen if these actions were carried out. When barriers were reached, the team searched for ways around the barriers, much like an individual relying on mental simulation.

The second study involved a non-military domain--forest fires (Taynor et al., 1987). We studied Incident Commanders overseeing large-scale operations, during an actual fire. Again, there was a predominance of recognitional decision making and mental simulation to ensure that actions could be carried out without running into problems.

The third study was conducted at the Command and General Staff College at Ft. Leavenworth during a Corps-level command post exercise in an advanced course (Thordsen & Klein, 1988). The purpose of this research was to collect data on the team decision processes for use during an After-Action Review; we also took advantage of the opportunity to observe the decision strategies and verified the observations made during the research at Ft. Hood.

6. Implications

There are a number of implications stemming from the concept of recognitional decision making. Because decision-making processes are embedded in such a wide variety of military activities, there will be many areas that can be affected if a purely analytical model of decision making is replaced by a quasi-rational model that combines analytical and recognitional approaches. Three primary areas to examine are training, decision support systems, and organizational planning.

Analytical decision models have suggested that if we could only teach people to use Decision Analysis, Multi-Attribute Utility Theory, and Bayesian statistics, then we would reap generalized advantages since this generic training could be applied to a number of different tasks. Unfortunately, this process-oriented training approach was not very successful. We do not feel that an RPD process approach should replace it, since the RPD model is already a description of what people do. Instead, we would argue that training is needed in recognizing situations, in communicating situation assessment, and in acquiring the experience to conduct mental simulations of options. Where process training does seem valuable is for team decision settings, where processes of management and coordination are critical.

The function of a decision support system would focus on situation assessment and mental simulation, for reasons described above. That is, we would recommend abandoning decision aids that required users to follow classical normative decision strategies, in favor of decision support systems that facilitated the use of recognitional decision making. Noble et al. (1986) has demonstrated the type of aid that would facilitate situation assessment, and Andriole and Hopple (1988) have developed display techniques to enable easier mental simulation. In addition, systems such as the Army's Brigade Planner System represent a major step forward in supporting recognitional decision strategies.

The nature of planning might undergo some re-orientation. We recently had the opportunity to collect some observational data at Ft. Stewart and Ft. Irwin (Whitaker, Thordsen, & Klein, 1989). The goal of this activity was to examine the way situation assessment was communicated during brigade and battalion exercises. One hypothesis that emerged from our work was that effective commanders were preparing their subordinates for improvisation. They appreciated the fact that plans usually break down, and they wanted their subordinates to quickly recognize when the plans were no longer feasible, or to recognize when opportunities had arisen necessitating the modification of plans. This is consistent with the German Army concept of *Auftragstatik*, or Mission Tactics, emphasizing guidance on objectives rather than on actions, in order to give meaningful flexibility to troops in the chain of command. There are different strategies to use if you are preparing a plan that you expect will be followed, vs. preparing a plan that you expect will degrade during the course of the operations.

In conclusion, a mixed recognitional/analytical model of naturalistic decision making has implications at a number of different levels for improving operational performance.

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