An Empirical Analysis of the Problem Recognition Process: Implications for Organizational Decision-Making

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ABSTRACT

This work in progress explores how certain perceiver, task, and situational characteristics affect an individual's problem recognition performance, and will discuss the implications for effective organizational decision making. The paradigm used to study these effects involves a real world simulation of a radar approach control facility. Specific hypothesis will be tested to explore how problem recognition processes are shaped by the psychophysical aspects and mental process that underlie the foundations of problem recognition. The data for this investigation has already been collected, therefore the objective of this project is to analyze and eventual publish the findings, with an eye towards maximizing both the theoretical and practical significance of the empirical analysis.

Keywords: Problem Recognition, Decision-Making, Signal Detection Theory, Selective Attention, Field-Dependence, Cognitive Style

INTRODUCTION

Why is this investigation important? Often, discrepant stimuli can be ambiguous and difficult to distinguish from other potentially distracting or confusing perceptual cues. For example, during the Persian Gulf War, military sonar and radar operators had difficulty distinguishing between "friend" (nontargets) and "foe" (targets). Mintzberg, Raisinghani, and Thoret (1976) suggest that indicators of problems do not always present themselves in convenient ways and often must be distinguished from environmental "noise". The implication is that delay will be a common response to the identification of informational cues that signal an existing or impending problem.

Other studies show that characteristics of a decision-maker, exert a direct impact on their problem-solving/decision-making processes (e.g., Hunt, Krzystofiak, Meindl, & Yousry, 1989; Mitroff & Kilmann, 1976; Henderson & Nut, 1980). These studies have shown that the decision-maker's own "cognitive style" or abilities may explain a substantial amount of variation in organizational decision-making strategies. Although this research has not focused specifically on the problem recognition component of decision-making, one might argue that such individual differences exist in the perception and identification of problems. In another study, Chi & Hunt (1992) found more direct evidence of consistent effects of cognitive style on problem perception, leading them to conclude that "there are generalized decision-maker effects on decision processes, specifically including the perception (or evocation) of the problems that are the subjects of the process (p.32)."

The purpose of this research, then, is first, to examine how certain perceiver, task, and situational characteristics affect an individual's problem recognition performance, and, second, to discuss the implications of the research findings for both the literature and effective organizational decision-making. Consistent with other research in detection performance, the project is conceptualized within the framework of a signal detection theoretical model. The main contribution of detection theory for this research is that it provides an independent measure of an individual's proficiency, or sensitivity to the problem/non-problem difference and a response-bias index to measure biases and criteria of the decision maker during the recognition process. In essence, the study attempts to extend the theory to the problem recognition paradigm.

Although it is obvious that no (conscious) decision can occur unless problem recognition occurs, there has been little research on the problem recognition component of decision-making. One reason might be that the predecision problem "sensing" process has been taken for granted. For example, managers are often assumed to be quick in defining and recognizing problems (Bazerman 1990). Managers commonly are presumed to know what the problem is, what values to serve via solutions, and what requirements to satisfy or strategies to follow while solving a problem (Dery, 1983).

Although these assumptions may have tended to discourage problem recognition research, it is hoped that this investigation will further illuminate understanding of those cognitive processes that are a precursor of subsequent phases of the decision process. This kind of intensive and narrowly focused research is needed to generate and evaluate inferences about "front-end" matters of decision modeling. Moreover, it allows for the possibility of observing interesting psychological processes that may occur during the problem recognition phase of organizational decision making.

PROPOSED MODEL

A proposed model of the problem recognition process is presented in Figure 1 (Appendix). In this model, problem recognition performance is seen as an outcome of a perceiver's cognitive orientation, representational dimensions of the task, and particular attributes of the situation. According to this model a contingent relationship between the independent variables, i.e., perceiver characteristics, task attributes, and situational features, and the dependent variable, i.e. problem recognition performance is posited. Problem recognition performance is represented by *sensitivity*, the observer's ability to discriminate between problem and nonproblem informational cues, and *response latency*, the time interval between stimulus onset and the individual's response. *Selective attention ability* is an indicator of the perceiver's cognitive orientation, and reflects individual stylistic differences in the tendency to perceive and process information in a global or analytic type fashion. Situational characteristics are described in terms of *target-distractor similarity*, the extent to which common features are shared between target (problem) and distractor (nonproblem) inputs, and *situation complexity*, the number of nontarget distractors in the visual field. Finally, the *analogical/propositional* dimension provides an indicator of the representational form of the task and describes how well target inputs "match" or "represent" real world objects and events.

Independent Variables:

The four independent variables that are used in this study are as follows:

i. ***Selective Attention Ability***. The Embedded Figures Test (EFT) is a commonly used measure of FDI (Goodenough, Oltman, Snow, Cox & Markowitz, 1991). In this situation, the subject must single out a simple figure, seen in a larger and more complex figure that tends to hide the simple figure. Test-retest correlations that have been obtained on the EFT reflect a high degree of stability in this measure over time (Pizzamiglio, Zoccolotti, 1986). Additionally, several studies have obtained the FDI classification through more than one measure of field-dependence, providing strong evidence for the construct validity of the EFT (e.g., Manning, 1991; Vernon, 1972). Data will be selected on the basis of selective attention scores. Subjects scoring in the upper and lower thirds of the distribution of the EFT scores will be used. Thus, subjects scoring in the lower third of the distribution will be considered low in selective attention ability, whereas those scoring in the upper third of the distribution will be considered as high in selective attention ability.

ii. ***Target-Distractor Similarity***. T-D similarity will be assessed by the degree of correspondence between target and distractor informational cues. High similarity correspond to small variations between correct and incorrect cues (e.g. 1000 ft. difference in altitude or 5 degree difference in heading) , low similarity correspond to large variations between correct and incorrect cues (e.g. 10,000 ft. difference in altitude or 20 degree difference in heading).

iii. ***Situation Complexity***. Situation complexity will be represented by the number of nontargets presented during each trial. Low complexity corresponds to 1 or 2 distractor inputs, while high complexity corresponds to 6 or 7 nontarget informational cues.

iv. ***Representational Form***. The representational form of informational cues are of two varieties: 1) propositional stimuli - stimuli that were abstractly or symbolically related to real world events (e.g. digital displayed altitudes); and 2) analogue stimuli - stimuli that more precisely resembled the form of the represented world (e.g. horizontal air traffic movements that more closely resemble actual air traffic movements) .

Dependent Variables:

The two dependent variables that are used in this study are as follows:

i. ***Sensitivity***. In SDT the sensitivity parameter d' is the distance between the point in ROC space and the major diagonal, when a z transformation is applied to the hit and false-alarm rates (Macmillan & Creelman, 1985). Thus, the following equation was used to assess sensitivity: d' = z(Hit Rate) - z(False Alarm Rate)

ii. ***Response Latency.*** Response latency was measured by the time interval between stimulus onset and an individual's response. The apparatus used to compute response latencies was specially designed for this investigation. It included a battery-powered portable electronic circuit, a two channel video cassette recorder, and a computer. Auditory and visual stimuli were recorded on one channel of the video tape. Corresponding with the onset of each problem cue, an electronic marker was recorded on the second channel. This marker served as a signal to the microcomputer to begin timing. Latencies were computed by measuring the amount of time from the onset of a problem to the depression of a response key

METHOD

Data was collected from 100 undergraduate students who participated in the study as part of the research requirements for an introductory management course. The experimental task required subjects to monitor the progress of aircraft in a region of airspace, recording speed, heading, altitude, airline, and type of aircraft information; and to indicate the presence of any informational input that might suggest an impending problem. Although the task represents a substantial reduction of rules and operational demands in comparison to the real-world job of an air traffic controller, it provides an excellent simulation vehicle for the study of problem recognition within a laboratory-based research environment.

Factorial multivariate analysis will be used to test the impact of the four independent variables on problem recognition performance. Main effects will be tested for selective attention ability (field-dependent, field-independent), T-D similarity (high, low), situational complexity (high, low), and representational form (analogue, propositional). Interaction affects between selective attention ability and the 2 situational characteristics (T-D similarity and situational complexity) will also be tested. In order to investigate specific differences between groups in the sample, a follow up analysis of variance (univariate F test) will be conducted with each of the two dependent variables. As seen in Fig 1, it is expected that sensitivity (d') and reaction time (less response latency) will be positively related to selective attention ability and representational form (more analogue stimuli), and negative related to T-D similarity and situation complexity.

DISCUSSION

Theoretical Importance

As the cognitive paradigm becomes increasingly popular, many contributions have been made by researchers interested in understanding the capabilities and limitations of humans in making choices. At the same time, there is a growing awareness that organizational and social influences affecting choices are at least as important as the characteristics of the individual decision-maker. Theoretical contributions of the present study can be characterized in four ways: First, as an exploration of events that occur prior to choice, it focuses exclusively on the evocation of choice, relating solely to the problem recognition component of decision-making, secondly, it explores individual differences in problem recognition performance by placing the individual decision-maker in a context of specific task and situational demands, conditions which have been insufficiently explored within the problem recognition domain, third, this study investigates the role of unique informational processing characteristics of the perceiver on problem recognition performance, and finally, and in most importantly, it attempts to merge the behavioral and quantitative aspects of decision-making.

Research methods used in investigating behavioral aspects of choice have been viewed as irreconcilable with the rigorous formulation of the quantitative methods which traditionally have been used in decision-making research (Taylor 1984). It seems likely that one reason for the limited research attention devoted to the events which occur prior to choosing is that many of these activities appear difficult to observe objectively and describe quantitatively. Hence, the processes involved in problem recognition do not lend themselves easily to investigation by the methods which traditionally have been used in decision-making research. The methodological approach taken here, which is based on signal detection theory (Tanner & Swets, 1954), offers a rigorous analytic technique for analyzing events that occur during the pre-decision period.

Practical Importance

Highly automated machine systems have influenced human task and role-related dynamics in the work place. With the growing number of complex automated systems in medical, aeronautical, and industrial settings, humans deal less and less with routine system control and more and more with complex troubleshooting, diagnosis, and decision-making (Shurtleff, 1991). Often, a human operator continually monitors equipment or the environment and determines if situations are normal or abnormal, acceptable or unacceptable, correct or incorrect. Focusing on pre-decision activities can not only contribute to our general understanding of the decision process, but can help sensitize individual decision-makers to the requirements of task performance. Thus, research on problem recognition performance can help insure professional competence in a variety of decision-making situations that have implications for product reliability, production efficiency, and personal safety.

APPENDIX

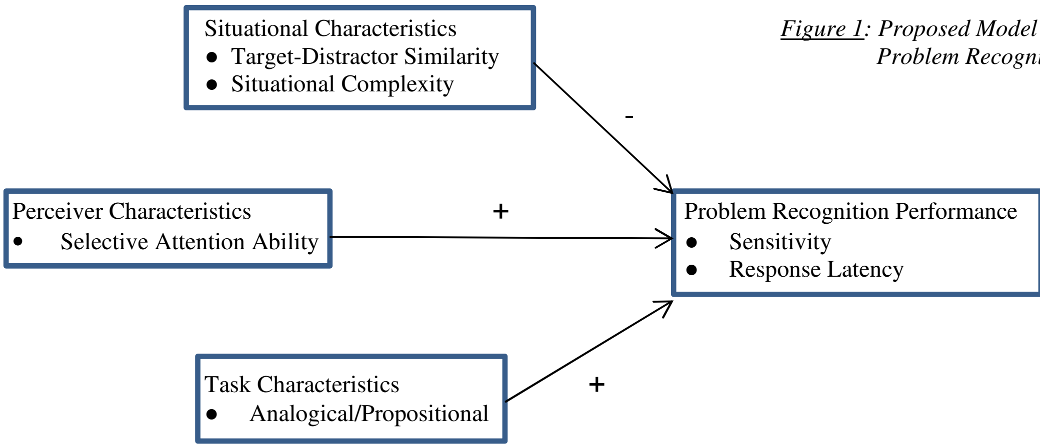

Figure 1: Proposed Model of The Problem Recognition Process

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