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## **FIVE COLLEGE** DEPOSITORY

## THE EFFECT OF DECISION STRATEGY AND TASK COMPLEXITY ON DECISION PERFORMANCE IN AN ACCOUNTING CONTEXT

A Dissertation Presented

By

Laurence R. Paquette

Submitted to the Graduate School of the University of Massachusetts in partial fulfillment of the requirements for the degree of

DOCTOR OF PHILOSOPHY

September 1985

School of Management

Laurence R. Paquette

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## THE EFFECT OF DECISION STRATEGY AND TASK COMPLEXITY ON DECISION PERFORMANCE IN AN ACCOUNTING CONTEXT

A Dissertation Presented

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### ABSTRACT

## THE EFFECT OF DECISION STRATEGY AND TASK COMPLEXITY ON DECISION PERFORMANCE IN AN ACCOUNTING CONTEXT September 1985

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When making decisions a variety of heuristics or decision strategies may be employed. The selection of these strategies depends to some extent on the complexity of the task. The objective of this research is to evaluate the performance of various formal decision strategies under differing levels of task complexity. The test for these effects involves and experimental accounting context where subjects choose companies with the highest bond ratings, given financial information. Performance is evaluated by measuring accuracy as well as time taken to make a choice.

Four decision strategies are tested: additive compensatory, additive difference, elimination by aspect (EBA) and mixed. The additive compensatory and additive difference can be characterized as high processing strategies. Since the reduced processing strategies often ignore much of the information available to the decision maker, a

question of interest is whether these reduced processing strategies result in less efficient decisions. An information board is used to monitor the search pattern of each subject in order to verify that the assigned strategy is being employed. The decision strategies are evaluated at three levels of task complexity: two, five, and nine alternatives.

A repeated measures ANOVA is used to study the effect on the variables time and accuracy. The results indicate that task complexity does impact both the time taken to make a decision, as well as the accuracy of the decision. The study also provides initial experimental evidence that the more efficient decision makers are the ones who use a reduced processing strategy when faced with a complex decision task. The decision makers achieve this efficiency by saving time with no compromise in decision quality.

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## CHAPTER I INTRODUCTION

Accountants have traditionally been interested in improving the quality of accounting numbers as well as the decisions that result from the use of those numbers. For example, Statement #1 of the Conceptual Framework project (1978) asserts that accounting information should be decision useful to present and potential investors and creditors and other users in making rational investment, credit, and similar decisions.

Human Information Processing (HIP) is a subset of behavioral accounting that is concerned with the impact of accounting information on the decision making efforts of internal and external users and preparers of that information. The goal of HIP research in accounting is to understand, evaluate, and improve decision making as it relates to accounting.

The following options for improving decisions have been suggested by Libby (1981):

- 1. Changing the information
- 2. Replacing the decision maker with a model
- 3. Educating the decision maker to change the way he or she processes information.

The first two options have received the greatest amount of attention. Early research focused on the lens model which was

especially successful in predicting judgments in a wide variety of studies. Surprisingly, these models of the decision maker outperformed the actual decision maker. While these models were a first step toward understanding cognitive processes, they only provide surface descriptions of the decision process. This is usually accomplished by studying the relationships between cues and judgments with linear regression or ANOVA. With these approaches the underlying successive stages of the decision process is not examined.

More recently, attention has shifted to process tracing models that more closely attend to the cognitive processes of the decision maker. Techniques commonly employed to study the way individuals go about making decisions include analysis of protocols, analysis of cue selection by means of information boards, self report using questionnaires and the study of eye movements.

The use of these techniques has resulted in the identification of various decision strategies or methods of processing information. However, most research employing these techniques has only been concerned with describing the decision process, and has not examined whether a certain decision strategy performs better under certain conditions. Biggs (1978) investigated the information processes underlying choice behavior in an accounting context. The result of this study confirmed that decision models widely documented in the behavioral literature, are used in accounting decisions. However,

this study only investigated types of strategies used and not whether those strategies provide the most efficient means to process information. Payne (1976, 1982), Olshavsky (1979), and Lussier and Olshavsky (1979) found that different decision strategies are used by the same decision maker depending upon the properties of the task. Task complexity appears to have a direct effect on the strategy used. The question therefore arises whether certain decision strategies perform better than others, and what effect task characteristics have on the performance of those decision strategies?

## Purpose of the Study

One possible way to improve decision making is to educate the decision maker to use the most efficient strategy for the decision context. It is therefore first necessary to establish whether or not certain decision strategies perform better than others under different conditions. The objective of this study is to evaluate the performance of various decision strategies under differing levels of task complexity. If a particular strategy emerges as being superior, one can then educate the decision maker to change the way he or she processes information. The research of Billings and Marcus (1983) demonstrated the feasibility of this approach. They indicated that subjects are flexible and adaptable in their decision behavior. This implies that decision makers can change their decision strategy if certain strategies appear to be superior.

The study involves subjects choosing companies with the highest bond ratings. Performance is defined as both decision accuracy as well as time taken to arrive at a decision. Accuracy will be determined by comparing the subjects' choices to a criterion that is evnvironmentally determined. The subjects' choices will be made by processing financial ratios under certain types of tasks. The manner in which the processing occurs or the decision strategy employed is the first treatment variable. The second treatment variable is task complexity. The experimental results should provide some insight concerning the efficiency of various decision strategies and hopefully prove to be a valuable contribution to the body of knowledge in human information processing in accounting.

### Decision Strategies

The decision rules or heuristics that an individual uses in arriving at a decision are numerous and include the following: Additive Compensatory (AC) Additive Difference (AD) Non-linear (multiplicative) Sequential Elimination

Conjunctive Elimination by Aspect (EBA) Disjunctive Lexicographic

A more complete discussion of these strategies is given in the literature review. Several key characteristics or dimensions can be used to either identify or categorize decision rules. These include:

- -the amount of information processed (high vs. reduced processing strategies)
- -the manner in which the aspects or cues are processed (compensatory vs. noncompensatory strategies)
- -the manner in which the alternatives are processed (dependent vs. independent strategies)

A high processing strategy is one where the maximum amount of useful information is used in arriving at a decision. All aspects considered relevant to the decision are examined for all alternatives. A reduced processing strategy, on the other hand, is one in which an alternative may be chosen or rejected after an incomplete search of the information.

A compensatory strategy is one where all relevant aspects or cues are examined for each alternative, and then combined in a fashion that allows a high score on one cue to offset or compensate for a low score on another cue. If one is using a noncompensatory strategy an alternative may be discarded on the basis of a low score on one cue without processing the remaining cues for that alternative. Compensatory strategies typically are high processing strategies, whereas noncompensatory strategies are reduced processing strategies.

Strategies are classified as being independent if an alternative is considered on its own merit without regard to any of the other alternatives. A dependent strategy is one where each alternative is considered in relation to one or more of the other alternatives. A description of some widely documented and used strategies follow. These are emphasized because they will represent the treatment levels in the present study.

An <u>additive compensatory (AC)</u> strategy is used when the decision maker processes all relevant aspects for an alternative resulting in an overall value for the alternative. This process is repeated for each of the alternatives and the alternative with the highest value is chosen. Each alternative is considered independently and the aspects are combined in a compensatory fashion.

The <u>additive difference (AD)</u> strategy compares two options or alternatives on each cue. That is, a decision regarding alternative 1 depends on how it compares with alternative 2. This model is compensatory and involves dependencies. Both the AC and AD strategies would typically be categorized is high processing strategies.

The <u>elimination by aspects</u> or EBA strategy is a noncompensatory strategy where all alternatives are first compared on the most important aspect. Those alternatives not having satisfactory values for this aspect are eliminated. This strategy is classified as noncompensatory because an alternative may be eliminated without regard to any other aspect. This strategy involves dependencies and is a reduced processing strategy.

All of the preceding strategies can be characterized as single stage strategies, but decision makers sometimes make use of <u>mixed</u>

strategies that involve the use of an elimination phase, followed by a compensatory phase (Payne, 1976 and Lussier and Olshavsky, 1979). This strategy is usually invoked in an effort to reduce time when the decision maker is faced with a complex task. Often the first stage involves a modification of the EBA strategy. It is modified in the sense that the goal is to reduce the set of alternatives to three or four rather than to a single alternative. This is followed by the application of a compensatory strategy to the reduced set of alternatives.

In summary, the four levels of the treatment variable decision strategy will be as follows:

Additive Compensatory (AC)

Additive Difference (AD)

Elimination by Aspect (EBA)

Mixed-EBA followed by AC

In the discussion of mixed strategies it was noted that this approach is usually invoked when the decision task becomes more complex. These strategies have been utilized in various choice situations, as evidenced by descriptive studies, but little has been done to determine if the use of these strategies in certain situations is optimal.

### Task Complexity

Previous research has shown that a major determinant of which strategy will be used in a decision situation is task complexity (Payne, 1976, 1982 and Olshavsky, 1979 and Lussier and Olshavsky, 1979). Task effects are factors associated with the general structural characteristics of the decision problem. Task complexity is one of many task effects. Some of the factors that comprise task complexity are the number of alternatives or choice options, the number of dimensions per alternative, and time pressure. Payne (1976) operationalized information load as both the number of alternatives and dimensions. He found that an increase in number of alternatives led to greater use of noncompensatory strategies, but that the number of dimensions had no such effect. Billings and Marcus (1983) note that the most common and successful manipulation of information load in choice contexts has been the number of alternatives.

The treatment levels for this variable will be as follows: Two alternatives

Five alternatives

Nine alternatives

A more detailed treatment of this variable and the other determinants of strategy selection can be found in the literature review.

### Overview

The remainder of the study is organized in the following way. Chapter II contains a survey of the predecisional behavior research and stresses the contingent nature of decision processing. Of particular interest is the association of task properties and strategy selection and implementation. Chapter III outlines the rationale for the selection of bond rating as an accounting setting. This chapter also reviews the literature on financial ratio classification and bond rating. Chapter IV describes the design of the experiment, the hypotheses to be tested and the conduct of the experiment. An analysis of the results of the experiment is presented in Chapter V. The results and implications of the study are covered in Chapter VI.

## CHAPTER II

### LITERATURE REVIEW

Libby (1982) outlines three major approaches to the study of behavioral decision research. They are the Lens Model or policy capturing approach, the probabilistic judgment or decision theory approach, and the predecisional behavior approach. This research project falls in the latter category and the literature review will focus on that area. The accounting research in this area is quite meager but is attracting increasing attention. Much of the work that has focused on this area is found in the psychology, sociology, marketing, and consumer research literature.

Beach and Mitchell (1978) proposed a contingency model to study decision behavior. Specifically, they proposed a model of individual decision making that included a series of distinct stages as shown in Figure 1.

This model is based on the assumption that strategy selection is contingent upon both the characteristics of the decision task and the characteristics of the decision maker. In their recent reviews Einhorn and Hogarth (1981) and Payne (1982) also recognize the contingent nature of decision processing.

The literature review will be broken down into the research that impacts the following areas:

>6	Choic ion
2	Strategy Implementat
4	Information Processing
3>	Strategy Selection
2>	Evaluation Oof task
	Problem Recognition
Stage	Activity

b

Figure 1. A Typical Model of Individual Decision Making

Evaluation of Task

Strategy Selection and Information Processing

Strategy Implementation

Choice

Following the literature review, a concluding section will look at the implications this research has for this particular study.

## Evaluation of Task

The evaluation of a particular task depends on the characteristics of the decision task as well as the characteristics of the decision maker. The decision task can be further broken down into those characteristics that are inherent in the decision process itself, and those that describe the decision environment. Payne (1982) describes this distinction as task effects and context effects. Task effects are those factors that can be associated with the general structural characteristics of the decision problem. Context effects are those factors associated with the values of the objects in the decision set under consideration.

#### Task Effects

Figure 2 outlines the task effects. As is evidenced by this figure, task complexity has many facets and will dominate the review of task effects.



Figure 2. Outline of Task Effects

Decision research has made use of two response modes; judgment and choice. In a judgment task, each individual alternative is assigned a value on a rating scale. A choice, on the other hand, involves the selection of one alternative from a list of two or more alternatives. Einhorn and Hogarth (1981, p. 20) discriminate between judgment and choice in the following way: "Judgments serve to reduce the uncertainty and conflict in choice by processes of deliberative reasoning and evaluation of evidence." That is, while judgment is possibly and aid to choice, it is neither necessary nor sufficient for choice. A generalization is that a choice task leads to more dimensional processing than does a judgment task. Most of the studies included in this review involve a choice response.

A major determinant of which strategy will be used in a task is task complexity (Payne, 1982). The characteristics of a problem that impact task complexity include the following:

Number of Alternatives Number of Dimensions Time Constraints Presentation Format Attribute Measures Impact on Future Decisions

The following two studies examined the impact of varying the number of alternatives on decision strategy use. Payne (1976) used two process tracing techniques, explicit information search and verbal protocols to examine the information processing strategies subjects used to reach a decision. Of prime concern was the effect of increasing the number of alternatives on choice strategy. When subjects were presented with two alternatives from which to choose, they used a compensatory strategy-additive compensatory or additive difference. In contrast, when faced with a multialternative decision task they used a noncompensatory conjunctive or elimination by aspect strategy.

Lussier and Olshavsky (1979) present further evidence that choice strategy is contingent upon task complexity in a consumer research study. They found that when subjects were presented with three alternatives or brands of a product a compensatory strategy was used. When the number of alternatives was increased (6 and 12), subjects used a more complex, two-stage strategy. In the first stage, a noncompensatory (conjunctive) strategy was used to eliminate unacceptable alternatives. In the second stage, a compensatory strategy was to evaluate the remaining alternatives (usually three or four).

Slovic and Lichtenstein (1971) made the following generalizations about the number of dimensions per alternative. They concluded that

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increasing the amount of information about alternatives

- (a) increases the variability of responses
- (b) decreases the quality of choices, and

(c) increases subjects' confidence in their judgments. Payne (1976) found no evidence that increases in the number of dimensions affected the choice of decision strategy. In a replication and extension of Payne's (1976) study, Olshavsky (1979) found that as the number of attributes increased, subjects differentially weighed the available information to simplify the choice task. The type of change observed did not involve a change in type of rule used, but rather, a change in the number of available attributes used.

When time is limited or becomes a constraint, an upper limit is placed on the resources that can be expended causing some strategies to be eliminated from consideration. A rationale for this can be found in the work of Einhorn and Hogarth (1981). As pointed out earlier, evaluative judgments are generally made to aid choice. Since judgment is deliberative, there must be sufficient time to allow for its formation. Therefore, as time pressure increases, one would expect less reliance on judgment and greater use of noncompensatory choice strategies (Wright, 1974). Billings and Marcus (1983) suggest the use of a time constraint as a method of implementing information load in a judgment situation and varying the number of alternatives in a choice situation. In experiments where the time variable is not

a constraint, it may be desirable to study time as a criterion variable. This subject will be addressed in a future section of the review.

The fact that information display can affect decision behavior is clearly established (Payne, 1982). An important implication of this effect is that format can be used as a method of decision aid during the information acquisition stage of decision behavior. This display effect was initially suggested by Tversky in 1969. He indicated that the additive rule would be more likely when alternatives were presented sequentially, and that the additive difference rule would be more likely if the alternatives were presented simultaneously. Much of the work in this area has been done in a marketing or consumer research context.

In general, there are three ways of presenting information: by alternative, by attribute or cue, or by a matrix format. In alternative presentation, information on all attributes of a specific alternative is presented together. With attribute presentation, information on each alternative for the given attribute is presented. The matrix format presents all information for all alternatives in a tabular format with each row representing an alternative, and each column representing an attribute. The matrix format is employed by researchers who monitor information search of subjects by the use of an information board. Each cell in the array, or matrix of information contains the value for the appropriate alternative and attribute.

Bettman and Kakkar (1977) used matrix, brand and attribute presentation conditions in studying the information processing behavior of subjects. They found that information is processed in the fashion which is easiest given the display used. If a brand format was used then subjects were found to almost exclusively use brand processing. That is, they would be more apt to use an additive compensatory, conjunctive or disjunctive strategies to combine information in making a decision. Similarly, if attribute format is used, subjects are most apt to use lexicographic, additive difference or elimination by aspects decision strategies to arrive at a decision.

It should be noted that if one is studying decision strategies there is the possibility of a strong bias due to format. This is true of the work of Lussier and Olshavsky (1979) who conclude that most subjects process by brand. This result should be expected in that information was presented by brand in their study.

Based on the results of Bettman and Kakkar (1977), Bettman and Zins (1979) hypothesized that performance in choice tasks will be affected by the degree of agreement or congruence between the type of processing encouraged by the presentation format and the type of processing required by the particular task. Specifically they argued that performance should be best for a lexicographic task if the format is matrix, next best with attribute format, and worst if the format is brand. Similarly, a compensatory task should

be easiest with a matrix format, next easiest with a brand format and most difficult with attribute format. Their results indicated that there was no effect of task on format choice. However, there were effects of task-format congruence on choice time. In the three studies, executed. matrix information was overwhelmingly chosen. and took less time. This result confirms the work of Bettman (1975) where he concluded that matrix formats may be more conducive to information processing than other formats.

The presentation format could also be verbal or semitextual. Huber (1980) studied the effect of numerical versus verbal presentation and found that there were more direct within-attribute comparisons with numerical information as well as less use of comparisons against a criterion.

Park (1978) suggests the possibility that the attribute measure itself can influence the choice and should be interpreted as part of the impact of the task dimension upon the choice process. Olshavsky (1979) included this variable in his experiment. He examined a choice object with two levels, simple attribute values and complex attribute values. Condominium apartments were selected as having many technically simple dichotomous attributes, and stereo receivers were selected as having many technically complex, mutlichotomous, or interval valued attributes. There was some evidence that subjects in the condition which involved a product with more complex attributes did adopt strategies which were different from

those in the simpler product condition. Subjects in the receiver condition appeared to adopt a three-stage strategy more often than those in the condominium apartment condition. This may be due to the fact that subjects in the receiver condition perceived the choice task to be so very difficult that they adopted a cognitively simple screening strategy which allowed them to reduce rapidly the possibilities.

One might also include in complexity the degree to which the problem will influence future decisions. A situation where one must anticipate the consequences of a decision on later events is more complex than one where future decisions are made independently of the current decision.

The remaining task effects outlined earlier will not directly impact this study.

#### Context effects

In addition to those factors inherent in the decision problem itself the selection of a particular strategy is also influenced by the more general situational factors, which Payne (1982) refers to as context effects. The following three studies examined the impact of the decision environment on strategy selection.

Christensen-Szylanski (1978) found that as the payoff for being correct increased, subjects used more complex strategies, spent more time in performing the task, and had greater confidence in their

profit estimates. McAllister, Mitchell, and Beach (1979) focused on the characteristics of irreversibility, significance, and accountability. They found that the decision strategy was more analytic and resulted in a greater amount of time and effort when (1) the decisions were more significant, (2) the decision could not be reversed, (3) the decision maker was held responsible for his actions. Smith, Mitchell, and Beach (1982) studied the effects of time constraints, task complexity, and task significance on the selection of a decision strategy. They found that the imposition of a time constraint led to the use of simpler strategies and/or lower confidence in the result of implementing that strategy. They also found that increased problem complexity led to the use of simpler strategies and task significance had no effect on strategy selection. The negative result was attributed to an inadequate experimental manipulation.

These findings suggest that rather complex information processing is performed when choosing a decision strategy and that similar decision problems encountered under different task or context effects can result in substantially different strategies being used in arriving at a solution. The value placed on the decision task variables, depends on the perceptions of the decision maker, and this will be the focus of the next section.

### Perception of the decision maker

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The decision maker's internal representation of the task environment is called a problem space. The structure of the problem space is determined in part by the task environment which was discussed in the previous section. Beach et al (1978) in an attempt to disentangle task characteristics and decision maker characteristics define the latter as enduring aspects of the decision maker that are not task specific. They include knowledge and ability of the decision maker as being instrumental in building a model of the decision task.

Driver and Mock (1975) use information utilization and objective focus to classify individual decision makers. By combining these two dimensions they derive four basic decision styles. They are as follows:

Decisive - uses a minimal amount of data to generate one firm opinion
Flexible - uses minimal data, but sees it as having different meaning at different times
Hierarchic-uses a mass of carefully analyzed data to arrive at one best possible conclusion
Integrative-uses a mass of data but generates a multitude of possible solutions.

These decision styles have five attributes dealing with values, planning, goals, organization and communication. A more recent development of decision style theory is the concept of mixed styles. A common mixed style is the integrative/hierarchic mix. This style reflects a more complex approach to data and is called the complex style. Savich (1977) and McGhee, Shields, and Birnberg (1978) studied the effect of this variable on information processing.

Vasarhelyi (1977) attempted to establish a link between a person's cognitive style and accounting information systems design. Benbasat and Dexter (1982) attempted to match individual's cognitive styles with decision support aids. Huber (1983), in a summary article, concludes that the literature on cognitive style is weak and inconclusive, and that to date the preponderance of evidence indicates that the practical significance of cognitive styles is relatively small. He advises that cognitive style should be abandoned as a basis from which to derive operational decision support system (DSS) guidelines. This advice is more convincing given the fact that current decision support systems are flexible and can be adapted to the user's cognitive style.

The inconclusive results of research in the area of the effect of cognitive style is perhaps due to the sensitivity of information processing and choice to seemingly minor changes in tasks and a better understanding of the contingent nature of decision behavior is needed.

### Strategy Selection and Information Processing

Decision strategies or heuristics that the decision maker uses can be categorized as follows:

aided-analytic

unaided-analytic

nonanalytic

Aided-analytic strategies require the decision maker to utilize a decision aid or tool in arriving at a decision. This aid can range in sophistication from a pad and pencil to a computer decision support system. Unaided-analytic strategies are those where decision processing is confined to the decision makers' mind, and one where no tools are used in arriving at a decision. These strategies have received much attention from psychologists, and will be the focus of this section. Nonanalytic strategies are those where little or no information is acquired or processed and can be characterized as a simple rule.

Within: the unaided-analytic category a host of strategies exist ranging from approximations to subjective expected utility maximization to noncompensatory strategies such as EBA to mental scripts. These heuristics are used by the decision maker to compare alternatives and make choices. These heuristics allow the decision maker, who has limited processing capabilities, to attempt to solve complex decision problems. The policy capturing approach
focused on how poorly the decision maker was doing because of his cognitive deficiencies rather than focusing on how well he is doing given his cognitive limitations.

The unaided-analytic strategies can be outlined as follows:

	Unaid	ed-Analytic			
Compensatory		Non-compensatory			Scripts
Additive Compensatory	Additive Difference	Conjunctive	EBA	Lexicograph	nic

Figure 3. Outline of Decision Strategies

Initially researchers attempted to characterize decision makers by a simple description of decision behavior. It is now recognized that decision makers do different things in different ways when faced with different decision problems. Specifically the strategy selected is contingent on the evaluation of the task, which in turn is influenced by the cognitive make up of the decision maker. Payne (1976) looked at the conditions that caused one to shift to the use of simpler non-compensatory strategies. These task characteristics were outlined in an earlier section of the literature review. In this section the strategies used by individuals in the process of making a decision will be examined in detail. As will become evident, the work of Tversky has made a significant contribution to this area of research.

#### Compensatory Strategies

A compensatory strategy is one where positive and negative data on several attributes can compensate for one another. The subjective expected utility strategy is one where the decision maker attempts to think about the outcomes that can result, given a set of available choices. He then chooses the alternative that seems best after considering the probabilities of each of the outcomes. This approach has been documented as being used by children (Gray, 1975) as well as adults (Tversky, 1967). Most utility maximization strategies are compensatory in nature. This characteristic makes them quite difficult to use if one is working in the absence of decision aids. An approximation to subjective expected utility is the additive compensatory strategy.

The additive compensatory (AC) strategy assumes that the decision maker selects a set of attributes relevant to all alternatives. He then selects an alternative and evaluates it on each of the relevant attributes by attaching weights to each attribute. A summation of all the weighted attributes would yield an overall evaluation of that alternative.

$$E = \sum_{i=1}^{n} w_i A_i$$

All alternatives are evaluated in a similar fashion, and then compared. The one with the highest evaluation is then chosen.

A less demanding strategy is the additive difference (AD) strategy proposed by Tversky (1969). This strategy is compensatory in nature and is similar to the AC strategy in that the decision maker first selects a set of relevant attributes on which to compare alternatives. He would then select two alternatives and compare them on each of the relevant attributes or dimensions. A difference is then determined, and the results summed to reach a decision. In the initial model developed by Tversky, the additive difference rule was formulated for a binary choice. Payne (1976) extended the rule to a choice among more than two alternatives by sequentially comparing pairs of alternatives retaining the best alternative as the new standard against which each of the remaining alternatives are compared. Unlike the additive compensatory model, which assumes that information is processed by alternative or interdimensionally, this model assumes that information is processed intradimensionally or by attribute for each pair of alternatives.

#### Non-compensatory strategies

The conjunctive model was proposed by Coombs (1964) and Dawes (1964) and is a non-compensatory celimination model. In using this strategy the decision maker determines minimum cutoffs for each attribute or dimension. If an alternative does not pass all of the cutoffs then that alternative is eliminated, without consideration of any other attribute of that alternative. Clearly the conjunctive rule may yield more than one acceptable alternative. One choice criterion that might be then applied is Simon's (1957) satisficing strategy in which the decision maker selects the first alternative that exceeds some "minimum aspiration level". Here we have sufficiency replacing maximization as the choice criterion. Another choice criterion that has been suggested is one where the process is applied recursively with changing cutoff levels. Once the criterion are set high enough only one alternative will remain, and that alternative represents the choice. Bettman (1979) says that this process does not seem relevant to what consumers, acting as decision makers, appear to do. It does appear as though decision makers do use this heuristic as a first stage (an elimination phase) in a two stage procedure which will be discussed later in this section. Processing is by alternative or is interdimensional.

The elimination-by-aspect (EBA) model, like the conjunctive model, is a non-compensatory elimination model. Unlike the conjunctive

model, processing is by aspect or is intradimensional. This theory of choice was also introduced by Tversky (1972). It assumes that the decision maker first selects an attribute probabilistically, with the probability being proportional to the weight assigned to that attribute. Alternatives not having a satisfactory value for that attribute are eliminated. This process is repeated until all but one of the alternatives is celiminated.

The lexicographic model is quite similar to the EBA model. First, the attributes are ordered in terms of importance, then alternatives are compared with respect to the most important attribute. If one alternative is superior over all others for this attribute, then that alternative is chosen. If alternatives are tied on the first attribute, then the second most important attribute is considered, and so on, until a single alternative is preferred.

## Mixed strategies

The non-compensatory strategies have the advantage: of reducing information processing by restricting attention to only part of the available information about the alternatives. It is felt that this reduction of processing is due to the cognitive limits of the decision maker, expecially when faced with a complex task. This is especially true when working without the benefits of decision aids.

However, the choice criterion is unspecified for the noncompensatory strategies. For this reason, decision makers will sometimes use a phased or mixed strategy when faced with a complex decision task.

The first phase involves the use of an elimination strategy where the decision maker makes use of a less cognitively demanding procedure such as a conjunctive or EBA strategy. This phase is used to simplify the decision process by eliminating alternatives until only a few alternatives remain as choice possibilities. This phase is then followed by a more cognitively demanding choice procedure such as the additive difference strategy, to make the final evaluations and choice.

The use of these two-step decision models is substantiated by the work of Payne (1976) and Lussier and Olshavsky (1979). In both of these studies, task complexity was manipulated and operationalized by varying the number of alternatives. In one of the few accounting studies to focus on the information processes underlying choice behavior, Biggs (1978), asked subjects to choose the company with the greatest ability to generate future earnings. None of the variables that are known to affect strategy selection were varied and the number of alternatives was fixed at five. Even in this task which was relatively simple, two of the eleven subjects used a hybrid or mixed strategy. This study did establish that users of financial data do

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indeed process information in ways that are consistent with the decision models outlined in this section. A more important question is the determination of which strategy performs best under various levels of task complexity. The goal of this study is to evaluate the performance of compensatory, non-compensatory and mixed decision strategies.

## Strategy Implementation

Within the process tracing framework, the goal is to attend to the actual cognitive processes of the decision maker. Although this appears to be a very reasonable way to proceed, it does pose some problems. The first involves how a particular choice heuristic is implemented. A related issue is whether a decision maker can be trained to use a particular choice heuristic. The second problem was introduced earlier and has to do with gathering data for a construct that is not observable, namely the decision strategy employed for processing information and arriving at a choice.

## Implementation of choice heuristics

One particular pair of methods for implementing choice heuristics is the stored rule method and the constructive method. The stored rule method involves characterizing the decision maker as having a set of strategies or rules in memory, and calling these rules forth

in their entirety when needed and directly applied. The constructive method is one where the decision maker is characterized as developing simple rules of thumb at the time of choice by using fragments or elements of rules stored in memory. The basic idea behind the distinction between stored and constructive methods is that in some cases completed rules do not exist in memory but must be built up from subparts. Another approach is to train the decision maker to store and utilize a particular strategy. Two conditions are necessary if this approach is to be implemented:

1. That a particular strategy be shown to be superior

2. That decision makers can adapt their decision behavior

The first condition is the goal of this study. The second condition is supported by Billings & Marcus (1983) where they claim that subjects showed remarkable flexibility and adaptability in their decision behavior. Subjects moved back and forth between compensatory and noncompensatory decision styles as the information load dictated. This research demonstrated that subjects can change their decision behavior as the demands change even after a certain strategy had been adopted. Similar results were found by Olshavsky & Acito (1980). Their results imply that subjects can comfortably use different decision rules in evaluating similar sets of alternatives. In order to determine whether the subject is in fact using the strategy he was instructed to, it is necessary to monitor the decision making process. This is the topic of the following section.

#### Methods for studying choice heuristics

Protocol methods, information monitoring methods, and questionnaires can be used to monitor which choice heuristic is being employed by the decision maker.

Verbal protocol analysis is a research method that has the decision maker think aloud in the process of making a choice. These protocols which are recorded on tape are then transcribed into short numbered phrases. Newell and Simon (1972) pioneered the use of structured methods for analyzing the protocols. This method involves the use of problem behavior graphs that depict the decision maker moving through the problem space using knowledge states and operators. The operators correspond to the implicit information processing assumptions of the decision models. The scoring of verbal protocols refers to the identification of operators. This procedure is usually done by more than one person in order to arrive at a measure of agreement or reliability.

These protocols can either be concurrent or retrospective. Payne (1976) and Biggs (1978) made use of concurrent protocols, and Larcker and Lessig (1983) used the retrospective process tracing technique. The concurrent approach is favored over the retrospective technique since there is less chance that the decision maker will use intermediate processes such as abstracting or applying his own psychological theory of what is going on, resulting in misleading and simplified information about the decision process. Although these protocols are rich in detail the sample size is usually small

due to the time required to analyze the protocols, there is a lack of a statistical error theory, and there are no established methods for determining cue importance.

Another method used to monitor the choice heuristic is an information board. With this approach the subject is presented with information in a matrix format with alternatives and attributes appearing as row and column headings. The researcher then monitors the sequence and amount of information searched for or examined. If the subject searches interdimensionally and examines a constant amount of information, then one can conclude the use of an additive compensatory model. If the subject searches intradimensionally and examines a constant amount of information, then one can conclude the use of an additive difference model. If a non-constant or variable amount of information is searched in an interdimensional fashion, then one can conclude the use of a conjunctive model. If a variable amount of information is searched in an intradimensional fashion, then one can conclude the use of an EBA model.

Payne (1976) made use of an information board as well as verbal protocols in an effort to study information processing strategies subjects used in reaching a decision. Although this approach overcomes some of the disadvantages of the process tracing approach it to has been criticized. It is usually viewed as being a fairly obtrusive process, so much so that it may cause the subject to bias his information seeking behavior. Secondly the focus is on information search or acquisition and not the internal processing of alternatives by decision rules.

Biggs (1978) made use of a questionnaire to determine each subject's self insight about the decision model he used to make his earning power decision. The questionnaire was used as a complement to verbal protocols in an effort to achieve convergent results. The questionnaire was composed of ten component or yes/no questions and one summary question where the subject selected the model that best characterized the way he made his decision. Convergence of the results were categorized at three levels. Of particular interest was the convergence of the summary question with verbal protocol analysis. In eightout of eleven subjects the results were the same. This suggests that a question that has a subject select from among alternative descriptions of decision processes may be a simple and effective way to identify major information processing characteristics used by subjects.

Most of the studies that involve the use of process tracing techniques have made use of multiple methods as advocated by Payne, Braunstein, and Carroll (1978), Svenson (1979) and others. This concept of multiple methods can be extended even further. Einhorn, Kleinmutz and Kleinmutz (1979) suggest that policy capturing and process tracing techniques tap the same underlying process and differ only in emphasis and level of detail. They advocate the use of multiple methods to guard against threats to validity. An example

of the use of this approach in the accounting area is given by Larcker and Lessig (1983).

## Choice

Initial work in the area of choice focused on the categorization of the decision maker by the type of decision strategy he used. Research has shown, however, that the decision strategy employed is highly contingent on the task (Beach and Mitchell, 1978; Payne, 1982). Another area of research is one that focuses on how well the decision maker performs given a particular decision making situation. One measure of performance is the accuracy of the choice. This requires the use of a design where there is a "best" alternative.

Wright (1975) conducted an experiment where the decision strategy as well as information load was manipulated in order to see which strategy was superior. Information load was operationalized by the use of choice sets that were comprised of 2, 6, or ten resistors. It is not clear from the research what determined a correct choice. It also was not indicated whether any manipulation checks were in place to determine if in fact the subject was using the prescribed strategy. Both factors were found to be significant. As the number of alternatives increased, decision accuracy decreased. The strategy effect was significant as a result of the better accuracy of the decision makers using a lexicographic strategy. There was also a significant interaction effect.

Another variable that should be studied in choice experiments is time. This is necessary because subjects may adapt to a given task by taking more time.

Bettman and Zins (1979), in an effort to study the congruence of the format effect and decision strategy, used both time and accuracy as dependent variables. Accuracy was experimenter determined as in the Wright study. The major findings using ANOVA were that accuracy varied over tasks, with no apparent effect of taskformat congruence. Choice time varied over both tasks and formats, with clear support for the congruence notion in this data.

## Implications for the Study

It is well established that strategy selection is highly contingent on task and context effects. An important task effect is task complexity which is best operationalized in a choice situation by varying the number of alternatives. The following decision heuristics have been well documented. They are the additive difference, additive compensatory, conjunctive, lexicographic, and the mixed or phased strategies. Decision makers appear to move between these strategies with ease and experiments have been performed that involved manipulation of this variable. If it is desired to have a

manipulation check, then one can use a variety of process tracing techniques. The following have been used: verbal protocols, information boards, and questionnaires. Because one is trying to study an unobservable variable the use of more than one technique has been advocated. None of the studies that involved manipulation of decision strategy reported using these techniques to verify that the assigned strategy was in fact being implemented. This is especially important when subjects are assigned a compensatory strategy under a high information load. The danger here is that they may slip into using a strategy that is less taxing, and for this reason they should be monitored. Lastly, in measuring the performance of the decision maker two performance variables should be studied. They are accuracy and time. This is necessary because a decision maker may increase the amount of time spent making a decision in an effort to maintain accuracy. This is more likely to happen in a problem where one would incur a more painful penalty for being in error. We have now come full circle in Beach and Mitchell's model in that we again must realize that decision behavior may change with a slightest change in task or context effect.

# CHAPTER III SELECTION OF AN ACCOUNTING CONTEXT

In order to study the performance of decision makers in an accounting context the following conditions need to be in place:

- 1) A decision criterion exists
- 2) The cues provide high environmental predictability
- The cues be relatively equal in predictive ability, otherwise the LEX strategy may be superior by design.

Unlike the policy capturing approach we do not have the additional constraint of low cue intercorrelations. However, this constraint cannot be dismissed altogether because if all the cues are highly correlated then a decision can be made by looking at a single cue.

With these constraints in mind, I have selected bond rating as the appropriate scenario. Other possible settings would be those that involve business failure or loan default. These latter two settings involve a binary outcome or grading standard where the subject is either in error or not in error. Since it was desirable to differentiate between major and minor errors the bond rating setting was chosen. A review of the literature on financial ratio classification and bond ratings follow.

## Review of the Financial Ratio Literature

Many models of bond rating made use of multiple regression. In some of the models several financial ratios were used as predictor variables, and a significant effort was made to eliminate the problem of multicollinearity among these ratios. This goal is best summarized in the following quote from Horrigan (1965: p. 561).

"The presence of collinearity is both a blessing and a curse for financial ratio analysis. It means that only a small number of financial ratios are needed to capture most of the information ratios can provide, but is also means that this small number must be selected very carefully".

In an effort to "carefully" select ratios, they are first classified according to different economic aspects of the firms operations and then one ratio is selected from that class. Lev (1974) classified ratios as follows:

```
PROFITABILITY RATIOS
Net Income to Total Assets
Income Available for Common Stockholders to St. Equity
Earnings-Per-Share
Price-Earnings Ratio
Other
Dividends to Net Income
Operating Income to Operating Assets
SHORT-TERM SOLVENCY (LIQUIDITY) RATIOS
Current (Working Capital) Ratio
Quick (Acid-Test) Ratio
Flows-of-Funds Ratio
LONG-TERM SOLVENCY RATIOS
Debt to Equity Ratio
Times Interest Earned
```

EFFICIENCY (TURNOVER) RATIOS Average Collection Period for Accounts Receivable Inventory Turnover Ratio

Pinches, Eubank, Mingo and Caruthers (1975) used factor analysis to empirically determine classifications that have high internal (within group ) homogeneity and high external (between group) heterogeneity. Oblique factor analysis of 28 financial ratios across 211 financial firms with different SIC classifications for the years 1966-1969 resulted in the following seven financial classifications. These factors along with the financial ratios that loaded the highest on that factor are shown below.

Return on Investment .97 total income/total capital .96 net income/net worth Capital Turnover .95 sales/net plant .89 sales/total assets Financial Leverage .99 debt/total capital .97 debt/total assets Inventory Turnover .97 inventory/sales -.97 cost of goods sold/inventory Receivable Turnover -.95 receivables/inventory -.82 receivables/sales Short-Term Liquidity .91 current assets/current liabilities .81 quick assets/current liabilities Cash Position .91 cash/total assets .91 cash/fund expenditures As mentioned earlier, a researcher can identify a set of

financial ratios that minimize multicollinearity by selecting one ratio from each class.

Cowen and Hoffer (1982) did a study that was similar to Pinches et al but looked at a set of ratios within a single homogeneous industry (oil-crude) rather than across industries. A principal components factor analysis was performed on 13 of the 14 key Dunn and Bradstreet ratios for 72 companies within a relatively homogeneous industry. The following classification resulted:

LEVERAGE -Fixed assets to tangible net worth -Current debt to tangible net worth -Total debt to tangible net worth -Funded debt to net working capital LIQUIDITY -Current assets to current debt -Inventory to net working capital -Current debt to inventory PROFITABILITY -Net profits on net sales -Net profits on tangible net worth -Net profits on net working capital TURNOVER -Net sales to tangible net worth -Net sales to net working capital -Net sales to inventory

During the period studied, it was found that certain categories of ratios do tend to move together. Superficially, there was consistency in the movement of the liquidity and turnover ratios and with the profitability\_and leverage ratios. A review of the role that financial ratios play in the bond rating process follows.

### Review of the Bond Rating Literature

Associated with a bond is an investment risk. This risk is reflected in the rating assigned to the bond. Many financial models have been designed to explain and predict these indicators. The bond ratings assigned to issues by rating agencies, such as Moody's and Standard and Poor's, are well known, respected, and extensively used indicators of bond quality. These agencies provide investors with a relatively up to date record of their opinions on the quality of most large, publicly held corporate, municipal, and governmental bond issues (Lev 1974). Bond ratings are designed primarily to rate issues in order of their default probability. The Moody ratings have the following connotations

Aaa	gilt edge or best quality
Aa	high grade
А	upper medium grade
Baa	medium grade
Ba	has speculative elements
В	lacks characteristics of a desirable investment
Caa	poor standing
Ca	highly speculative
С	lowest rated

The following studies have tried to predict or duplicate bond ratings by using financial ratios and or summary statistics. Horrigan (1966) used a multiple regression model to predict bond rating coded on a nine-point scale 9=(S&P)AAA and (Moody's) Aaa to 1=C.

The independent variables eventually selected by Horrigan were: total assets (TA) and O-1 dummy variable to represent subordination status of a bond. These two variables were the most significant in the regression equation. In addition, the following ratios were used: net worth to total debt, net operating profit to sales, working capital to sales (industry adjusted), and sales to net worth (industry adjusted). These six variables explain about 65% of the variation in the dependent variable and predicted 58% of Moody's ratings and 52% of Standard and Poor's ratings. The results of this study and all subsequent studies are summarized in tabular form at the end of this section.

West (1970) used the same dependent variable as Horrigan, but estimated the equation in logarithmic form as was done previously by Fisher. The same four independent variables that were used by Fisher were used by West. The predictive ability of West's model was about the same as Horrigan's.

Pogue and Soldofsky (1969) investigated bonds in the top four rating categories. They avoided the interval scale assumption by comparing only two of the four categories at a time, using a O-1 dummy variable scheme for the two categories considered.

Subsequent studies on bond ratings will make use of multiple discriminant analysis (MDA) to classify bonds avoiding the interval scale assumption required to do OLS.

The independent variables used were

-long term debt as a percentage of total capitalization

-after-tax net income as a percentage of net assets

-coefficient of variation of net income

-net total assets

-after-tax sum of net income and interest over interest charge

When applied to the holdout sample, eight out of ten bonds in the holdout sample were predicted correctly.

Unlike the previous studies Pinches and Mingo (1972) drew their sample from a population of newly issued bonds (1967-1968) rather than estimated ratings on outstanding bonds. Only bonds that were rated Aa to B (5 categories) were selected. Pinches and Mingo were the first to use a factor analysis/multiple discriminant analysis model for the predictions of industrial bond ratings. Using factor analysis 35 accounting variables were found to load on seven dimensions given the following names:

Size Leverage Long-term capital intensity Short-term capital intensity Return on investment Earnings stability Debt coverage Then using a ratio or statistic from each essentially independent dimension, an attempt was made to develop a predictive model using MDA. The two factors labeled capital intensity proved to be unimportant and a dummy variable subordination status was included in the final model.

The final model predicted approximately 65% of the Moody's ratings for the holdout sample. The classification of Baa bonds proved to be especially troublesome and was never correctly classified more than 16 percent of the time. This is partly due to the fact that the most important overall variable, subordination status, was not a helpful predictor for this category. A second study (1975) using both separate discriminant analysis functions for subordinated and nonsubordinated bonds and quadratic rather than linear discriminant functions increased correct predictions by 5%.

Similar to Pinches and Mingo (1973) Kaplan and Urwitz (1979) focused on newly issued bonds. A statistical procedure (N-chotomous multivariate probit analysis) which is appropriate to the ordinal nature of a bond rating was used. A simple linear model using a subordination dummy variable, total assets, the long term debt to total assets ratio, and the common stock systematic risk measure were chosen as the independent variables.

The market beta for the firm's common stock is used as a reflective indicator of systematic risk. This procedure correctly

classified 66 percent of a holdout sample of newly issued bonds and no bond was predicted more than one rating category away. Market-yield data suggest that some other so-called "misclassifications" are actually closer to the perceived riskiness of bonds than the Moody's rating would indicate. They also compared OLS results with the N-probit technique and found OLS to be robust.

A recent study by Belkaoui (1980) uses MDA and a randomly selected sample of 275 industrial corporate bonds rated B or above by Standard and Poor's during 1978. The "economic" rationale of this model is that the investment quality of a bond is determined by the interaction among three general variables: firm-, market-, and indenture-related variables.

The firm variables of interest are command over resources and coverage. Reflective indicators of resource command are 1) total size of the firm, 2) total size of the debt, 3) the long-term capital intensiveness, and 4) the short term capital intensiveness. Indicators of coverage are 5) the total liquidity of the firm and 6) the debt coverage. The stock price/common equity per share is used as a measure of investor's expectations or a market variable. A 0-1 dummy variable is included as the most relevant covenant of the indenture. The discriminant analysis model developed in this study correctly predicted 62.8% of the ratings in an experimental sample and 65.9% of the ratings in a control sample.

The following two studies focused on bond rating changes: Backer and Gosman (1978) compared the ratio levels of 18 firms downgraded by S&P from BBB to BB (BB to B if subordinated) with a control group which S&P chose to maintain at BBB. Eight of the 19 financial ratios examined for the downgraded firms exhibited statistically significant deterioration while none did for the control group. They are as follows:

-Return on Sales

-Return on Total Assets

-Return on Tangible Net Worth

-LTD/Capitalization

-Net Tangible Assets/LTD

-LTD/Net Prop Pl. + Equip.

-Cash Flow/LTD

-Cash Flow/Senior Debt

In the year of the downgrade, MDA achieved a 72-81% correct classification range. This is a vast improvement in the 16 percent correct classification rate reported for Baa (S&P's BBB) bonds in the Pinches and Mingo study.

Bhandari and Soldofsky (1983) used discriminant analysis to study the relationship between a change in an industrial bond rating and six independent variables-the most recent level and the past 5 year's trend of times-interest earned, debt-to-capitalization and return on assets. This model duplicated over 75% of rating chages for industrial bonds. Kessler and Ashton (1981) used a set of three ratios in studying the effect of different types of feedback in a setting where subjects had to predict the bond rating assigned by Moody's. The ratios used were operating income/net sales, price-earnings, and LTD/TA. The environmental predictability squared was .55.

The following table summarizes the variables used, the technique employed, and the R-squared value for the studies discussed.

## TABLE 1

# A SUMMARY OF THE BOND RATING RESEARCH

H=Horrigan(66)P&M=Pinches&Mingo(73)B&G=Backer&Gosman(78)B&S=Bhandari&Soldofsky(83)K&U=Kaplan&Urwitz(79)W=WestP&S=Pogue&Soldofsky(69)B=Belkaoui(80)K&A=Kessler&Ashton(81)

				STUD	Υ <b>*</b>				
	Η	Ħ	P&S	P&M	K&U	В	B&G	B&S	K&A
PROFITABILITY NOP/Sales NI/TA Trend NI/TA NI/NW	X		X	χ			X X X	X	X
<u>LIQUIDITY</u> Working cap./S CA/CL	X					X			
LEVERAGE Net Worth/TD LTD/TC Trend LTD/TC LTD/TA Net tang.A/LTD LTD/Pr.P1.&Eq. Interest Cov.	X	X	X	X	X	X	X X X	X X X	X
Trend Int.Cov.			л	A		K		X	
<u>EFFICIENCY</u> Sales/NW	X								
OTHER Subordination Total Assets Earnings Var. Period of Solv Total Debt	X X	X X	X X	X	X X	X X X			
Bonds Outstand Issue Size Yrs.Consec.Div Reta	•	X		X X	X				
Sh.term debt/T P/E Cash Flow/LTD Cash Flow/S.D.	С					X	X X		X
# VARIABLES	6	4	5	6	4	8	8	6	3
R <sup>2</sup> or propor- tion correctly classified	.58	.62	8/10	.65	.66	.63	.72	.75	.55
TECHNIQUE	OLS	OLS Log Form	0-1 Dep. Var.	MDA	PROBIT	MDA	MDA	MDA	OLS

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# CHAPTER IV

## D DESIGN OF THE EXPERIMENT

The purpose of this study is to evaluate the performance of various decision strategies over differing levels of task complexity. The test for these effects will involve an experimental accounting context that will have subjects choose companies that have the highest bond rating. These choices will be made by processing financial ratios.

## Summary of the Decision

In this experiment subjects are asked to choose the bond with the highest rating. Their performance in this task will be evaluated by measuring accuracy as well as time taken in making a choice. In addition to these two metric criterion variables, there will be two nonmetric treatment variables: decision strategy and task complexity. The first treatment variable, decision strategy (A) will have four levels or categories:

- 1. Additive Compensatory (AC)
- 2. Additive Difference (AD)
- 3. Elimination by Aspect (EBA)
- 4. EBA followed by AC (MIXED)

The second treatment variable, task complexity (B) will have three levels:

1. Two alternatives

2. Five alternatives

3. Nine alternatives

.

Both of these treatments are considered to be fixed effects, and the result is a 4x3 design.

It is important to note that the decision strategy selected is usually contingent on the complexity of the task as was described in the literature review. However, in order to examine the relative benefits of different strategies under different task complexities, they will be orthogonal in this experiment. This is achieved by instructing the subject to use a particular strategy regardless of the level of task complexity. Because the same subjects are observed for more than one treatment combination, the use of a repeated measures design is required. The use of different subjects under each treatment combination would have the advantage of providing statistically independent estimates of treatment effects from all cells in the experiment, and a simpler design. However, this would also have the effect of reducing the number of observations per cell, if total sample size remained the same. The economy of subjects ultimately dictated the use of a repeated measures design. Twelve subjects will be randomly assigned to each decision strategy for a

total of 48 subjects. Each subject will be observed over three levels of task complexity. Two observations, accuracy and time, will be recorded at each of these levels, for each subject. This will yield 24 data points per cell, twelve for each criterion variable.

## Methodology and Hypothesis

A two factor repeated measures ANOVA will be used to study the effect of task complexity and decision strategy on performance as measured by time and accuracy. This technique is required because each subject is observed under all levels of task complexity (B) but only under one level of decision strategy (A). Further, the subjects can be considered a third factor, which is nested under factor A but crossed with factor B. The model on which the analysis will be based has the following form.

 $\beta\pi$  is the interaction of subject and task complexity

ε is a dummy term in that experimental error is nested within the individual observation.

In order to determine if there are significant factor or interaction effects three F ratios will be calculated which will allow the testing of the following hypotheses for each performance measure:

 The type of decision strategy will have no effect on performance.

 $H_{01}:\alpha_i=0$  for i=1,2,3,4

One might expect that a compensatory or high processing strategy will take longer to execute and also may be more accurate than the noncompensatory or reduced processing strategies because more data is attended to (Wright, 1975).

 The level of task complexity will have no effect on performance.

 $H_{02}: \beta_{j} = 0$  for j=1,2,3,

One would expect to reject this hypothesis based on the literature reviewed. As tasks become more complex one would expect the length of time to reach a decision to increase as well as observing a decrease in accuracy. The decrease in accuracy may be minimal in that subjects may attempt to maintain accuracy by increasing the time used in arriving at a decision.  There is no interaction between decision strategy and task complexity.

 $H_{03}: \alpha\beta_{ij}=0$  for i=1,2,3,4 and j=1,2,3

The EBA and MIXED strategies should be easier to execute than the additive compensatory strategy when task complexity is high. It is also known that decision makers will shift to this strategy in an effort to save time or reduce cognitive strain. The key question, which is one of the objectives of the study, is whether accuracy suffers as a result.

# Selection of Firms and Formation of Choice Sets

In selecting those firms to be included in the experiment the following criteria were used:

- Only those firms that have all their bond issues in the same rating category are used. The reason for this constraint is that the alternatives in the choice set and associated financial ratios represent a company and not a specific bond issue.
- Since only a small percentage of nonsubordinated bonds receive a Moody rating below Baa, only bonds that fall in the first four rating categories will be selected.
- 3. The company has a stable bond rating over a period of three years.

4. If a sufficient number of firms resulted after applying the first three criteria, then an effort would have been made to have homogeneity as regards to firm size, industry, etc.

The number of restrictions imposed in selecting the firms was also determined by the environmental reliability or predictive ability of the firms included. That is, if task predictability was low, then a more restrictive selection criteria would have been imposed in an effort to increase homogeneity among firms. The issue of environmental reliability will be taken up in the next section.

Another selection goal was to have a sufficient number of firms in each bond rating category. The firms that were presented to the subjects were randomly drawn from the pool of selected firms.

The 1983 Moody's Industrial Manual was used to identify those firms that satisfied the first two criteria previously outlined. Once this was done the 1982, and 1984 Manuals were referenced and only those firms whose ratings had remained the same were retained. This resulted in a pool of 100 firms that were classified as follows:

### TABLE 2

## FIRMS CLASSIFIED BY BOND RATING

BOND RATING	NUMBER OF FIRMS
Aaa	10
Aa	25
A	51
Baa	14
	100

Because of the limited number of firms that satisfied the first three criteria no other restrictions were imposed.

Twenty one choice sets were formed, seven for each of the three levels of task complexity. In forming the choice sets the correct choice was either a firm that was rated Aaa or Aa. The closest alternative came from the next rating category. For example if it was desired to form a choice set comprised of two firms with the proper choice being an Aaa rated firm, then one firm was randomly selected from the pool of Aaa rated firms and the alternative was randomly selected from the pool of Aa rated firms. Because numerical modifiers of 1, 2 or 3 are appended to the Aa, A and Baa ratings it is possible to have two choice sets, each containing an Aaa and Aa rated firm to have a different distance measure between the correct choice and the alternative.

Recognizing this, the distribution of the distance measures between the correct choice and the closest alternative was the same for each level of task complexity. This avoids the biasing of a particular level of task complexity.

# Cue Selection and Assessment of Environmental Reliability

Although the goal of this study is to assess the performance of various decision strategies, it should be apparent that the subjects achievement is in part determined by the environmental predictability of the cues. For this reason the cues that will be used will have the following constraints:

- 1. High environmental reliability
- 2. No one cue overpowers the others

Because the scenario involves the decision usefulness of accounting information, the cues will all be financial ratios that result from the firm's accounting system, rather than from other sources. The reasonableness of this approach is substantiated in a quote by William Purcell, Vice-President of Dillon, Read and Co. "Based on our experience with the rating agencies there is no question that the financial condition of a company based on various statistics is very important in the determination of that company's bond or debenture rating" (Backer & Gossman, 1978, p. 81). Also, Ross (1976) suggests that bond raters rely heavily (perhaps excessively so) on accounting numbers.

Studies that attempted to predict or duplicate bond ratings using financial ratios were reviewed in the previous chapter and summarized in Table 1. Because it was decided to vary task complexity by increasing the number of firms included in the choice set, the number of ratios presented will not vary and will be fixed at five throughout the experiment.

An additional constraint in choosing the ratios is that they should each capture a different dimension that is incorporated into an overall financial analysis of a firm. Data was collected on the following ten ratios which had been included in prior studies:

Current Ratio	Pretax Return to Total Capital
Quick Ratio	Cash Flow to Total Debt
Earnings per Share	Times Interest Earned
Return on Equity	Debt to Capitalization
Return on Assets	Operating Profit Margin

Five ratios were selected from this original set of ten in a manner that assured satisfaction of the specified constraints. The five ratios presented to the subjects along with the explanation to them are presented in Figure 4. Each ratio had high predictive ability and captured a separate dimension of interest. These dimensions are as follows:

RATIO	DIMENSION
NI/TA	Profitability-Return
OI/S	Profitability-Margin
%LTD	Amount of debt
TIE	Coverage of debt
CF/TD	Cash flow generated in relation to debt
1. The percent net income to total assets is a measure of the profits generated in relation to the assets used in generating this income. This ratio measures how efficiently total assets are being utilized by a firm and is positively associated with bond ratings.

Net Income NI/TA = ----- x 100 Total Assets

2. The percent profit margin reflects the proportion of net sales that remains after deducting the cost of goods sold, depreciation and selling and general expenses. This ratio provides a measure of management's performance in the operation of the firm and is positively associated with bond ratings.

> Net Operating Income OI/S = ----- x 100 Net Sales

3. The percent long term debt to capitalization or long term leverage is a measure of the percentage of total funds provided by long term creditors. The lower the ratio, the greater the cushion against creditor's losses in the event of liquidation. Therefore this ratio is negatively associated with bond ratings.

Long Term Debt %LTD = ----- x 100 Long Term Debt + Stockholders' Equity

4. The following ratio indicates the average number of times that interest charges have been earned within a year and is interpreted as "Times Interest Earned". This ratio is a measure of the ability of a firm to meet annual interest costs and is positively associated with bond ratings.

# Net Income before Interest and Taxes TIE = ----Interest Expense

5. The cash flow to total debt ratio measures how much cash was generated this year in relation to total debt. Cash flow can be approximated by adding back to the net income depreciation and amortization, since these are the major non cash items in determining income. Bond ratings are positively associated with this ratio.

Net Income + Depreciation and Amortization CF/TD = ----- x 100 Total Debt

Figure 4. Financial Ratios and Their Interpretations

The environmental reliability (R) of the five financial ratios, for the 100 firms employed in the experiment, was .69. The correlations between the ratios and bond rating as well as the intercorrelations are given in Table 3.

#### TABLE 3

#### CORRELATION MATRIX

	RATING	NI/TA	0I/S	%LTD	TIE
NI/TA	.475				
OI/S	.511	.579			
%LTD	555	530	233		
TIE	. 444	.525	.355	481	
CF/TD	.511	.769	.594	548	.639

Examination of the first column of Table 3 confirms that each cue is significantly correlated with bond rating with no one ratio overpowering the other. Selecting the ratios in a manner that assured satisfaction of the constraints resulted in a set of ratios that were highly intercorrelated as evidenced by the correlation matrix. Although this was a byproduct of the selection process it was felt that the presence of intercue correlations is a realistic representation of many actual decision making tasks.

#### Subjects and Procedure

The forty eight individuals who participated in the experiment represent a cross section of users as well as preparers of accounting information. The participants were all volunteers that were arranged by the author after a request for participants had been directed to many firms and individuals in the greater Hartford, Connecticut-Springfield, Massachusetts area. All of the participants were professionals and 27 were Certified Public Accountants. The average number of years of experience was 9.2. The participants can be categorized as follows:

#### TABLE 4

#### SUBJECTS CLASSIFIED BY JOB DESCRIPTION

JOB DESCRIPTION	<u>NUMBER</u>
Public Accounting	20
Financial, Cost Accounting	9
Financial Analysis	7
Controller	6
Federal, State or Internal Auditor	6

Because the experiment required that the participant's choice process be monitored by the author via the use of an information board, the experiment was administered 48 separate times at the participant's convenience. The use of this technique is discussed in more detail in the following section.

Each subject was randomly assigned to one of the treatment groups for decision strategy, instructed on how to apply that strategy, and then required to make twenty one decisions, seven for each level of task complexity. The instructions included an example of the actual implementation of the assigned strategy. Each subject was informed that his/her only task was to apply the designated strategy as <u>quickly</u> and <u>accurately</u> as possible, the objective being to choose the firm that had the highest bond rating for each choice set. There were seven choice sets for each of the three levels of task complexity. A decision was required for each choice set. The general instructions as well as those that relate to a particular strategy and a sample choice set are included in Appendix A.

Because application of the assigned choice strategy involved learning, a learning carryover effect had to be controlled for in the repeated measures design. This was achieved by counterbalancing the order in which the choice sets were presented to the subjects. The actual conduct of the experiment is closely tied to the manipulation check which is discussed in the next section.

#### Manipulation Checks

One possible reason why equation (1) and its subsequent analysis of variance may be incorrect stems from the representation of the independent variable, i.e. the experimental manipulation. This suggests that one should obtain evidence (independent of the dependent variable) indicating whether the experimental manipulation was indeed effective (Bagozzi, 1977).

Since the primary goal of the study is to establish the effect of decision strategy on performance it seems imperative that one verify that the subjects are in fact using the strategy

that they were instructed to use. The manipulation check utilized was an information board. With this technique information on a number of dimensions of interest is made available for each firm. The format of the information can be conceptualized as a matrix with each row representing a firm and each column a dimension of interest captured by a financial ratio. Using this format subjects were presented with an array of information that was concealed by magnets. The information search required the subject to move the magnet in order to reveal the desired piece of information. The use of this technique allows one to monitor the information search pattern used by the subject. Although the manner in which information is searched does not necessarily reflect the manner in which it is processed it is the most feasible way to observe the decision-making process in this study. The objective of this check is to see if the information searched for is consistent with the strategy they were instructed to use. This is especially important since subjects assigned to a compensatory strategy under high information load may slip into a strategy that is less taxing.

The manner in which this check is implemented is closely tied to the instructions given the subject. The instructions for each strategy can be found in Appendix A. These instructions are very explicit as regards the method to be followed in arriving at a

decision. The search behavior of each subject was directly observed, by monitoring his information acquisition. More specifically, if one was assigned to an AC strategy then the information should be revealed by row, one alternative at a time. If one is assigned to an AD strategy then the search should again be by row but two alternatives would be considered at a time. An EBA strategy would require that the search be by column and the mixed strategy would require that the information search be first by column with a switch to a search by row.

If the instructions were not being followed during the first trial the experiment was stopped in order to clear up any misunderstandings, and then resumed. If during the course of the experiment it appeared as though the subject was slipping into using a different strategy, then he/she was reminded that he/she was no longer applying the strategy, and that an extra effort should be made to apply the assigned rules. In this case the experiment was not halted. All of the subjects were extremely cooperative and no observations were discarded because a subject did not apply their strategy.

## CHAPTER V DATA ANALYSIS AND RESULTS

## This chapter provides a look at the data used as input to the data analysis, descriptive statistics for the two criterion measures, the test of assumptions required for the analysis of variance when using repeated measures, the results of the repeated measures ANOVA and subsequent statistical tests performed.

#### Input to the Data Analysis

Forty eight subjects were randomized to one of four decision strategies, resulting in 12 subjects per strategy. Two performance measures were used in evaluating each subject: accuracy and time. Each subject was presented with twenty one choice sets, seven for each level of task complexity. The first decision for each level of task complexity allowed the subject to become familiar with the task and the score was discarded. This resulted in six observations on each of the performance measures for each level of task complexity. Accuracy was determined by dividing the number of correct choices by six and time was the average time used in making the six decisions.

Table 14 (Appendix B) reports the scores for the 48 subjects on the two performance measures under the three levels of task complexity.

Once the data were input, descriptive statistics were obtained and box plots were used to identify outliers. Table 15 (Appendix B) presents summary statistics on time and the boxplots did not reveal any outliers. Table 16 (Appendix B) presents the summary statistics for accuracy. There was no need to do boxplots in that all values for accuracy were between .33 and 1.00 as can be verified by looking at the rows labelled MAX and MIN for the three different levels of task complexity. After exploring the data, it was decided that no subject should be excluded from the analysis. The fact that all the data were usable most likely resulted from the use of volunteers and close supervision throughout the experiment.

#### Tests of Assumptions Underlying a Repeated Measures Design

Four assumptions must be met in order to perform a repeated measures ANOVA:

-Homogeneity of variance for the subjects within groups variation.

-Homogeneity of variance for the level of task complexity (B) by subjects within groups variation.

-Homogeneity of covariances.

-Compound symmetry.

The tenability of these assumptions will be investigated for both performance measures. The results of these tests will in part guide the future analysis of the data.

#### Homogeneity of Variance Assumptions

The homogeneity of variance assumption was investigated for the subjects within groups variation (SWG) and the level of task complexity by subjects within group variation (BxSWG). Because F tests are robust with respect to departures from these assumptions they were tested at the .01 level of significance. The  $F_{max}$  test was employed for both performance measures and the results are presented in Table 5.

#### TABLE 5

#### TEST FOR HOMOGENEITY OF VARIANCE

Performance Measure	F <sub>max</sub> for SWG	F <sub>max</sub> for BxSWG
Time	3.58	3.70
Accuracy	1.89	1.44
F <sub>crit</sub>	7.75	4.30
Degrees of Freedom	4.11	4.22

The homogeneity of variance assumptions are not rejected for either performance measure.

## Homogeneity of Covariances and Compound Symmetry Assumptions

In order to pool the covariance matrices they must be equal. The Box procedure was used to test for homogeneity of covariances, and the following results were obtained.

Performance of measure	Chi-Square	Р
Time	29.84	.039
Accuracy	15.29	.642

The hypothesis of homogeneous covariances is not rejected at the .01 level.

An additional assumption is that of compound symmetry. Testing the hypothesis of compound symmetry is equivalent to testing the hypothesis that the covariance matrix of the transformed variables is a diagonal matrix (Boch, 1975, p. 459). Thus the Bartlett test for sphericity can be used.

	Bartlett test	Significance
Time	.464	.494
Accuracy	2.917	.088

This assumption is not violated and a univariate analysis can be employed. If this assumption was violated, Wilks' lambda (with the corresponding approximate F) could be used to test for the within subjects factor effects.

In summary, none of the assumptions appear to be severely violated. When the criterion variable involves a measure of time, logarithmic transformations have been found to be useful. Similarly, when the criterion variable is a proportion an arcsine transform is suggested. In this experiment both transforms may be appropriate although they are not required to stabilize the variances, given that the homogeneity assumptions were not rejected. Both of these transforms will be explored further when the criterion variables are analyzed.

#### Results of the Analysis on the Variable Time

Since multiple observations were made on each subject, the observations are not independent and special procedures must be used for analysis of repeated measures data. The SPSS MANOVA commands were used to perform an analysis of the repeated measures data for the variable time. Before executing this procedure, it would be helpful to examine Table 6 which reports the means and standard deviations for each strategy for all levels of task complexity.

#### TABLE 6

#### CELL MEANS AND (STD. DEVS.) FOR THE VARIABLE TIME\*

Task Complexity

Strategy	Two Alt.	Five Alt.	Nine Alt.	A11
A-C	30.83	74.83	124.50	76.72
	(18.61)	(32.47)	(28.89)	(46.99)
A-D	19.00	58.92	106.25	61.39
	(12.68)	(20.93)	(37.08)	(43.92)
EBA	22.42	49.42	78.75	50.19
	(14.39)	(13.09)	(22.52)	(28.68)
Mixed	31.17	53.92	84.33	56.47
	(13.80)	(22.94)	(32.27)	(32.26)
A11	25.85	59.27	98.46	61.19
	(15.50)	(24.63)	(34.91)	(39.56)

#### \*Time in seconds

For the two alternative case the time taken to make a decision is similar for the A-C (30.83) and the Mixed (31.17) strategy. This is as expected in that the second stage of a mixed strategy, which is the only stage executed when there are two alternatives, is an A-C strategy. The EBA and A-D strategies required the least amount of time at this level of task complexity. For the five alternative case the two reduced processing strategies, EBA and Mixed, begin to display an efficiency of reduced time to arrive at a decision. This efficiency becomes more apparent at the third level of task complexity (9 alternatives), with the A-C strategy requiring the most time (124.5) and the EBA strategy the least time (78.75) to arrive at a decision. Profiles of the four decision making strategies are shown in Figure 5. The positive slope of each curve indicates that task complexity has an effect. Also, because the factor level curves are not parallel one would suspect that there is an interaction effect. The differences in the height of the curves show the effect of decision strategy on time taken to arrive at a decision. The statistical analysis is reported in Table 7.

The following symbols are used in the ANOVA tables:

- A = strategy effect
- B = task complexity effect (number of alternatives)

AB = interaction

SWG = subjects within group variation

BxSWG= B x subjects within group variation.

#### TABLE 7

#### ANALYSIS OF VARIANCE TABLE FOR TIME

Source of Variation	df	MS	F	SIG
Between subjects A (strategy) SWG	3 44	4613 1080	4.27	.009
Within subjects B (task complexity) AB BxSWG	2 6 88	63389 1306 316	200.20 4.13	.001 .001

All of the effects are reported as being significant. The presence of a significant interaction term in a two-way design precludes the



testing of the main effects, because the effect of one factor differs at each level of the other factor. Instead, the differential or simple effects are tested for significance.

#### Tests of Simple Effects

In this experiment tests on simple effects provide insight into how the strategies differed in performance. Single factor ANOVAS were carried out at each level of task complexity. The overall significance of each simple effect was tested by means of an F ratio. The results are shown in Table 8.

#### TABLE 8

TESTS OF SIMPLE EFFECTS FOR THE VARIABLE TIME

Leve	l of task complexity	F	Р
1 (2	alternatives)	1.98	.131
2 (5	alternatives)	2.69	.058
3 (9	alternatives)	5.65	.002

There is a significant simple effect when 9 alternatives are included in the choice set. To further identify the source of differences among means, the Tukey-B (Winer, 1971) multiple comparison test was performed for the third level of task complexity. This procedure indicated significant differences between the A-C and EBA strategies and between the A-C and Mixed strategies. The .05 level of significance was used for the multiple comparison procedure. The P value for the 5 alternative case is marginal and this may be the result of low power given that there were only 12 subjects assigned to each treatment group. Although the differences were marginally significant the pattern of differences is the same as in the nine alternative case, with the largest difference occurring between the A-C and EBA strategies. The P value for the two alternative case was not significant. The Mixed strategy is identical to the A-C strategy when there are only two alternatives. and the time data reflect this fact.

Because there may be concern about the normality of the data within groups, the Kruskal-Wallis non-parametric procedure was employed to test the simple effects of the strategy or A factor. The results of this procedure were the same as when the parametric F test was employed.

#### Log Transform of the Variable Time

Winer (1971) as well as Kirk (1982) suggest the use of a logarithmic transformation when the criterion of interest is in terms of a time scale, i.e. number of seconds to reach a decision in this experiment. The use of the range statistic indicated that a logarithmic transformation would help to stabilize the variances. In order to verify that the interaction effect witnessed with the original data is not an artifact of the scale

of measurement the repeated measures ANOVA was executed using the transformed variable log(time). The interaction term was still significant (p=.002).<sup>1</sup>

#### Results of the Analysis on the Variable Accuracy

Table 9 reports the mean accuracy score and standard deviation for each strategy under each level of task complexity.

Profiles of the four decision decision making strategies are shown in Figure 6. The negative slope of each curve indicates that as task complexity increases accuracy decreases. There does not appear to be an interaction effect since the profiles are reasonably parallel. The differences in the heights of the curves show the effect of decision strategy on accuracy. The EBA strategy has the highest overall accuracy rate. The statistical analysis is reported in Table 10.

No further analysis was executed with the transformed data because it was felt that analysis performed with the original data would be more meaningful.

## TABLE 9

CELL MEANS AND (STD. DEVS.) FOR THE VARIABLE ACCURACY

Task Complexity

Strategy	2 Alt.	5 Alt.	9 Alt.	A11
A-C	.832	.763	.513	.703
	(.100)	(.130)	(.151)	(.187)
A-D	.818	.735	.557	.703
	(.084)	(.130)	(.132)	(.159)
EBA	.859	.820	.584	.754
	(.096)	(.148)	(.134)	(.175)
Mixed	.804	.764	.556	.708
	(.094)	(.149)	(.166)	(.175)
ALL	.828	.771	.553	.717
	(.093)	(.139)	(.144)	(.174)



Figure 6. Profiles for Accuracy

## TABLE 10

## ANALYSIS OF VARIANCE TABLE FOR ACCURACY

Source of Variation	df	MS	F	SIG
Between subjects A (strategy) SWG	3 44	.02255 .01613	1.40	.256
Within subjects B (task complexity) AxB BxSWG	2 6 88	1.01483 .00479 .01681	60.36 .29	.001 .940

The only significant effect is that of task complexity. This indicates that as task complexity increases accuracy decreases even though more time is spent on the decision making process. Although there were no significant strategy effects, one might expect a strategy where the decision maker looks at more data, such as the A-C or A-D strategies, to have the highest accuracy. On the other hand one might argue that these two strategies could result in a decrease in accuracy as a result of information overload. Although not significant Figure 6 and Table 9 surprisingly reveal that the EBA strategy was higher in accuracy over all levels of task complexity.

Because the strategy and interaction of strategy and task complexity effects were not rejected, the power of the test was assessed. With the present sample size,  $\alpha = ..05$ , and assuming that the observed means were population means as well, the power of the test is .38 for the strategy effect. Even if sample size were doubled to 24 subjects per cell, the power would only be .66. This increase is prohibitive, given the available resources and would still not yield the desired power. It was not possible to determine the power for the interaction effect because the noncentrality parameter was less than one. When this parameter is equal to one the power is evaluated as being .48. If sample size were doubled, the power of the test for an interaction effect would still be less than .48.

When the variable of interest is a proportion it is often suggested that an arcsin transformation be applied. Application of a range test indicated that this transformation would not be helpful: in this case.

#### Analysis of Responses to the Questionnaire

After each subject applied his/her decision strategy in making the 21 choices, he/she was asked to answer 10 questions regarding the task just performed. This questionnaire labelled "Post Experiment Evaluation Form" is shown in Figure 7. The first 8 questions examine how the subjects perceived their strategy and their responses were measured using seven-point bi-polar scales. The results were analyzed using ANOVA and are summarized in Table 11.

#### TABLE 11

#### SUMMARY OF QUESTIONNAIRE RESULTS

			Means for	· Each Stra	ategy	
Question	A-C	A-D	EBA	Mixed	F Value	
1.	5.5	5.5	5.1	5.5	.32	
2.	5.8	5.7	5.0	5.5	1.05	
3.	5.4	6.0	6.0	5.8	.58	
4.	5.6	4.5	4.7	4.8	1.40	
5.	5.4	4.8	4.6	5.1	.89	
6.	4.8	5.4	5.3	5.2	.46	
7.	4.5	4.8	4.1	4.3	.29	
8.	5.8	5.7	6.3	6.3	1.21	

Respond to each of the following questions by checking the space that best corresponds to your feelings about the prescribed strategy. (This \_\_\_: X :\_\_\_ not this \_\_: X \_\_) How difficult was it for you to execute the prescribed strategy? Very hard : : : : : : : : Very easy to use :----: to use 2. How frequently were you confused ? confused :----: confused 3. How difficult was it to retain the presribed strategy in mind? Very hard to: : : : : : : : Very easy to keep in mind:----:keep in mind 4. How confident were you that the right choice was made? Not at all: : : : : : : : : Very confident :----: confident 5. How efficient do you feel your prescribed strategy is in general in detecting the correct choice in a set? Very : : : : : : : Very inefficient:----:-efficient 6. How realistic do you think this strategy is? Not at all: : : : : : : : Very realistic :----:realistic 7. Now that you have been exposed to this strategy are you likely to use it in the future? to use \_\_\_\_\_:----: to use 8. Do you feel that this strategy takes too long in general to execute? Takes too : : : : : : : : Does not take long :----: too long 9. Please allocate 100 points to indicate the relative importance you placed on the ratios. <u>NI/TA OI/SALES %LTD TIE CF/TD TOTAL</u> + + + + = 100 10. For which number of alternatives (# of companies in set) do you feel the assigned strategy is best suited for? 2\_\_\_\_ 5\_\_\_\_ 9\_\_\_\_ ALL\_\_\_\_ NONE\_\_\_\_

Figure 7. Post Experiment Evaluation Form

The critical F value for  $\alpha = .05$  is 2.82. None of the tests for equality of means had a significant F value. This occurrence may due in part to the repeated measures design. Each subject applied their assigned strategy under all levels of task complexity, when in fact, a particular strategy may be best applied at a particular level, hence we may be seeing an averaging effect.

The high means for question 3 are offered as further evidence that the subjects used their assigned strategies. The acquisition of information was montiored via an information board to verify that the acquisition of information was consistent with the assigned strategy. Given that the information search was consistent with the strategy, coupled with the response that the assigned strategies were easy to keep in mind, leads one to believe that the information was processed as instructed.

Also of interest is the reply to question 4 which addresses the confidence that the subject had in his/her decision. Although the F value was not significant the mean response for the AC strategy was higher than the other three strategies. This higher level of confidence may be due to the fact that all the useful data is attended to with the use of this strategy. Participants were reluctant in answering this question in that there was no feedback about accuracy throughout the experiment.

The insignificant F value for question 8, length to execute, did not agree with the finding of a strategy effect when the time to

execute choice data was analyzed. This difference between actual time and perceived time to execute, may again be explained by the fact that their perceptions were affected by having them apply the strategy to all levels of task complexity, when subsequent analysis of the time data indicated an interaction effect.

Question 9 asked the subject to allocate 100 points to the five ratios, indicating the relative importance they placed on each of them. A Friedman one way ANOVA was used to test the hypothesis of no difference in mean rank for the ratios for each treatment group and the results follow.

Strategy A-C A-D EBA Mixed  $\chi^2$  3.44 10.40\* 5.18 13.30\*\* \*Significant at the .05 level. \*\*Significant at the .01 level. The mean weights and (rank) assigned to each ratio for the four strategies are shown in Table 12.

#### TABLE 12

RELATIVE WEIGHTS ASSIGNED EACH RATIO FOR ALL STRATEGIES

STRATEGY	NI/TA	OI/S	%LTD	TIE	CF/TD	ALL
A-C	20(2.5)	15(1)	21(4)	20(2.5)	24(5)	100
A-D	15(2)	13(1)	27(5)	23(4)	22(3)	100
EBA	22(4)	18(2.5)	28(5)	14(1)	18(2.5)	100
Mixed	12(1)	14(2)	24(4)	21(3)	29(5)	100
ALL	69	60	100	78	93	400

Inspection of Table 12 indicates that the ratios NI/TA and OI/S are considered least important and %LTD and CF/TD most important. Because one might argue that the time or accuracy differences noted earlier could be accounted for by differential cue usage among the participants between strategies, Kendall's coefficient of concordance was calculated. This statistic provides a measure of the extent to which the rank orderings of the ratios tend to be similar for each strategy. Kendall's W (Winkler and Hays, 1975) was calculated as being .545 indicating a fairly high degree of concordance.

Whether or not the subjects perceived their assigned strategy as being suited to a particular level of task complexity was the purpose of question 10. The results are presented in Table 13. It is interesting to note the universal appeal of the A-D strategy. Eight of the twelve subjects assigned to this strategy felt that it could be used in choice situations that involved few or many alternatives. It was expected that the reduced processing strategies, Mixed and EBA would be identified as being best suited to the 9 alternative choice set and the AC to the 2 alternative choice set.

## TABLE 13

SUITABILITY OF STRATEGY TO LEVEL OF TASK COMPLEXITY

Level of Task Complexity	Strategy				
	A-C	A-D	EBA	Mixed	Total
1-Two Cos. in choice set	2	2	1	1	6
2-Five Cos. in choice set	2	2	3	4	11
3-Nine Cos. in choice set	4	0	5	3	12
ANY LEVEL	4	8	2	3	17
NONE OF THE LEVELS	0	0	1	1	2
	12	12	12	12	48

#### Summary of Results

Data were gathered on accuracy and time to reach a decision in 21 different choice sets under three levels of task complexity for each subject. Repeated measures ANOVA was used to analyze the two criterion variables. None of the assumptions required for this procedure were severely violated and the tests performed are robust with respect to minor violations of these assumptions. These data were tested for a strategy effect, a task complexity effect, and an interaction of strategy and task complexity effect. The level of task complexity was manipulated by increasing the number of alternatives in the choice set. Both the time and accuracy data confirmed the presence of a task complexity effect. As the task became more complex, the time required to make a decision increased and the accuracy rate decreased.

The strategy effect was manipulated by assigning the participants of the experiment to one of four decision making strategies. Two of the strategies can be characterized as being high processing strategies or strategies that require all useful information to be used in making a choice. They are the additive compensatory (A-C) and the additive difference (A-D) strategies. The remaining two strategies are characterized as being reduced processing strategies or strategies that allow one to make a choice without using all available information. They are the elimination by aspect (EBA) and the Mixed

strategies. An information board was used to trace the decision making process so that the experimenter could be assured that the assigned strategy was being used. The time data confirmed the existence of an interaction effect so simple effects rather than treatment effects were analyzed. When nine firms were included in the choice set there was a significant difference, in the time taken to reach a decision, between the AC strategy (125 sec.) and the EBA strategy (84 sec.). Given that there were only 12 subjects per cell the differences observed when five firms were included in the choice set may also be considered significant. The time required for the AC strategy was 75 seconds, as compared to the EBA strategy which required 49 seconds. The accuracy data failed to confirm an interaction or strategy effect. A surprising finding was that the EBA strategy had the highest accuracy for all levels of task complexity with the lowest time for the last two levels of task complexity. This result suggests that decision makers do not, in general, have to make a compromise between decision effort and decision quality. This topic will be discussed further in the next chapter.

The subjects were asked to indicate how they perceived the particular strategy they were assigned to, after all choices had been made. No one strategy was perceived as being superior on eight different dimensions. This result was surprising but may be due to the fact that

most replies would be condiditioned by the level of task complexity and they were required to make an unconditional statement after using their strategy under different levels of task complexity. This would result in an averaging effect.

## CHAPTER VI CONCLUSIONS

Four topics are discussed in this final chapter. In the first section the study is summarized and the findings are compared to those reported in previous studies. Next, potential implications of the results in the area of accounting are explored. The limitations of the experiment are then reviewed and the final section suggests some directions for future research.

#### Summary and Findings of the Study

The goal of this study was to evaluate the performance of various decision strategies under differing levels of task complexity. Participants in the study were instructed to use one of four decision strategies. Two of the assigned strategies can be described as being high processing strategies: the additive compensatory (AC) and the additive difference strategy. The remaining two are categorized as reduced processing strategies. They are the elimination by aspect (EBA) and the Mixed strategies. The mixed strategy involves the use of an EBA strategy until the number of firms in the choice set is reduced to three. The AC strategy is then

used. The information search pattern of each subject was monitored by the use of an information board to verify that the assigned strategy was being used.

The subjects who participated in the experiment represented a cross section of users of accounting information with an average of 9.2 years of experience. They were asked to choose the company with the highest bond rating as quickly and accurately as possible. Task complexity was operationalized by having the subjects choose from choice sets comprised of two, five or nine companies. The experimental results for time and accuracy were then analyzed using a two factor repeated measures ANOVA.

It was expected that as task complexity increased, time would increase and accuracy would decrease. This was confirmed. A more interesting issue was the comparison of the various strategies under the different levels of task complexity. The question of interest is: Do those strategies that lack a complete information search result in a decrease in decision accuracy as compared to full processing strategies? If they do then a compromise must be made between decision effort and decision quality. If not, then what strategy is preferable?

When nine firms were included in the choice set there was a significant difference in the time taken to reach a decision, between the AC strategy and the EBA strategy. A significant difference

was also observed between the AC and the Mixed strategy. A similar effect was observed when 5 alternatives were included in the choice set, however the time differences at this level of task complexity were associated with a P level of .058. It is this reduction in time and effort that is an incentive for a decision maker to shift to a reduced processing strategy when faced with many alternatives. There were no significant differences in time at the two alternative level.

Because there was no strategy effect when the variable accuracy was analyzed one cannot conclude that the reduced processing strategies were associated with lower accuracy. For example, if one looks at the accuracy figures when there were nine firms in the choice set the opposite occurs, although the differences are not significant. The EBA strategy had an accuracy rate of 58% compared to the AC strategy which had an accuracy rate of 51%. It is also interesting to note that the Mixed strategy had an accuracy rate of 56% compared to 58% for the straight EBA strategy. It appears that the simplifying heuristics are not associated with a decrease in accuracy in this decision context and suggests that they may be beneficial to decision makers when many alternatives are included in the choice set.

Comparing these results to those of Wright (1975), the effect of increasing the number of options in the choice set had similar results for the variable accuracy. Wright also observed a significant strategy effect for the variable accuracy which was not observed in the present study. The reason for this discrepancy can be explained by the fact that Wright made use of a time constraint. The fact that decision makers could use as much time as required in the present study allowed them to maintain accuracy by taking more time to reach a decision. This is supported by the existence of a strategy effect when studying the variable time. The overall accuracy for the lexicographic strategy was 77% in the Wright study as compared to an overall accuracy of 75% for the EBA strategy in this study. The LEX strategy is very similar to the EBA in that processing is by attribute. The only difference is that the focus is on selecting the alternatives that are superior rather than eliminating those that are inferior. The other strategies all had an overall accuracy rate of 70% in this study compared to an average of 64% for the Wright study.

In the Biggs (1978) study, eleven subjects were asked to identify the firm with the greatest earning power from a group of five firms. The subjects were classified by the type of decision strategy they employed. Those classified as using an AC, AD or conjunctive strategy took the longest amount of time to reach a decision. Those classified as using an EBA or HYBRID strategy used the least amount of time. All eleven decision makers chose the same firm as the one with the highest earning power. Consensus was used as the criterion for accuracy in the Biggs study, and the consensus was interpreted as no difference in accuracy. Similar results were obtained in this study

however, an environmentally determined criteria was used as a standard by which to measure accuracy.

All three studies support the notion that the reduced processing strategies are more efficient than the high processing strategies used by decision makers. The decision makers in the present study achieved this efficiency by saving time, with no compromise in decision quality. In the Wright study the efficiency was observed by the reduced processing strategies having higher accuracy rates when a time constraint was placed on the decision process.

#### Implications for Accounting

In Chapter I it was stated that a desired goal of accounting information is that it should be decision useful. An initial step in determining if the set of accounting information is decision useful.is to see if it is high in predictive ability. However, the ultimate test of whether or not information is decision useful is to see, if in fact, the data is accessed by decision makers, and then processed in a fashion that results in a more efficient decision.

The role of an accounting information system is to map the state or condition of a firm into a set of signals, whereas the role of a decision strategy is to map signals into actions or decisions. In prior studies that attempted to educate the decision maker in order to improve decisions, the education was limited to learning the

environmental relationships of the individual cues as well as the most effective way of conveying this information to the decision maker. The focus was on the mapping of the condition of a firm into a set of signals rather than on how to arrive at a decision given a set of signals. The question addressed in this study is how to educate the decision maker to process the information or map the signals into actions. The study is process oriented rather than being input-output oriented.

Subjects were educated to apply a decision strategy and the study provides initial experimental evidence that the more efficient decision makers were the ones who used a reduced processing strategy when faced with a complex decision task.

However, before one can advocate the use of these reduced processing strategies the study must be replicated under those conditions that might limit the generalizability of the results.

#### Limitations of the Experiment

The cues utilized in this experiment were selected because they tapped different financial dimensions and had high and similar predictive ability. If one were to add less valid cues to the existing set of cues and then allow the use of reduced processing strategies the efficiencies may evaporate if the decision maker chooses to process those cues with low environmental predictability
first. In this type of task it would be important that the decision maker be educated as to the environmental reliability of the cues as well as how to process them.

Another limitation is that in order to economize on the use of subjects a repeated measures design was employed. This required that a given individual use the same strategy under all levels of task complexity rather than using a different subject for each level of task complexity. Even though this design was employed so that the number of subjects/cell would be increased there were only 12 subjects/ cell. This low sample size did raise concern regarding the power of several tests.

Only four of the many decision strategies that individuals employ was tested. This also was due to the limited resources of the experiment. Only one method of varying task complexity was employed and no other task characteristics were manipulated. The strategies were executed by a cross section of users of accounting information and performance might vary depending on the type of user that employs a certain strategy.

#### Directions for Future Research

In the literature review the contingent nature of the decision making task was emphasized. With this in mind, it would not be appropriate to globally prescribe the use of a particular decision strategy without first attending to the general structural characteristics of the decision problem. This experiment focused on the evaluation of four formal decision strategies under differing levels of task complexity. Economy of subjects dictated the use of only four decision strategies. One might want to conduct the experiment with the use of different decision strategies such as the lexicographic or conjunctive strategies. A mixed strategy that employs an elimination by aspect strategy, followed by an additive difference strategy, would also be of interest. In addition, one might want to use an alternate method of manipulating the variable task complexity. Also, further research is needed to explore how sensitive these results are to changes in the other components of task effects. The following specific issues need to be addressed in future extensions to this research.

First, the cues or financial ratios presented to the subjects were chosen so that they would all have high predictive ability while tapping different dimensions that are of concern when evaluating the financial condition of a firm. Although such a scenario is representative of many realistic decision tasks, this factor may

limit generalization of the results. The experiment should be replicated with a set of cues that are differentially predictable. In addition future research is needed to determine the sensitivity of accuracy to the degree of correlation among the cues.

During the course of the experiment, many subjects indicated that outcome feedback after each choice would be desirable. Kessler (1981) studied the effect of different types of feedback in a similar type of experiment where the response mode was a judgment rather than a choice. A possible extension to this research would be to investigate the learning effects for each strategy using different methods of feedback.

Ashton and Kramer (1981) suggested that students are good surrogates for real world individuals in decision making tasks. One might see if this surrogation capacity extends to the students realizing the same accuracy rates as well as the efficiencies rendered by the reduced processing strategies.

The goal of financial reporting is to provide information that is useful in making business and economic decisions. Once this information is produced by the accounting information system the user must process the information in order to arrive at a decision. The objective of this study was to examine the performance of various processing strategies under differing levels of task complexity.

The ultimate goal is improved decision making and this area of research should be especially useful in efforts to reach this goal.

### REFERENCES

- Ashton, R., Human Information Processing in Accounting. Studies in Accounting Research #17. American Accounting Association. Sarasota, FL 1981.
- Ashton, R. and S. Kramer, Students as Surrogates in Behavioral Accounting Research, Journal of Accounting Research (Spring, 1980), 18, pp. 1-15.
- Backer, M. and M. Gosman, Financial Reporting and Business Liquidity New York, NY. National Association of Accountants, 1978.
- Bagozzi, R., Structural Equation Models in Experimental Research. Journal of Marketing Research (May 1977), XIV, pp. 209-226.
- Beach, L.R. and T.R. Mitchell, A Contingency Model for the Selection of Decision Strategies. Academy of Management Review, 1978, 3, pp. 439-449.
- Belkaoui, A., "International Bond Ratings: A New Look", Financial Management (Autumn 1980), pp. 44-51.
- Benbasat, I. and A. Dexter, Individual Differences in the Use of Decision Support Aids. Journal of Accounting Research (Spring, 1982), 20, pp. 1-11.
- Bettman, J.R., Issues in Designing Consumer Information Environments. Journal of Consumer Research (1975), 2, pp. 169-177.
- Bettman, J., An Information Processing Theory of Consumer Choice, Reading, MA. Addison-Wesley, 1979.
- Bettman, J. and P. Kakkar, Effects of Information Presentation Format on Consumer Information Acquisition Strategy. Journal of Consumer Research (1973), 3, pp. 233-240.
- Bettman, J. and M. Zins, Information Format and Choice Task Effects in Decision Making. Journal of Consumer Research (1979), 6, pp. 141-153.
- Bhandari, S. and R. Soldofsky, What's in a Change in an Industrial Bond Rating, Journal of Business Research (March 1983), pp. 91-106.
- Biggs, S.F., An Experimental Investigation of the Information Processes Underlying Four Models of Choice Behavior, Behavioral Experiments in Accounting II. Ohio State University 1978.

- Billings, R.S. and S. Marcus, Measures of Compensatory and Noncompensatory Models of Decision Behavior: Process Tracing versus Policy Capturing. Organizational Behavior and Human Performance (1983), 31, pp. 331-352.
- Bock, R.D., Multivariate Statistical Methods in Behavioral Research. New York, NY, McGraw-Hill, 1975.
- Christensen-Szalanski, J.J.J., A Mechanism for Decision Strategy Selection and Some Implications. Organizational Behavior and Human Performance. (1978), 22, pp. 307-323.
- Coombs, C., A Theory of Data. New York: Wiley, 1964.
- Cowen, S. and J. Hoffer, "Usefulness of Financial Ratios in a Single Industry", Journal of Business Research (March 1982), pp. 103-118.
- Dawes, R., Social Selection Based on Multidimensional Criteria. Journal of Abnormal and Social Psychology (1964), 68, pp. 104-109.
- Driver, M. and T. Mock, Human Information Processing, Decision Style Theory and Accounting Information Systems Accounting Review (July 1975), 50, pp. 490.
- Einhorn, H.J. and R. Hogarth, Behavioral Decision Theory: Processes of Judgment and Choice. Annual Review of Psychology (1981), 32, pp. 53-88.
- Einhorn, H.J., Kleinmutz, D. and B. Kleinmutz, Linear Regression and Process Tracing Models of Judgment. Psychological Review (1979), 86, pp. 465-485.
- Financial Accounting Standards Board. SFAC No. 1, Objectives of Financial Reporting By Business Enterprises. November 1978.
- Gray, C., Factors in Students' Decisions to Attempt Academic Tasks. Organizational Behavior and Human Performance. (1975), 13, pp. 147-164.
- Horrigan, J., "The Determination of Long-Term Credit Standing With Selected Financial Ratios", Empirical Research in Accounting Selected Studies, 1966, Supplement to Volume 4, Journal of Accounting Research, pp. 44-62.
- Horrigan, J., "Some Empriical Bases of Financial Ratio Analysis", Accounting Review (1965), pp. 558-568.

- Huber, G.P., Managerial Decision Making. Glenview, IL. Scott, Foresman, 1980.
- Huber, G., Cognitive Style as a Basis for MIS and DSS Designs: Much Ado About Nothing. Management Science (May 1983), 29, pp. 576-579.
- Joyce, E., The Implications of the Information Processing Paradigm for Decision Research in Accounting. Decision Making and Accounting: Current Research Norman, OK. (1984), pp. 214-217.
- Kaplan, R. and G. Urwitz, "Statistical Models of Bond Ratings: A Methodological Inquiry,", Journal of Business (April 1979), pp. 231-262.
- Kessler, L. and R. Ashton, "Feedback and Prediction Achievement in Financial Analysis", Journal of Accounting Research (Spring 1981), pp. 146-162.
- Kirk, R.E., Experimental Design, Monterey, CA: Brooks/Cole Publishing Company, 1982.
- Larcker D. and V. Lessig, An Examination of the Linear and Retrospective Process Tracing Approaches to Judgment Modeling. Accounting Review (January 1983), pp. 676-689.
- Lev, B., Financial Statement Analysis: A New Approach, Prentice-Hall, Englewood Cliffs, NJ, 1974.
- Libby, R., Accounting and Human Information Processing: Theory and Applications. Englewood Cliffs, NJ, Prentice-Hall, 1981.
- Libby, R., Behavioral Research in Accounting. Accounting Dissertations: Research Design and Implementation. Proceedings 1982 Big Ten Doctoral Consortium. Ohio State University .
- Lussier, D. and R. Olshavsky, Task Complexity and Contingent Processing in Brand Choice. Journal of Consumer Research (September 1979), 6, pp. 154-165.
- McAllister, D., Mitchell, T. and L. Beach, The Contingency Model for the Selection of Decision Strategies: An Empirical Test of the Effects of Significance, Accountability, and Reversibility. Organizational Behavior and Human Performance (1979), 24, pp. 228-244.

- McGhee, W., Shields, M. and J. Birnberg, The Effect of Personality on a Subject's Information Processing. Accounting Review (July 1978), 53, p. 681.
- Newell, A. and H. Simon, Human Problem Solving. Englewood Cliffs, NJ: Prentice-Hall, 1972.
- Olshavsky, R.W., Task Complexity and Contingent Processing in Decision Making: A Replication and Extension. Organizational Behavior and Human Performance (1979), 24, pp. 300-316.
- Olshavsky, R. and F. Acito, An Information Processing Probe into Conjoint Analysis. Decision Sciences (1980), 11, pp. 451-470.
- Park, C. Whan, A Seven-Point Scale and a Decision-Maker's Simplifying Choice Strategy: An Operationalized Satisficing-Plus Model. Organizational Behavior and Human Performance. (1978), 21, p. pp. 252-271.
- Payne, J. Task Complexity and Contingent Processing in Decision Making: An Information Search and Protocol Analysis. Organizational Behavior and Human Performance (December 1976), 16, pp. 366-387.
- Payne, J. Contingent Decision Behavior. Psychological Bulletin (1982), 92, pp. 382-402.
- Payne, J., Braunstein, M., and J. Carroll, Exploring Pre-Decisional Behavior: An Alternative Approach to Decision Research. Organizational Behavior and Human Performance (February 1978), 22, pp. 17-44.
- Pinches, G. and K. Mingo, A Multivariate Analysis of Industrial Bond Ratings. The Journal of Finance (March 1973), pp. 1-18.
- Pinches, G. and K. Mingo, The Role of Subordination and Industrial Bond Ratings. The Journal of Finance (March 1975), pp. 201-206.
- Pinches, G., Eubank, A., and Mingo, K. and Caruthers, The Hierarchical Classification of Financial Ratios. The Journal of Business Research (October 1975), pp. 295-310.
- Pogue, T. and R. Soldofsky, What's in a Bond Rating. Journal of Financial and Quantitative Analysis (June 1969) pp. 201-228.
- Savich, R., The Use of Accounting Information in Decision Making. Accounting Review (July 1977), 52, pp. 642.

.

Simon, H., Models of Man, New York: Wiley, 1957.

- Slovic, P. and S. Lichtenstein, Comparison of Bayesian and Regression Approaches to the Study of Information Processing in Judgment. Organizational Behavior and Human Performance, (1971), 6, pp. 649-744.
- Smith, J., Mitchell, T. and L. Beach, A Cost-Benefit Mechanism for Selecting Problem-Solving Strategies: Some Extensions and Empirical Tests. Organizational Behavior and Human Performance, (1982), 29,
- Svenson, O., Process Descriptions of Decision Making. Organizational Behavior and Human Performance (1979), 23, pp. 86-112.
- Ross, I., Higher Stakes in the Bond-Rating Game. Fortune (April 1976), pp. 132-140.
- Tversky, A., Additivity, Utility and Subjective Probability. Journal of Mathematical Psychology (1967), 4, pp. 175-202.
- Tversky, A., Intransitivity of Preferences. Psychological Review. (1969), 76, pp. 31-48.
- Tversky, A., Elimination by Aspects: A Theory of Choice. Psychological Review (1972), 79, pp. 281-299.
- Vasarhelyi, M., Man-Machine Planning Systems: A Cognitive Style Examination of Interactive Decision Making. Journal of Accounting Research (Spring 1979), pp. 138-153.
- Vasarhelyi, M., Cognitive Style Tailored Information Systems. Unpublished Manuscript, Columbia University, 1981.
- West, R., An Alternative Approach to Predicting Corporate Bond Ratings. Journal of Accounting Research (Spring 1970), pp. 118-125.
- Winer, B.J., Statistical Principles in Experimental Design. New York: McGraw-Hill, 1971.
- Winkler, R.L. and W.L. Hays, Probability, Inference and Decision. New York: Holt, Rinehart and Winston, 1975, second edition.
- Wright, P., The Harassed Decision Maker: Time Pressures, Distraction, and the Use of Evidence. Journal of Applied Psychology, (1974), 59, pp. 555-561.
- Wright, P., Consumer Choice Strategies: Simplifying vs. Optimizing, Journal of Marketing Research (February 1975), XII, pp. 60-67.

APPENDICES

### APPENDIX A

### MATERIALS PRESENTED TO THE SUBJECTS

Appendix A contains the materials that the subjects were given. The general instructions were presented to all subjects and are found on pages 108 to 110. In addition to the general instructions each subject received instructions specific to the particular decision strategy he/she was assigned to. These instructions are found on pages 111 to 122. Following the instructions is a sample choice set that was presented to each subject. The last page is the evaluative questionnaire that each subject was asked to respond to.

#### General Instructions

This experiment is specifically concerned with the decision usefulness of financial ratios in the bond rating process. You will be given five financial ratios for a set of companies and then will be asked to identify which company from the set has the highest bond rating. You will be asked to make a decision for 21 different sets of companies. These sets will consist of two, five or nine companies.

Bond ratings are essentially designed to rank bond issues in order of their default probability. This default probability is the possibility that the firm's future resources will be insufficient to meet all or part of the bond interest and principal payments. The following rating symbols are used to indicate the investment quality of a bond:

> Aaa Best Quality Aa High Quality A Upper Medium Grade Quality Baa Medium Grade Quality

Although Moody's employs nine different ratings in classifying industrial corporate bonds, only bonds that are rated Baa or above will be used in the experiment. Bonds receiving these ratings are classified as investment grade bonds.

Financial ratios are critically important in assessing the ability of a firm to meet interest and principal payments associated with a bond issue. This ability is reflected in the rating assigned to a bond issue. The financial ratios you will be provided with are as follows:

1. The percent net income to total assets is a measure of the profits generated in relation to the assets used in generating this income. This ratio measures how efficiently total assets are being utilized by a firm and is positively associated with bond ratings.

NI/TA = ----- x 100 Total Assets

2. The percent profit margin reflects the proportion of net sales that remains after deducting the cost of goods sold, depreciation and selling and general expenses. This ratio provides a measure of management's performance in the operation of the firm and is positively associated with bond ratings.

> Net Operating Income OI/S = ----- x 100 Net Sales

3. The percent long term debt to capitalization or long term leverage is a measure of the percentage of total funds provided by long term creditors. The lower the ratio, the greater the cushion against creditor's losses in the event of liquidation. Therefore this ratio is negatively associated with bond ratings.

Long Term Debt %LTD = ----- x 100 Long Term Debt + Stockholders' Equity

4. The following ratio indicates the average number of times that interest charges have been earned within a year and is interpreted as "Times Interest Earned". This ratio is a measure of the ability of a firm to meet annual interest costs and is positively associated with bond ratings.

Net Income before Interest and Taxes
TIE = ----Interest Expense

5. The cash flow to total debt ratio measures how much cash was generated this year in relation to total debt. Cash flow can be approximated by adding back to the net income depreciation and amortization, since these are the major non cash items in determining income. Bond ratings are positively associated with this ratio.

Net Income + Depreciation and Amortization CF/TD = ----- x 100 Total Debt

The preceeding financial ratios will be used in arriving at a decision for each choice set. The NI/TA, OI/S, TIE, and CF/TD are positively associated with bond rating and %LTD is negatively associated with bond rating. Each choice set is on a seperate page and you should circle the alternative that you feel has the highest rating. The decision should be arrived at as <u>quickly</u> and <u>accurately</u> as possible using the designated choice strategy. You will be instructed to use a particular decision strategy, and this strategy <u>must</u> be used even though you may feel that you could arrive at a decision in a more effective way. The instructions for the strategy that you should employ is found on the following page.

#### Instructions for Additive Compensatory Strategy

The use of an additive compensatory strategy involves your selecting a company and evaluating the financial ratios for that company. These evaluations are then weighed in a manner that reflects their importance. That is, the ratios you think are more important should be given more weight than those considered less important. The sum of these weighed evaluations yields an overall evaluation for that company. When all the companies have been evaluated in a similar fashion, the overall company evaluations are compared and the one with the highest evaluation is then chosen.

In order to implement this strategy you should perform the following steps:

- 1. Choose a company and uncover each ratio you want to look at beginning with the one you feel is most important. If you feel that a particular ratio is not relevant to the bond rating process then there is no need to reveal that ratio.
- Make an overall evaluation of the company. Keep in mind that the ratios you think are more important should affect your decision more than those considered to be less important.

3. Repeat steps 1 and 2 for all remaining companies.

4. Choose the company with the best overall evaluation.

An example follows.

EXAMPLE If ratio 2 is considered most important then that ratio is examined for company 1 and weighed accordingly.

	Ratio 1	Ratio 2	Ratio 3	Ratio 4	Ratio 5
Company 1	$\bigcirc$	14%	$\bigcirc$	$\bigcirc$	$\bigcirc$
Company 2	$\bigcirc$	$\bigcirc$	$\bigcirc$	$\bigcirc$	$\bigcirc$

If ratio 5 is considered second most important then that ratio is examined for company 1 and weighed accordingly. Assuming that you consider all the ratios relevant, ratios 3, 4 and 1 are subsequently revealed, weighed and then an overall evaluation is made for the company. Remember that the last ratio revealed is considered the least important and should be weighed accordingly. That is those ratios considered to be less important should not affect your decision as much as those considered to be more important.

		Ratio 1	Ratio 2	Ratio 3	Ratio 4	Ratio 5
Company	1	2.2	14%	2.0	5.0	2%
Company	2	$\bigcirc$	$\bigcirc$	$\bigcirc$	$\bigcirc$	$\bigcirc$

The ratios are then revealed in a similar fashion for company 2 and an overall evaluation is made. Remember that one or more ratios may be negatively associated with bond ratings.

	Ratio 1	Ratio 2	Ratio 3	Ratio 4	Ratio 5
Company 1	2.2	14%	2.0	4.2	1%
Company (2)	1.5	15%	5.0	5.0	2%

Compare the evaluations of the companies and choose the company with the highest rating. Assuming that company 2 is the choice, indicate this by circling company 2.

#### Instructions for Additive Difference Strategy

The use of this strategy involves your selecting two companies and comparing pairs of financial ratios beginning with the pair that you feel is most important in the determination of a bond rating. The differences in the ratio pairs are evaluated and then weighed in a manner that reflects their importance. The weighed differences are summed and one company is identified as being preferred to the other company. The preferred company is then compared with another company and this process continues until only one company remains. In order to implement this strategy you should perform the following steps:

- 1. Choose two companies.
- 2. Uncover each pair of ratios beginning with the pair you feel is most important. A difference is evaluated and weighed reflecting its importance to you in making your decision. If you feel that a particular ratio is not relevant to the bond rating process then there is no need to reveal that pair.
- 3. If the sum of the weighed differences favor one company in a positive manner then that company is the preferred company. Keep in mind that the differences you think are more important should affect your decision more than those considered to be less important.
- 4. Compare the preferred company with another company using the procedure outlined in steps 2 and 3. When only one company remains it represents your choice as the one with the highest bond rating.

An example follows.

#### EXAMPLE

If ratio 2 is considered most important then that ratio is examined for the two companies and weighed accordingly.

Ratio 1 Ratio 2 Ratio 3 Ratio 4 Ratio 5 Company 1 0 9% 0 0 0 Company 2 0 15% 0 0 0

A difference exists between these two ratios favoring company 2 assuming a positive relationship between the ratio and bond rating. The evaluation of this difference should be weighed in a manner that reflects the importance of this ratio. If ratios 3 and 4 are considered next in importance then the difference is evaluated for each ratio and weighed accordingly. Assuming that ratio 4 is negatively associated with bond rating then company 2

Company 1 9% 2.0 5.0 0		Ratio 1	Ratio 2	Ratio 3	Ratio 4	Ratio :
	Company 1 Company 2	$\bigcirc$	9% P 15% P	2.0 g	5.0 4.2	0

performs better than company 1 on the basis of these two ratios, and is evaluated accordingly. These differences would be assigned a lower weight than was assigned to ratio 2. Assume you want to look at ratios 1 and 5 even though you consider them less important.

	Ratio 1	Ratio 2	Ratio 3	Ratio 4	Ratio 5
Company 1	1.6 8	9% A	2.0 P	5.0 P	14% 9
Company 2	1.3 0	15%	5.0×	4.2 ×	10%

Given that both of these differences favor company 1, the weight attached to them would be lower and should not affect your decision as much as the other differences. Assuming that company 2 is your choice another company would then be selected to be compared with company 2. This process of sequentially comparing pairs of companies would continue until only one company remains. This company would be considered the one with the highest bond rating.

#### Instructions for the EBA Strategy

To use this decision strategy you should first decide which ratio is most important in identifying the bond with the highest rating. The companies are then compared on this ratio. All companies not having satisfactory values for the selected ratio are eliminated. A second ratio is then selected. This ratio is the one that is the second most important. The companies that were not eliminated are then compared on this ratio, and those not having satisfactory values are eliminated. This process continues until all but one company is eliminated.

In order to implement this strategy you should perform the following steps:

- Pick the ratio which you think is most important in determining a company's bond rating.
- Uncover the values for this ratio for all companies. All those companies that have an unsatisfactory value for this ratio are eliminated. If only one company remains then the process is complete.
- 3. Identify the next most important ratio and apply step 2 only to the set of companies that were not eliminated using the previous ratio. Repeat this procedure until one company remains.
- 4. If after using all the ratios you want to look at, more than one company remains, then the process is repeated beginning with step 1 using a more stringent definition of satisfactory value.
  An example follows.

#### EXAMPLE

If ratio 3 is considered most important then all the values for this ratio are revealed.

	Ratio 1	Ratio 2	Ratio 3	Ratio 4	Ratio 5
Company 1	$\bigcirc$	0	8%	$\bigcirc$	$\bigcirc$
Company 2	$\bigcirc$	0	×	$\bigcirc$	$\bigcirc$
Company 3	$\bigcirc$	$\bigcirc$	14%	$\bigcirc$	$\bigcirc$
Company 4	$\bigcirc$	$\bigcirc$	12%	$\bigcirc$	$\bigcirc$
Company 5	$\bigcirc$	$\bigcirc$	×	0	$\bigcirc$

If the ratios for Company 2 and 5 are considered unsatisfactory they are eliminated. Assuming that ratio 2 is the second most important ratio then only the values for companies 1,3 and 4 are uncovered.

	Ratio 1	Ratio 2	Ratio 3	Ratio 4	Ratio 5
Company 1	$\bigcirc$	M	8%	$\bigcirc$	$\bigcirc$
Company 2	0	Õ	×.	$\bigcirc$	$\bigcirc$
Company 3	$\bigcirc$	2.1	14%	0	$\bigcirc$
Company 4	$\bigcirc$	2.2	12%	0	$\bigcirc$
Company 5	$\bigcirc$	0	×1.	$\bigcirc$	0

If a value of 1.1 is considered unsatisfactory then company 1 would be eliminated. Assume that ratio 4 is next in importance and that this ratio is negatively associated with bond rating. The values are revealed for companies 3 and 4 (see following page) and company 4 is eliminated if a value of 43% is unsatisfactory. Company 3 is then the choice.

	Ratio 1	Ratio 2	Ratio 3	Ratio 4	Ratio 5
Company 1	$\bigcirc$	Ì	8%	0	$\bigcirc$
Company 2	$\bigcirc$	$\bigcirc$	X.	$\bigcirc$	$\bigcirc$
Company③	$\bigcirc$	2.1	14%	10%	$\bigcirc$
Company 4	$\bigcirc$	2.2	12%	27.	$\bigcirc$
Company 5	$\bigcirc$	$\bigcirc$	X1.	$\bigcirc$	$\bigcirc$

#### Instructions for the Mixed Strategy

To execute a mixed decision strategy you will first make use of an elimination phase followed by a compensatory phase. An elimination phase is used first to simplify the decision making process by eliminating companies until only a few remain as choice possibilities. This phase is then followed by an additive compensatory phase where an overall evaluation is made for each of the remaining companies. Once all of the remaining companies have been evaluated the company with the highest evaluation is chosen as the one having the highest bond rating. In order to implement this strategy you should perform the following steps:

#### Phase I

- If the case is one with only two companies go to Phase II.
   If there are five or nine alternatives proceed to the next step.
- Pick that ratio which you feel is most important in determining a company's bond rating.
- 3. Uncover the values for this ratio for all companies. All those companies that have an unsatisfactory value for this ratio are eliminated. If only one company remains then that company is the choice and the process is complete. If three or less companies remain then proceed to Phase II of the decision process. If more than three companies remain then choose the next most important ratio and repeat this step for those companies that have not been eliminated.

#### Phase II

- Choose a company that was not eliminated in Phase I and uncover the remaining ratios that you want to look at, in order of their importance. If you feel that a particular ratio is not relevant to the bond rating process then there is no need to reveal that ratio.
- 2. Evaluate the financial ratios for the company. These evaluations are then weighed in a manner that reflects their importance. That is, the ratios you think are more important should be given more weight than those considered less important. The sum of these weighed evaluations yields an overall evaluation for that company.
- 3. Repeat steps 1 and 2 for all remaining companies.
- Choose the company with the highest overall evaluation as the one having the highest bond rating.

#### EXAMPLE

If ratio 3 is cosidered most important then the values for this ratio for all companies are revealed.



If you think that the ratios for company 1, 2 and 5 are

unsatisfactory then eliminate those companies. Because only two companies remain proceed to phase II of the decision process. Note that if after examining ratio 3 only one company was eliminated then you should examine all the remaining companies on the second most important ratio. This process continues until 3 or fewer companies remain and then phase II is applied.

#### Phase II

Assume that it is decided to reveal all of the ratios for company 3. Remember that the last ratio revealed is considered the least important and should not affect your decision as much as those considered more important. It was determined in the previous stage



that ratio 3 was most important and that ratio is examined for company 3 and given the most weight. If ratio 2 is considered second most important then that ratio is examined for company 3 and also weighed accordingly. Ratios 1, 4 and 5 are subsequently examined and weighed and an overall evaluation is made.

The ratios are then examined and weighed in a similar fashion for company 4 and an overall evaluation is made. Remember that



one or more ratios may be negatively associated with bond rating. The evaluations for company 3 and 4 are then compared. Assuming that company 3 is the choice indicate this by circling company 3.

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### CIRCLE THE COMPANY

## THAT YOU CHOOSE AS HAVING THE HIGHEST RATING

COMPANY	NET INC/TA	OP INC/S	LTD/TA	TIE	CF/TD
	"/.	"/"	"/#		"/"
1	6.8	7.5	18.2	6.7	16.5
2	7.4	9.2	19.8	7.2	23.2
3	5.8	7.9	22.5	4.9	23.9
4	8.3	11.0	24.9	18.3	24.9
5	8.4	9.1	9.1	8.9	24.5

Respond to each of the following questions by checking the space that best corresponds to your feelings about the prescribed strategy. (This \_\_\_\_\_ X \_\_\_\_ not this \_\_\_\_\_ X \_\_\_) 1. How difficult was it for you to execute the prescribed strategy? Very hard : : : : : : : : : Yery easy to use \_\_\_\_\_:-----: \_\_\_\_:-----: \_\_\_\_:-----: to use 2. How frequently were you confused ? Very often : : : : : : : :Very rarely confused :----: confused 3. How difficult was it to retain the presribed strategy in mind? keep in mind:----:keep in mind 4. How confident were you that the right choice was made? Not at all: : : : : : : : : Very confident :----: confident 5. How efficient do you feel your prescribed strategy is in general in detecting the correct choice in a set? : : : : : : : : Very Verv inefficient:----:efficient 6. How realistic do you think this strategy is? Not at all : : : : : : : : Very realistic :----:realistic 7. Now that you have been exposed to this strategy are you likely to use it in the future? to use :----: to use 8. Do you feel that this strategy takes too long in general to execute? Takes too : : : : : : : : : Does not take long :----: too long 9. Please allocate 100 points to indicate the relative importance you placed on the ratios. <u>NI/TA DI/SALES %LTD TIE CF/TD TOTAL</u> + + + + = 100 10. For which number of alternatives (# of companies in set) do you feel the assigned strategy is best suited for? 2\_\_\_\_\_ 5\_\_\_\_ 9\_\_\_\_ ALL\_\_\_\_ NONE\_\_\_\_\_



SUMMARY STATISTICS OF SUBJECT PERFORMANCE

# TABLE 14

# PERFORMANCE MEASURES FOR THE SUBJECTS

		TWO AL	Τ.	FIVE	E ALT.	NINE AL	.Τ.
STRATEGY	SUBJECT 1 _ 2 3 4 5 6 7 8 9 10 11 12	ACCURACY .83 .67 .67 .83 .83 .83 1.00 .83 .83 .83 .83 .83 .83 .83 .83 .83	TIME 32 28 21 68 25 21 46 18 14 63 24 10	ACCURAC .67 .83 .83 .83 .50 .83 .67 .83 .83 1.00 .67	CY TIME 43 121 40 64 123 73 94 56 58 62 124 40	ACCURACY .83 .33 .50 .50 .50 .50 .50 .67 .33 .33 .50 .67	TIME 64 140 117 125 138 167 150 95 142 127 139 90
2	13 14 15 16 17 18 19 20 21 22 23 24	.67 .83 .83 .83 .83 .83 .83 .83 .83 .83 .67 .83 1.00	49 5 10 33 8 9 26 17 14 27 15 15	.67 .50 .83 .83 .83 .83 .83 .83 .67 .83 .50 .83	94 30 42 65 58 46 78 88 37 41 74 54	.67 .67 .67 .50 .67 .67 .33 .50 .50 .33 .50	169 40 86 146 66 86 104 131 105 88 105 149
3	25 26 27 28 29 30 31 32 33 34 35 36	1.00 .83 .83 .83 1.00 .83 .83 .83 .83 .83 .83 1.00 .67	53 6 9 38 31 9 23 15 14 35 12 24	1.00 .67 1.00 .67 1.00 .67 .83 .83 .67 .67 .83 1.00	66 39 33 54 54 26 50 65 45 39 60 62	.33 .50 .67 .83 .50 .67 .50 .50 .50 .67 .67 .67	83 53 87 85 46 89 93 92 86 54 54 123

		TWO ALT	•	FIVE AL	.Т.	NINE AL	Τ.
STRATEGY	SUBJECT	ACCURACY	TIME	ACCURACY	TIME	ACCURACY	TIME
	37	.83	62	1.00	93	.50	143
	38	.83	28	.67	65	.33	91
	39	.83	36	.83	56	.67	114
	40	.67	18	.67	15	.67	34
	41	.83	44	.67	81	.50	87
	42	.67	26	.83	55	.67	102
4	43	.83	45	.67	79	.50	125
	44	.67	16	1.00	57	.83	57
	45	.83	30	.67	41	.67	64
	46	.83	32	.83	37	.67	56
	47	. 83	19	.50	33	.33	60
	48	1.00	18	. 83	35	.33	79

# TABLE 15

# SUMMARY MEASURES FOR THE VARIABLE TIME

N MEAN MEDIAN STDEV MAX MIN Q3 Q1	TWO A-C 12 30.8 24.5 18.6 68.0 10.0 42.5 18.7	ALTERNATIVES A-D 12 19.0 15.0 12.7 49.0 5.0 26.8 9.2	IN C	HOICE SET EBA 12 22.4 19.0 14.4 53.0 6.0 34.0 9.8	M 1 3 2 1 6 1 4 1	IXED 2 9.0 3.8 2.0 6.0 2.0 8.3
N MEAN MEDIAN STDEV MAX MIN Q3 Q1	FIVE A-C 12 74.8 63.0 32.5 124.0 40.0 114.3 46.3	ALTERNATIVES A-D 12 58.9 56.0 20.9 94.0 30.0 77.0 41.3	IN C	HOICE SET EBA 12 49.4 52.0 13.1 66.0 26.0 61.5 39.0	M 1 5 2 9 1 7 3	IXE 2 3.9 5.5 2.9 3.0 5.0 5.5 5.5
N MEAN MEDIAN STDEV MAX MIN Q3 Q1	NINE A-C 12 124.5 132.5 28.9 167.0 64.0 141.5 100.5	ALTERNATIVES A-D 12 106.2 104.5 37.1 169.0 40.0 142.3 86.0	IN C	HOICE SET EBA 12 78.7 85.5 22.5 123.0 46.0 91.3 54.0	M 1 8 3 14 3 11 5	IXEE 2 4.3 3.0 2.3 3.0 4.0 1.0 7.8

## TABLE 16

## SUMMARY MEASURES FOR THE VARIABLE ACCURACY

N MEAN MEDIAN STDEV MAX MIN Q3 Q1	TWO ALT A-C 12 0.832 0.830 0.100 1.000 0.670 0.830 0.830	ERNATIVES II A-D 12 0.818 0.830 0.084 1.000 0.670 0.830 0.830	N CHOICE SET EBA 12 0.859 0.830 0.096 1.000 0.670 0.958 0.830	MIXED 12 0.804 0.830 0.094 1.000 0.670 0.830 0.710
N MEAN MEDIAN STDEV MAX MIN Q3 Q1	FIVE ALT A-C 12 0.763 0.830 0.130 1.000 0.500 0.830 0.670	ERNATIVES II A-D 12 0.735 0.830 0.130 0.830 0.500 0.830 0.670	N CHOICE SET EBA 12 0.820 0.830 0.148 1.000 0.670 1.000 0.670	MIXED 12 0.764 0.750 0.149 1.000 0.500 0.830 0.670
N MEAN MEDIAN STDEV MAX MIN Q3 Q1	NINE ALT A-C 12 0.513 0.500 0.151 0.830 0.330 0.627 0.373	ERNATIVES II A-D 12 0.557 0.585 0.132 0.670 0.330 0.670 0.500	N CHOICE SET EBA 12 0.584 0.585 0.134 0.830 0.330 0.670 0.500	MIXED 12 0.556 0.585 0.166 0.830 0.330 0.670 0.373