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THE EFFECTS OF TIME CONSTRAINTS
AND
CATEGORY ACCESSIBILITY ON DECISION MAKING PROCESSES

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BRIAN MATSU HULTS

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# THE EFFECTS OF TIME CONSTRAINTS

# AND

# CATEGORY ACCESSIBILITY ON DECISION MAKING PROCESSES

BY

**BRIAN MATSU HULTS**

A DISSERTATION

Submitted to
Michigan State University
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for the degree of

DOCTOR OF PHILOSOPHY

Department of Psychology

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## ABSTRACT

## THE EFFECTS OF TIME CONSTRAINTS AND CATEGORY ACCESSIBILITY ON DECISION MAKING PROCESSES

By

Brian Matsu Hults

This research investigated the effects of time constraint, category accessibility, and subject knowledge on decision making processes. A model of the decision making process was developed, and time constraint, subject knowledge, and memory structure effects on decision making processes were examined within the framework provided by that model. Subjects participated in a personal computer choice task. They were primed with schema relevant to personal computers. Then, subjects were presented with several computer choice problems using a micro computer to present the alternatives and attributes that described the alternatives. The choice problems varied in the amount of time subjects had to complete the problem. It was hypothesized that priming would lead subjects to increase the number of times they examined the primed attribute, and select a computer high on the primed attribute. This effect was posited to be moderated by subject knowledge of computers. However, under conditions of high time constraint, computer experts were expected to be as susceptible to priming effects as novice subjects.

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A major limitation of the study was the unreliability of the subject knowledge measure ($\alpha$ = .55). Thus, a second measure of subject expertise was developed (Experience Working with Personal Computers). This construct had an alpha reliability of .72.

It was found that time constraints caused subjects to switch from linear to nonlinear decision making strategies. There was no effect of subject knowledge or experience on linearity of search. Time constraints caused subjects to increase the amount of search on the primed attribute, but there was no prime X time constraint interaction on the number of times the primed attribute was accessed. There was also no interaction between subject knowledge and priming on search processes. However there was a significant subject experience X prime interaction on the number of times they accessed the primed attribute.

Time constraints, subject knowledge, and subject experience all had significant effects on access latency. Time constraints led to a significant decrease in the number of times subjects chose an alternative rated highly on the primed attribute. The effect of the time constraint X priming interaction was in the expected direction, but did not reach statistical significance. The effect of the prime X knowledge interaction on choice was significant, but in the opposite of the expected direction. There was no significant interaction between subject experience and priming on choice.

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The results of this study are discussed with respect to the Wyer and Srull (1986) information processing model. It was concluded that the nature of the priming mechanism is probably more complex than originally postulated by Wyer and Srull. More research needs to be done to clarify the nature of the priming mechanism, goal schema, and processing procedures outlined in the model. Future research should also combine input (e.g., time constraints, priming), process (e.g., latency, access, linearity), and outcome (e.g., final choice, ratings) variables within single studies. These studies should be based on *a priori* determined theoretical frameworks and integrated bodies of hypotheses.

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## ACKNOWLEDGMENTS

I would like to thank my wife, Tammy Ervin-Hults, for her love, encouragement, and patience while I completed the requirements for my Ph.D.

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# INTRODUCTION

The topic of decision making has recently received increased attention in several diverse literature areas including cognition (Kahneman and Tversky, 1974), social cognition (Bargh, 1984), consumer behavior (Bettman & Sujon, 1987; Wright, 1977), medicine (Eddy, 1982), and clinical psychology (Butcher & Scofield, 1984). The factors and processes examined in decision making research have also been extremely diverse. Some researchers have examined the biases and inaccuracies involved in the statistical reasoning processes of individuals (Kahneman & Tversky, 1974; Nisbett, Krantz, Jepson, & Kunda, 1983). Other researchers have examined the effects of time constraints on confidence in final decisions (Christian-Szalanski, 1980). Still other researchers have taken a process tracing approach, and examined the effects of information load on subsequent information processing (Payne, 1976).

Somewhat juxtaposed to this wealth of empirical research has been the marked lack of theoretical development in the field. While several theorists have reviewed the literature (Abelson & Levi, 1985; Pitz & Sachs, 1984; Payne, 1982, Einhorn & Hogarth, 1981, Slovic, Fischoff, &

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Lichenstein, 1977), a dominant theoretical perspective did not result from these reviews.

An exception to this rule is the work of Beach and Mitchell (1978). They proposed a six step model of the decision making process, and describe two steps in the process in some detail. Unfortunately, their work addresses only a portion of the decision making process. Further, their model does not adequately describe the complex information processing activities that are involved in most decision making tasks. It is too simplistic to allow for a detailed discussion of decision making processes. This model is described and critiqued in more detail in the General Theory of Information Processing chapter.

While the theoretical sophistication of this literature remains suspect, the practical importance of the research cannot be disputed. For example, there are very few people who would argue against the necessity of a thorough understanding of the factors and processes involved in how physicians make decisions on the necessity of patient open heart surgery or mammography. Clinical psychologists must decide whether clients should be institutionalized. Organizational leaders must decide on the direction in which their corporation will move over the course of several years. These decisions have enormous implications for the lives of the individuals involved. Further, there is evidence that suggests that these "experts" are subject to a vari

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variety of biases and inaccuracies in their decision making processes (Eddy, 1981). Thus, there is a pressing need to obtain a greater understanding of how these decisions are made and to develop mechanisms to assist people to make more accurate, unbiased decisions.

This dissertation integrates research and theory across several areas of decision making. A general information processing framework is presented to organize the results of previous research, and to indicate areas in which additional research is needed. The focus of this research is on identifying factors affecting decision making processes, and the impact of these processes on final choice.

There have been two basic approaches used to study decision making processes. While these approaches have generally not provided decision makers with normative rules for making appropriate decisions, they are useful for describing the processes involved in various decision making situations. One approach is the statistical modeling approach (Dawes & Corrigan, 1974). This approach is based on an input-output analysis of the decision making situation. First, the factors relevant to a particular decision are presented to subjects. Then, subjects are asked to make a decision based on an analysis of the factors. Subject decisions are then regressed on the factors presented to them. Statistical weights are assigned to describe the importance of each factor.

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The validity of the statistical model for predicting the decisions of subjects has been well documented (Dawes & Corrigan, 1974; Dawes, 1979). However, the linear model retains its predictive power even if the model does not faithfully replicate the processes used by decision makers. For example, two or more models may be algebraically equivalent, but suggest different underlying cognitive processes (Anderson, 1969; Hoffman, 1960). This problem is exacerbated by correlated predictors, and the subsequent instability of the beta-weights of the predictors.

An alternative approach to examining decision processes is the process tracing approach (Svenson, 1979). Process tracing examines the discrete steps taken in the implementation of decision strategies used by decision makers. These steps are usually recorded through the use of verbal protocols or information boards.

Studies using a verbal protocol procedure require subjects to think aloud during the decision making process. The verbal statements are recorded and search strategy is inferred from the pattern of search evidenced by the verbal statements.

There are two ways to present decision tasks using information boards. Early information board studies primarily utilized mechanical boards. These boards contain cards with pieces of information written on them placed face down in an alternative - attribute matrix. Subjects are ask

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asked to manually turn over the pieces of information they wish to examine. The experimenter manually records the subjects' pattern of search.

Recent technological advances have resulted in the development of computerized information boards. These boards allow subjects to interactively search through alternative - attribute matrices. The computer displays the relevant information, and often records the search process, latency of response, and final choice. These types of information boards reduce demands on experimenter time, are less intrusive to subjects, and are usually more accurate than mechanical information boards (Lantos, 1982).

The process tracing approach overcomes some of the problems incurred from the use of the statistical model and allows for an in-depth analysis of the search processes leading to the decision (Svenson, 1979). The utility of this approach for examining decision making processes has been demonstrated in a number of studies (see Ford, Schmitt, Schectman, Hults, & Doherty, in press, for a review).

Because of the process focus of this paper, and the advantages provided by the process tracing approach for examining decision processes, this method will be utilized in the present study. This paper examines the effect of two factors, time constraints and category accessibility, on the decision making processes and subsequent choice.

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Time and Category Accessibility in Decision Making

Time constraints and category accessibility effects on decision making have been examined from two very different research paradigms. The effects of time constraints on decision making have been primarily examined in the more traditional decision making literature. These studies typically focus on the effects of time constraints on strategy selection, search processes, type of information searched, decision confidence, and accuracy.

Category accessibility effects have primarily been examined from an information processing perspective in a social judgment paradigm. These studies typically focus on the effects of priming on the processing and storage of incoming information, likelihood of construct activation, and final choice.

Dependent variables similar to those used in the more traditional decision making research are examined in this study in order to more adequately describe the effects of time constraints and category accessibility affects on search processes. Examining the effects of time constraints and category accessibility on search processes will clarify how contextual factors (time constraints) and memory factors (category accessibility) interact to affect search processes and final choice. Further, the utilization of the information processing perspective provided by the category accessibility literature should allow for more specific predi

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predictions about the effects of these two factors on search processes and final choice than were previously possible. The practical and theoretical implications of this integration are discussed in more detail below.

Time Factors in Decision Making. From a practical perspective it is not unusual for decisions to have to be made under some sort of time constraint. In the operating room, doctors often need to make decisions very quickly. Similarly, in the rapidly changing world of business, it is not unusual for very important and very complex decisions to have to be made within remarkably short time constraints.

Yet, there has been very little research on the impact of time constraints on the decision making processes. Most of the research examining the effect of time constraints on decision making has been based on an input-output analysis (e.g., Christian-Szalanski, 1980, Zakay & Wooler, 1984). These studies typically examine the effects of time constraints on a variety of factors including confidence in decisions, strategy selection, or accuracy of choice. There have also been a very few process tracing studies examining the effects of time constraints on search processes (Ford et al., in press). The effects of time constraints on search processes have been examined from only one research paradigm and these studies used very similar sets of alternatives and attributes. Further, the interactions of time constraints with

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with other potentially relevant variables (e.g., category accessibility) have not been examined.

Memory Accessibility and Decision Making. Category accessibility research has examined the availability of mental constructs on the processing of incoming information and final choice. Category accessibility has been shown to influence how incoming information is processed and stored (Wyer, Srull, & Gordon, 1984), and final judgment (Higgins, Rholes, & Jones, 1977). While most of this research has been done in a social judgment paradigm, the basic information processing principles which are involved can be applied to any decision making context (Wyer & Srull, 1986).

From a practical perspective, under most conditions decision makers have certain schema or mental constructs primed in memory when entering a decision making context. Some schema are chronically more accessible in memory than others (Higgins, King, & Mavin, 1982). Other schema are likely to be highly accessible because they have been recently used in another context (Wyer & Srull, 1986).

The primed schema are likely to affect the processing of information within the subsequent decision making context, even if they are not directly relevant to the decision to be made (Wyer et al., 1984). The impact of that influence on the decision making process is currently not clear.

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Recent research has demonstrated that the primed schema may affect both search processes and final choice in other types of decision making contexts (i.e., consumer behavior: Bettman & Sujon, 1987). The primed schema are likely to cause subjects to differentially weight the importance of certain factors when making the decision. This research is currently in its infancy and there are a number of methodological shortcomings that must be overcome before firm conclusions may be drawn. Further, a number of important factors, such as the effect of multiple primes on search processes and the interaction of priming effects with the decision context remain unexamined.

<u>Integration and Theoretical Implications</u>. The hurried decision maker is much more the norm than the exception in modern society (Toffler, 1970). Rapid changes in increasingly complex environments place severe demands on decision makers. This situation is dramatically illustrated in the business environment. Research has shown that managers spend an average of less than four minutes on any given decision (Mintzburg, 1973). They do not have time or the expertise to utilize sophisticated management information systems for making many of their decisions. Thus, they must a) make decisions very rapidly, and b) switch from issue to issue very rapidly.

The decision making processes involved in this increasingly common situation are poorly understood. The

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effects of time constraints and the processing of previous information on subsequent decisions has not been examined. This study is an attempt to delineate the processes underlying decision making in these types of situations. Further, it is hoped that by examining this very practical issue, a valuable theoretical contribution to the literature will result.

There is currently a rich body of theory in the category accessibility literature that is potentially relevant to other judgment and decision making paradigms. However, most of the research in this area has focused on the impact of an environmental factor (e.g., a prime) on final choice. Within this paradigm, there have been few attempts to examine the effects of priming on the search process. Process implications have been inferred from the impact of the prime on final choice. Further, this literature has not examined various aspects of the problem situation, other than priming, on the decision making processes. An examination of contextual (e.g., time constraints) factors within a priming paradigm could do much to expand knowledge and theory in this area.

Conversely, while there has been a good deal of process focused research in the more traditional decision making literature, there has been a marked lack of theoretical development. The theory that has been discussed has been very simplistic in nature, and constrained to the decision maki

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making context (e.g., Beach & Mitchell, 1978; Payne, 1982). These theories attempt to describe how people may behave in various decision making situations. However, they do not adequately describe the complex information processing activities that are involved in most decision making situations. Thus, they are too simplistic to allow for a detailed examination of decision making processes. Further, the role of memory in the decision making process has generally not been addressed by these theories (Einhorn & Hogarth, 1981).

Utilizing information processing theory drawn from the category accessibility literature in a decision making paradigm clarifies the nature of the processing that occurs when making a decision. Further, information processing models help describe the role of memory structure in the decision making process. Thus, while the process tracing literature has assisted researchers to map the processes involved in decision making, the use of theory drawn from social psychology can help us to understand and predict these processes. In other words, previous research has led to the identification of several types of compensatory and noncompensatory decision making processes (e.g., additive difference, conjunctive, lexicographic, and elimination by aspects). Utilization of information processing theory from social psychology should allow researchers to predict not only which strategy will be chosen, but which pieces of

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information will be examined, the order those pieces of information are examined in, and final choice. Thus, utilization of this theoretical base should assist researchers to predict more accurately the behavior of decision makers.

For example, the literature has shown very clearly that when decision makers are presented with a large number of alternatives and a large number of dimensions describing the alternatives in a decision making context, they tend to use noncompensatory decision processes (Ford et al., 1987). However, it is not clear which pieces of information are most likely to be searched or contribute to the final decision. Knowledge about the structure and accessibility of memory is needed to increase understanding in this area. Thus, the use of theory from the category accessibility literature allows researchers to hypothesize not only which strategy decision makers are likely to use, but also which pieces of information are most likely to be searched, the order of search, and final choice.

The next two sections (Chapters 2 and 3) review the literature on time constraints on decision making and category accessibility effects on social judgments. This information provides the necessary background for the development of an information processing model of decision making drawn from the social cognitive literature in Chapter 4. The next section utilizes the model developed in Chapter

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4 to develop the hypotheses of this proposed study. This is followed by a description of the Method used in this study. Following the Method section, the Results of the study are described. Finally, the Discussion section examines the implications of the results, and describes some future research directions.

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## TIME CONSTRAINTS and DECISION MAKING

In this section, studies examining the affects of time constraints on strategy selection, search strategy (process), and the type of information examined are reviewed. Then, the effects of time constraints on decision confidence and decision accuracy are described. In the last section of this chapter, the findings of these studies are summarized.

### Strategy Selection

Most of the studies examining the effects of time constraints on strategy selection look at the type of problem solving heuristic adopted by subjects under various time constraints. For example, Smith, Mitchell, and Beach (1982) examined the complexity of various accounting methods used by subjects in an investment analysis problem under different conditions of time constraint.

Christensen-Szalanski (1978) examined a cost-benefit model of strategy selection. The basic premise of this model is subjects select a strategy that results in the greatest expected gain in utility given certain outcome contingencies and the costs or effort to the subject associated with solving a problem. Thus, decision makers do not necessarily seek to obtain the optimal, or best solution to any given prob

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problem. They will primarily seek to maximize their benefits given certain parameters associated with the problem.

Christensen-Szalanski (1978) manipulated decision value (the benefit of using a complex decision strategy) and measured the complexity of the strategy chosen to solve various accounting problems and how much time was taken to solve the problems. It was found that as the value of making a correct decision increased, subjects used more time and selected more complex strategies to solve the problems.

Christensen-Szalanski (1980) performed a further examination of the cost-benefit model of strategy selection. In the first experiment, time constraints and expected benefits were manipulated. The dependent variables were problem solving method chosen and preferred strategy (i.e., if you had more time to solve the problem, which strategy would you have chosen?). The results indicated that immediate deadlines caused subjects to use less complex strategies, less time to solve their problems, and increased the number of subjects who would have preferred to use an alternative (more complex) strategy.

In a second experiment, Christensen-Szalanski (1980) examined the relationships among aptitude, strategy selection, and time. It was found that high and low ability subjects did not differ in the complexity of strategies used to solve problems. However, high ability subjects had much more accurate problem solutions then low ability subjects.

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It was also found that high and low ability subjects used similar amounts of time to solve problems. This result is consistent with the model's predictions. Intuitively, it would seem that, for novices, the cost of thinking of a problem would be greater than that for an expert. Thus, the novices should spend less time on the task. However, strategy selection is a function of strategy accuracy, strategy cost, and expected benefit. Thus, for a given level of benefit, a problem solver appropriately invests more time when it is more costly to think and less time when it is less costly to think to obtain a given level of benefit. For example, low ability subjects are likely to invest more time (higher cost) to obtain some desired minimal level of benefit.

Smith et al. (1982) also examined the utility of the cost benefit model of strategy selection. They investigated the effects of task complexity, task significance and time constraints on strategy selection. It was found that under conditions of high time constraint, subjects used less complex problem solving strategies. There was no effect of task significance on strategy selection. As task complexity increased, strategy complexity decreased. This was a rather surprising finding. However, they posited that under time constraints, or when working on very difficult problems, subjects doubt their ability to implement difficult solutions to problems. This affects the expected benefits associated wit

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Search Process

Zakay (1985) studied nurses and decisions that they typically have to make on-the-job. He manipulated time pressure and measured final choice. Zakay (1985) structured the decision problems so that search process could be inferred from final decision. It was found that as time pressure increased, there was an increase in the use of noncompensatory decision processes.

Stein (1981) mailed questionnaires to top managers in medium to large sized organizations. The questionnaires were designed to measure the various factors that determined organizational strategy decisions. It was found that as time pressure increased (in crisis or opportunity situations) managers performed less extensive searches and performed fewer analyses on the information they had.

Johnson and Payne (1985) simulated the implementation of various search strategies, and examined their effectiveness under various problem conditions. They found that a number of different choice rules appeared to provide approximately the accuracy of a normative (linear) procedure while requiring substantially less effort. Further, the parameters (e.g., attribute variance, task complexity) of the task had a substantial impact on the amount of processing required by the strategy. This affected accuracy under various

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conditions of time constraint. For example, strategies requiring a good deal of processing (e.g., compensatory strategies) under conditions of high task complexity were less effective under conditions of high time constraint than strategies requiring less processing (e.g., noncompensatory strategies).

Johnson and Payne (1985) concluded that alternative heuristics (nonlinear strategies) could be highly accurate, but that no single heuristic would do well across all contexts. If a decision maker wanted to maintain a high level of accuracy with minimal effort, she or he would have to choose among a repertoire of strategies contingent on the decision context.

Utilizing a process tracing approach, Ben Zur and Breznitz (1981) studied the effects of time constraints and the variance in probabilities on the decisions of students in a gambling choice task. They measured how much time was spent looking at each piece of information, search process, and choice. It was found that under conditions of time constraint, subjects attended to negative information. They spent less time looking at each piece of information (acceleration of processing), and looked at less information overall (filtration of information). In the low time constraint condition, subjects spent more time examining positive information.

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In another process tracing study, Payne, Bettman, & Johnson (1987) performed a series of three studies that examined the effects of time constraints on decision making. In the first study, they performed a series of simulations with an increased set of problem solving strategies. They found that some decision strategies were much more sensitive to the effects of time constraints than others. Under severe time pressure, it is important to do a quick, if incomplete, evaluation of all the possible alternatives. This type of strategy is superior to ones that evaluate some alternatives more completely, but may not examine others. A related finding is that strategies which involve attribute based processing (i.e., nonlinear decision making processes) appear to hold up better under time pressure than alternative-base processing strategies (i.e., linear decision making strategies).

In the second study, the decision processes of undergraduates in a risky option task were examined. They manipulated time constraint and variance in the task and measured the amount of time each piece of information was examined, search process and choice.

It was found that subjects acquired fewer pieces of information (overall) in the time constraint condition. Under time constraints, subjects processed each piece of information faster than in the no time constraint conditions. Further, under time constraints, subjects spent more time exa

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examining important information (One of the dimensions in the decision problem was defined a priori by the experimenters as the most important dimension). There was also a greater incidence of noncompensatory search processes under time pressure conditions. The variance in attribute processing also increased in the time constraint condition. Finally, noncompensatory search processes were more accurate than alternative based processing under time constraint conditions.

In the third study, Payne et al. (1987) examined the effects of moderate time pressure on decision processes. It was found that moderate amounts of time pressure had little effect on processing pattern (attribute or alternative based). However, subjects spent less time examining each piece of information (acceleration). Payne et al. (1987) concluded that when subjects are faced with a time constraint in a decision making context, they first attempt to accelerate processing, then they shift processing strategy.

Type of Information Searched

Wright (1974) examined the decision processes of students choosing a car. Time constraints were manipulated, and the criterion measure was the mathematical model that best predicted subjects' final decision. Under conditions of time constraint, a mathematical model with a negative bias most accurately predicted subjects' final choice. These results were interpreted in terms of a loss avoidance model.

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Under conditions of time constraint, subjects attempt to minimize their possible loss as opposed to maximizing their potential gain.

Wright and Weitz (1977) studied the decision making processes of women choosing birth control devices under time constraints. They manipulated time constraint, choice or continued search condition, and anticipated time of usage (immediate or in 6 months). They measured the probability of subjects purchasing or searching for more information on a given product. They also examined whether acceptance, rejection or further search decisions were based on a given level of a factor.

Consistent with the findings of Wright (1975), under conditions of time constraint, subjects tended to use a loss-aversive evaluation procedure. This procedure ignored fine distinctions between undesirable outcomes. With high time constraints, and immediate usage, there was a greater sensitivity to moderate possibilities of pregnancy and other side effects. There was also a greater down scaling of less than desirable outcomes in the choice conditions. The search condition led subjects to make decisions based on an analysis of one dimension. Only in the low time constraint/immediate usage condition did subjects make decisions based on multiple factors.

The two process tracing studies examining type of information searched under conditions of time constraint pr

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produced similar findings to those of Wright and his colleagues. Ben Zur and Breznitz (1981) found that under time constraints, subjects tended to focus their search of information on the amount and probability of loss. Similarly, Payne et al. (1987) found subjects employed a loss aversive strategy under conditions of time constraint.

Confidence

Christensen-Szalanski (1980), in addition to search strategy, examined the confidence subjects had in the strategy they implemented in the decision problem. As noted previously, it was found that under conditions of time constraint subjects used less costly and less potentially accurate strategies. However, this resulted in less confidence in their final decisions. In the second experiment, the relationship between aptitude and confidence was examined. It was found that subjects with higher aptitude had greater confidence in their final decisions overall, and across all levels of task complexity.

Smith et al. (1982) also examined the effects of time constraints and task complexity on confidence in their ability to implement various strategies across different decision making contexts. They found that subjects were more confident in their ability to implement complex strategies under low time constraint conditions. Subjects believed that more complex strategies were more accurate, but tended not to

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utilize them under conditions of high time constraint because they could not be implemented properly.

Zakay (1985) found subjects were more confident in decisions they made using less complex (noncompensatory) decision strategies. There was no effect for time constraint on decision confidence. Zakay (1985) interpreted these findings in terms of conflict accompanying a decision. With complex decision strategies, subjects have an opportunity to examine all the information relevant to a particular decision. Some of this information may be conflicting, and its consideration may cause hesitancy on the part of subjects. If subjects use less complex decision strategies, they are less likely to encounter conflicting information in their evaluation of the problem and, thus are more confident in their decisions.

Decision Accuracy

A small number of studies have examined the effects of time constraints on decision effectiveness. Zakay and Wooler (1984) manipulated time pressure and decision making training. They measured the accuracy of the final decision. In the time constraint condition, performance deteriorated significantly. With no time constraint, subjects in the training condition performed better than subjects in the nontraining condition. With time pressure, subjects with no training performed better than subjects that had been trained. Zakay and Wooler concluded that time pressure added

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a specific type of constraint to a decision making problem. Thus, special training is needed that is specifically targeted at helping subjects work within time constraints.

Payne et al. (1987) noted that under conditions of time constraint, there was an initial drop-off in performance. However, performance improved with repeated exposure to time pressure to levels similar to those in the no time pressure condition. Overall, alternative based strategies were more accurate than attribute based processing strategies. However under conditions of high time constraint and high variance in probabilities, attributed based processing strategies were more accurate.

Conclusions

It is clear that time constraints have an effect on the selection of a decision strategy, across both task complexity and task significance conditions (Christensen-Szalanski, 1978, 1980). However, the relationship between time constraint and strategy choice is not a simple one. Confidence in the ability to implement strategy within time constraint or complexity condition also affects strategy choice (Smith et al., 1982). Time constraints affect decision makers' confidence in their ability to implement strategy, thereby affecting the expected benefits associated with the strategy and strategy selection.

Search strategies are differentially effective under various conditions of time constraint, task complexity, and

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attribute variability (Johnson & Payne, 1985). It may be reasonable to hypothesize that subjects are aware of the differential effectiveness of search strategies in different decision making contexts. Subjects consistently utilize noncompensatory search strategies under conditions of time constraint (Payne et al., 1987; Zakay, 1985). Subjects also accelerate processing and spend less time analyzing the information they examine under conditions of time constraint (Ben Zur & Breznitz, 1981; Stein, 1981).

Under conditions of time constraint, subjects tend to focus on negative information in a loss avoidance paradigm as opposed to a multi-attribute search equally weighing all evidence (Wright, 1974; Wright & Wietz, 1977). Finally, time constraints can have a deleterious effect on the accuracy of subjects' judgments (Zakay & Wooler, 1984), though this effect may be moderated by practice (Payne et al., 1987).

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## CATEGORY ACCESSIBILITY

Most of the early work on category accessibility was done in the area of cognitive psychology. The typical paradigm primes words that are semantically similar to the stimulus words and observes the effect on recognition latency. Studies of this type have typically found that primed words were recognized more quickly than words that were not primed (Meyer & Schvanedveldt, 1976; Collins & Quillian, 1969).

This basic paradigm was adopted by researchers in social psychology and used in work on social judgments (Higgins et al., 1977). Since the early work by Higgins et al. (1977), the effects of category accessibility on social judgments has been clearly established (Higgins & Bargh, 1987).

Higgins and his colleagues (Higgins et al., 1977) primed subjects by having them hold single trait adjectives in memory while naming the color in which a different word was presented. Trait terms varied across condition as to whether they were positive or negatively valenced and with respect to the subsequently presented information about the target's behavior.

After priming, subjects were led to believe they were about to participate in a second "unrelated" experiment. They read descriptions about a target individual. The description of the target consisted of behaviors that were ambiguous as to which of two traits differing is social desirability they indicated. For example, a description may have contained the phrase "was well aware of his ability to do many things well". This could be interpreted in terms of self-confidence or conceit. After the subjects read the behavioral description of the target, they rated the target as to his overall desirability and/or characterized him with respect to the primed trait term.

It was found that subjects' characterizations and evaluations of the target were influenced by the desirability of the trait terms that had been primed in the "unrelated" first experiment. However, this effect occurred only if the trait terms were applicable to interpreting the target's behavior. It was concluded that the primes in the first experiment activated specific mental representations or categories of trait related behavior. These activated constructs were more likely to be used in subjects' later interpretation of the ambiguous target behaviors that were equally relevant, but less accessible.

Higgins and Bargh (1987) noted that there were four important implications of this study. First, the primes in the first experiment automatically activated the constructs related to them. Second, when one has the goal of forming an impression of someone based on their behavior, those behaviors spontaneously activate categories relevant to them. Third, categorization of behavior occurs even when the behavioral data are ambiguously diagnostic with respect to the trait category if that category is accessible in memory. And finally, categorization did not occur if the activated trait constructs were not applicable to the behavioral data.

In a series of studies, Srull & Wyer (1979, 1980) extended these findings by demonstrating that clearly diagnostic behavioral descriptions, not just trait adjectives, automatically activated trait constructs relevant to them. Consistent with Higgins et al.'s (1977) findings, processing trait-relevant behaviors in one context (allegedly a study of sentence construction) resulted in a greater likelihood that the abstract trait construct relevant to those behaviors is subsequently used to interpret trait-related ambiguous behaviors.

Since this early work, there has been a great deal of research on the effects of category accessibility on social judgments. The results of the research on category accessibility in social information processing is presented topically. The topical organization will follow general information processing categories, not those typically associated with social psychological research.

First, research relating to category accessibility affects on the processing and storage of incoming information is reviewed. Then, research on the likelihood of construct activation is presented. Third, research contrasting frequency versus recency of priming is discussed. Then, research on category accessibility and time constraints is examined. Fifth, category accessibility research from other paradigms (not social psychological) is presented. In the last section of this chapter, overall conclusions regarding the effects of category accessibility on the processing, storage, and subsequent use of information are discussed.

Processing and Storage of Incoming Information.

One of the interesting findings of the Higgins et al. (1977) study was that if there was a delay in the rating of the target person, ratings become more extreme in the direction of the primed trait. It was concluded that this effect was due to a categorization effect on judgment. However, there was not a categorization effect on the reproduction of the traits. This could be due to the nature of the rating task. Subjects were told that they were participating in a reading comprehension study, and to try to reproduce the paragraph describing the target as completely and accurately as possible. Reproduction errors consistent with primes have been found in other research (Higgins & Rholes, 1978), and probably would have been found in this study if the stimulus had not been presented as a reading comprehension test.

Srull and Wyer (1979) had subjects perform a sentence construction task that activated concepts associated with either kindness or hostility. Subjects then read a description of a target that was ambiguous with respect to hostility or kindness. They found attribute ratings became more extreme in the direction of the prime with the number of prior activations in memory (primes), but were reduced with the length of the delay between the prime and the stimulus. They concluded that category accessibility is a major determinant of the way information is encoded in memory and subsequently used to make judgments.

Srull and Wyer (1980) extended their previous findings by manipulating the frequency of priming and the delay between the prime and the onset of the stimulus or judgment task. If the delay occurred between the presentation of the stimulus material and the judgments, ratings became more extreme with an increased number of primes and the length of the delay. If the delay occurred between the prime and the stimulus, ratings increased with the number of primes, but decreased with the length of the delay.

It should be noted that Srull and Wyer (1980) tested the hypothesis that simply increasing the number of times the subject is exposed to the trait related words affects the extremity of ratings. The sentence construction task was presented to a group of subjects after the presentation of the stimulus, and before making their judgments. There was no effect for presenting the primes after the stimulus materials.

Wyer et al., (1984) had subjects receive adjectives describing a particular type of person, and then rate the likelihood that the person would manifest behaviors that exemplified both the primed and a related second trait. Subsequent judgments of the person with respect to the second trait were biased toward the descriptive implications of the behaviors they predicted and toward the evaluative implications of the original stimulus adjectives. These findings were interpreted as suggesting a cognitive representation of the target person is formed in the course of making initial judgments and predictions. Features of this representation, rather than the information that led to its construction are used as the bases for subsequent judgments.

Likelihood of Automatic Activation.

The likelihood of automatic activation is an important issue in category accessibility. It may be that there are situations in which schema cannot be activated. Further,in certain situations or with certain individuals, it may be more likely that certain schema are more likely to be activated than others. Most of the work in this area has examined individual differences in category accessibility.

Higgins et al. (1982) performed two studies examining individual differences in category accessibility. In the first study, accessibility was defined as the number of times a trait appeared when a subject was asked to describe a variety of individuals. Two weeks after writing their individual descriptions, subjects returned and read a description of a student that included five accessible and five nonaccessible traits. Subjects then performed a nonverbal counting task for 10 minutes. After the delay, subjects were asked to reproduce the essay and provide impression ratings of the target. The dependent variables in this study were the number of times accessible and nonaccessible traits appeared in the reproductions and a measure of the subjects impressions of the target.

It was found that subjects deleted significantly more inaccessible trait related information than accessible trait related information. Subjects were asked to return after a second two week delay and again reproduce the descriptions. The results were consistent with the first reproduction. Subjects deleted more inaccessible material than accessible material. Further, subjects ratings of the target on the trait scales became more extreme over time.

In a second study, Higgins et al. (1982) used a similar method, but this time measured accessibility in terms of primacy of descriptions. Traits that appeared first in the subjects descriptions of other people were determined to be accessible. Subjects were also tested for cognitive differentiation based on Zajonc's (1960) card sorting technique. For reproductions and ratings, the findings were identical to those in the first study. However, if subjects were low in cognitive differentiation, they evidenced a positivity bias in their impressions of the target.

Bargh and Pratto (1986) used a similar method to study the effects of individual differences in category accessibility on latency of response. Chronicity was defined in terms of the primacy with which traits describing significant others were presented (see Higgins et al., 1982, experiment 2). They presented subjects with accessible and inaccessible trait words in different colors, and asked subjects to name the colors as quickly as possible. The dependent variables were latency of recognition (color) and word recall at the end of the task (a surprise recall task). It was found that when accessible trait words were presented to subjects, latency of color recognition was longer. Further, subjects recalled more accessible than inaccessible words. They interpreted these results as being consistent with a model in which stimulus properties relevant to one's accessible categories receive preferential treatment in the initial automatic analysis of the environment.

Fazio, Sanbonmatsu, Powell, and Kardes (1986) examined the effects of priming on the latency of judging whether an adjective had a positive or negative connotation. They manipulated the strength of the association between the prime and the stimulus object (e.g., strong congruent prime, weak congruent prime, strong incongruent prime, weak incongruent prime). The dependent variable was latency of response. It was found that evaluatively congruent primes shortened latency of response. Further, evaluatively incongruent primes inhibited judgment. The results were interpreted as inferring that the strength of the object evaluation association determines the likelihood of automatic activation.

Bargh, Bond, Lombardi, and Tota (1986) examined the effects of chronic and temporary sources of construct accessibility on likelihood of activation. The independent variables in this study were the accessibility of constructs in memory and primes (presented/not presented to subjects). Subjects with or without a long-term, chronically accessible construct for either kindness or shyness were exposed subliminally to either 0 or 80 trait-related words. Then, they read a behavioral description that was ambiguously relevant to the primed trait descriptions. For both the kind and shy trait conditions, both chronic accessibility and subliminal priming reliably and independently increased the extremity of the impression ratings. They interpreted their results as supporting a model in which long- and short-term sources of accessibility combine additively to increase the likelihood of the construct's use.

Frequency Versus Recency of Prime.

Srull and Wyer (1979, 1980) manipulated the number of times a concept had been primed and the delay between the presentation of the stimulus or the judgment task. They found that if there was a delay between the primes and the stimulus, the ratings increased with the number of primes, but decreased with the length of the delay. If the delay occurred between the presentation of the stimulus and the judgment task, ratings increased both with the number of primes and the length of the delay.

Higgins, Bargh, and Lombardi (1985) attempted to more clearly delineate the relationship between frequency and recency of primes. They addressed the question of when frequency of prime predominates over recency of prime, and vice versa. They manipulated the type of stimulus (social desirability), the number of primes, and the delay between the presentation of the prime and the stimulus. They measured one word descriptions of the ambiguous person described in the stimulus materials. They found that with short delays recency of primes predominated the trait ratings. With a long delay, the most often primed trait dominated ratings.

Time Constraints and Information Overload.

Bargh and Thein (1985) examined the relationships between individual construct accessibility and time constraint. They measured free recall of the stimulus person's behavior, subjects ratings of the target's behavior, the amount of time subjects examined each piece of information, and they obtained subjects' responses to a cued recall test of the target's behavior. Subjects read a list of behaviors of a target on a computer screen. The behaviors either described a person who behaved honestly most of the time, and dishonestly some of the time, or a person who behaved dishonestly most of the time, and honestly some of the time.

They found that with adequate time, there was a greater processing of infrequent information. In this condition, infrequent behaviors were recalled more accurately than frequent behaviors. Under conditions of severe time constraint, subjects with a chronically accessible category for honesty were able to recall more infrequent behaviors than subjects that did not have a chronically accessible category for honesty. Both groups recalled a similar number of frequent behaviors. It was posited that subjects that had the chronically accessible categories formed an on line impression of the target and had more processing capacity available to process the minority information.

Category Accessibility in Other Research Paradigms

Performance Appraisal. DeNisi & Summers (1986) examined the effects of presenting subjects with a performance appraisal rating form prior to and after observing ratee behavior. They also manipulated the type of rating scale (trait or behavioral) given to subjects. They measured how information was stored in memory, the accuracy of behavior recall, rating accuracy, and the performance ratings themselves. Priming had a significant effect on the organization of information in memory. Information was most organized if the scales were presented prior to observing ratee behavior. Further, priming had a significant effect on rating accuracy and behavior recall. The authors concluded that the results provided strong evidence that rating instruments should be given to raters before they observe ratee behavior.

Murphy and Constans (1987) also examined the effects of scale presentation order on performance ratings. They had subjects view video tapes of targets performing various tasks, and then provided performance ratings of the targets. Murphy and Constans (1987) also manipulated the relationship of scale anchors (high and low) to specific behavioral incidents exhibited by ratees. They found that order of scale presentation did not affect performance ratings. However, if targets exhibited specific behaviors described in an anchor on the BARS form, performance ratings were biased in the direction of that anchor (high or low), regardless of actual target behavior. There was no interaction between order of presentation and scale content.

Murphy and Constans (1987) interpreted these results as indicating rating scale presentation affects the recall of information but not the encoding of information. While these results are somewhat contradictory to those of DeNisi and Summers (1986), they also indicate the importance of cues (priming) on the organization and recall of information in memory. More research needs to be done to determine the relationships among scale presentation and content on behavioral observation and recall.

Problem Solving. Higgins and Chaires (1980) examined the effects of priming on problem solving behavior. They presented subjects with a version of Dunker's (1945) candle problem in which subjects are given a candle and a box of tacks and told to hang the candle on the wall. The key to solving the problem is using the box for the tacks as a holder for the candle. Research on this problem has found that labeling the box facilitated problem solving only when it clearly differentiated the box from the tacks (e.g., for the label "box and tacks" but not for the label "box of tacks". The facilitating effects of labeling have previously been explained as being due either to the label calling attention to the key object (Glukcksberg & Weisberg, 1966) or to the label directing subjects to the solution desired by the experimenter (Weisberg & Suls, 1973). Higgins and Chaires noted that these effects were contingent on the box being labelled by the experimenter. They then reasoned that if the facilitating effects were due to the label activating a differentiated categorization of the box, it should be possible to obtain the same results by activating a general mode of categorization through verbal exposure in an extraneous task.

Higgins and Chaires told subjects that they were participating in an experiment on long term memory. Subjects were informed that they would be shown a series of objects, with and without descriptions, and tested on their recall of the objects after a problem solving task. Pictures of a variety of household objects were presented to subjects, one of which was a box of tacks. In one condition, the picture was labelled "box of tacks", in the second condition, "box and tacks", while in the third condition subjects did not receive any description. The results indicated a much higher percentage (80%) of the subjects solved the problem in the "and" condition than in the "of" and no verbal description conditions. Post experiment interviews demonstrated that subjects had no awareness of the prime or its effect on their problem solving performance. These results were interpreted as demonstrating the importance of unconscious priming effects on information processing in a problem solving context.

<u>Decision Making</u>. Bettman and Sujon (1987) investigated the effects of priming on decision making. The independent variables were the presence or absence of primes and subject experience in the task. They measured search processes and choice. It was found that priming had no effect on the

search processes or final decisions of experts. However, novices were strongly influenced by the primes. They rated the primed attribute as more important than the other attributes. They also evaluated the alternative characterized by the primed attribute more positively, and examined that alternative more often. Novice subjects also chose the alternative characterized by a high rating on the primed attribute more often. The results were interpreted as indicating that experts had well developed schema for choosing between the alternatives, and were relatively unaffected by the priming of any given schema in memory. However, novices, who do not have well developed schema for making a choice, were highly sensitive to category accessibility effects.

Conclusions.

Category accessibility effects are a strong and pervasive phenomena (Higgins & Bargh, 1987). It is also clear that category accessibility has an impact on the storage and subsequent use of incoming information (Wyer et al., 1984). While category accessibility affects have been shown to affect a wide variety of subject populations, there are individual differences in category accessibility (Higgins et al., 1982). Recency effects dominate over frequency effects with short delays between the prime and the stimulus, while frequency effects dominate with longer delays (Higgins et al., 1985). Further, under conditions of time constraint, category accessibility facilitates the processing of incoming information (Bargh & Thein, 1985).

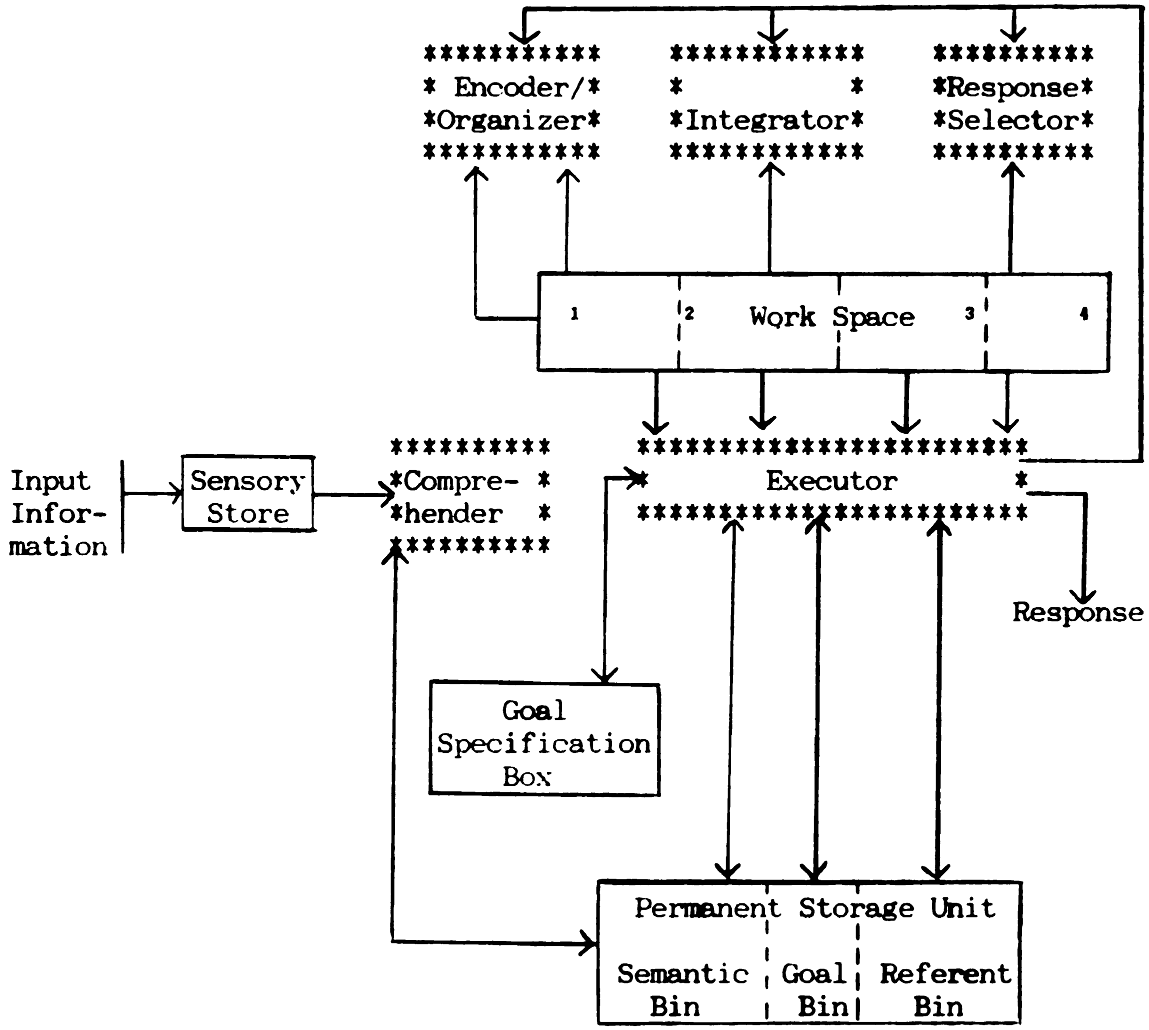
Perhaps most importantly, category accessibility affects have been demonstrated in areas outside social judgment (Bettman & Sujon, 1987; DeNisi & Summers, 1986). These studies argue for the generality of category accessibility effects, and a unified model of decision making and information processing. The next section examines Wyer and Srull's (1986) information processing model in detail, and notes its applicability to decision making contexts.

## A GENERAL THEORY OF INFORMATION PROCESSING

The most clearly delineated human information processing model in the social psychological literature is Wyer and Srull's (1981, 1986) bin processing model (see Figure 1). Wyer and Srull have been refining this model for several years, and recently presented its latest version and the relevant research supporting it (Wyer & Srull, 1986). The model's operation and the functions of the various boxes within the model are reviewed from a generally left to right manner in the following pages. Note that in the figure, processing units are denoted by stars (*'s), storage units by plain boxes.

### Sensory Store

The Wyer and Srull (1986) model begins with the initial sensory experience of the stimulus information. They posit that before information can be represented in terms of any mental code, it must be acquired by the various sense organs. In their model, all external information, regardless of the sensory modality through which it is acquired, enters the system through a single sensory store. At any given moment, this unit holds all the information impinging on any of the sense organs, and it maintains them in roughly veridical




<u>Figure 1</u>. Wyer and Srull's (1986) Model of Human Information processing.

form. However, the initial representation of this information is assumed to decay extremely rapidly, usually within seconds (Crowder, 1976; Sperling, 1960).

In a decision making context, this is the step at which the features of the decision situation first reaches the decision maker. It should be noted that at this stage of processing, there is no comprehension. This step precedes Beach and Mitchell's problem recognition stage (see Figure 2). This is merely a stimuli awareness stage.

Overview of the Processing Units

According to the Wyer and Srull (1986) model, each of the processing units has a different function. These range from low level comprehension to higher order decisions. Each of processing unit has within it a library of alternative procedures. Which of these procedures is used in any given situation is determined by the information to be processed (e.g., verbal or nonverbal), and the specific purpose for which it is to be used. These procedures are assumed to be performed automatically, without conscious awareness of the various steps involved.

Most of the procedures that make up each processing unit's library are performed without conscious awareness of the cognitive steps involved in them. The activities of the Executor, though, are consciously directed. Therefore, information retrieved from Permanent Storage, instructions to processors about what procedures to activate and the output

| | | | |
|---|---|---|---|
| Stage | 1 ⟶ | 2 ⟶ | 3 ⟶ |
| Activity | Problem Recognition | Task Evaluation | Strategy Selection |
| Stage | ⟶ 4 ⟶ | 5 ⟶ | 6 |
| Activity | Information Processing | Strategy Implementation | Choice |

<u>Figure 2</u>. Beach and Mitchell's (1978) model of a typical individual decision making process.

of processing units are subject to conscious awareness.

The procedures in a processing unit library are each identified by a name or symbol. The individual steps in any given procedure are learned and initially performed in a conscious manner. Over time, however, the procedure may be performed automatically. The automatization of a library is a function of learning and practice. Automatization of responses reduces processing time and load.

<u>Comprehender</u>

The Comprehender is an initial pattern recognition device. It interprets raw stimulus information represented in terms of several memory codes that may be verbal, visual or auditory. However, the encodings are at a very low level of abstractness. The recognition occurs automatically and independently of the specific goal directed processing governed by the Executor. Similar low level processing occurs when individuals are presented with any set of stimuli, such as those associated with entering a restaurant, or classroom.

Thus, at this point, the subject becomes aware that s/he is in a situation in which there is a decision to be made, or a problem to be solved. This step corresponds to Beach and Mitchell's (1978) problem recognition stage (step 1).

<u>Work Space</u>

The Work Space temporarily stores both input information and prior knowledge that may be involved in various stages of processing. This is the area in which the actual work involved in solving the problem is carried out. It may contain: a) new stimulus information from the Comprehender, b) previously formed knowledge representations drawn from Permanent Storage, c) more abstract encodings of new stimulus information in terms of trait or more general behavior concepts from the Encoder/Organizer, d) integrated representations of the information that have been formed with reference to a prototypic person or event from the Integrator, e) subjective judgments, and f) episodic presentations of overt responses from the Response Selector.

The Work Space has limited capacity. This is particularly important with respect to the effects of task complexity on decision making, and provides an explanatory mechanism for the phenomena of subjects utilizing nonlinear decision making strategies under conditions of high task complexity.

## Executor

The Executor directs the flow of information to and from other processing and storage units. Its activities are based on the instructions specified in the goal schema (problem solving strategy) pertaining to the objective (e.g., solve this problem in less than three minutes) deposited in the goal specification box. Its activities include: a) the retrieval of prior knowledge (problem solving schema) from Permanent Storage for use in attaining the specified processing objective; b) the transmission of this information to the appropriate compartment of the Work Space; c) the transmission of instructions (from the objective in the Goal Specification Box or goal schema) to an appropriate processing unit; d) the retrieval of the results of processing from the Work Space; and e) the transmission of the results of processing to the appropriate bin in Permanent Storage.

It should be noted that the Executor is not the intelligence of the system. It possesses little decision making capability. It is primarily an information transmission device told what to do by the goal schema. The intelligence of the system resides in the learned goal schema and the libraries or routines that are hard wired into the various other processing units.

If the Goal Specification box is empty (no immediate processing objectives), the Executor initiates a default procedure involving relatively low levels of comprehension and processing. The main function of this procedure (which continues until a more specific objective is identified) is to keep an updated internal representation of the environment in memory.

Goal Specification Box

The Goal Specification Box stores immediate processing objectives (e.g., solve this problem under given constraints) of the system along with appropriate sets of instruction (goal schema or problem solving strategy from Permanent Storage) for how to attain them. These instructions are used by the Executor both a) to tell the relevant processing units which of several alternative procedures should be activated and b) direct the appropriate flow of information between those units and the storage units.

The Goal Specification Box can contain information about more than one objective at a time, but space is limited. As additional objectives and procedures for attaining them enter the unit, others are displaced and consequently cease to affect any current information processing activity. This limited capacity restricts both the number of objectives that can be pursued and the complexity of the procedures used to attain them.

Encoder/Organizer

The Encoder/Organizer is a higher level interpreter of material that has been transmitted to the Work Space from either the Comprehender or Permanent Storage (via the Executor). It can identify the referent of information as an instance of a more general concept or category. It can also interpret individual episodes (e.g., order a meal, pay the waiter) in terms of a more general event sequence (eating at a restaurant). Thus, while the Comprehender identifies some of the more general features of the situation, the Encoder/Organizer identifies the specific aspects of the situation that require a specific type of processing.

Further, these higher order encodings are typically not made unless some higher order processing objective requires it. The recognition stimulated by the Comprehender occurs automatically. These higher level encodings are performed by the Encoder/Organizer upon instruction transmitted by the Executor.

The Encoder/Organizer functions in pursuit of specific processing objectives, using procedures indicated in the goal schema. These procedures are automatically performed once they are called. The goal schema only needs to name the procedure without reiterating the steps involved in it.

The output of the Encoder/Organizer (unlike that of the Comprehender) depends heavily on the nature of the goal schema, and the primary procedure that is used. For example, encoding is quite different for a decision making task than it would be for a memorization task. In the decision making task, the characteristics of the decision context would have to be encoded in terms of a problem solving heuristic that would be called to solve the problem. In a memorization task, the incoming information would have to be placed within an appropriate network of existing information.

In a decision making context, this processing unit is likely to evaluate the task (Beach & Mitchell, 1978, step 2). The aspects of the problem situation (as specified by Beach & Mitchell, 1978) are encoded in terms of general problem solving strategies. Once this encoding has occurred, then the features of the problem are matched to the features of the appropriate goal schema in the Goal Bin. This feature matching corresponds to Beach and Mitchell's strategy selection stage (step 3).

The information processing and strategy implementation stages postulated by Beach and Mitchell (steps 4 and 5) are indistinguishable in this model. In this model, information processing and strategy implementation occur simultaneously. Once the appropriate goal schema are accessed from memory, these schema are used to process the incoming information, and implement the problem solving strategy. The incoming information in the problem solving context is interpreted in terms of the goal schema.

Beach and Mitchell cite Tversky and Kahneman (1974) noting that the types of biases and heuristics subjects use in a problem solving situation are information processing strategies (step 4). This assertion is, in my opinion, nonsensical. These heuristics represent means subjects use to solve the problem, whether the strategy be to make a judgment based upon representativenss or on a more sophisticated probabilistic reasoning method. They are strategies that are implemented to solve a problem (Beach and Mitchell, 1978, step 5). Thus, from an operational perspective, in Beach and Mitchell's (1978) model, steps 4 and 5 cannot be differentiated.

Conceptually, it appears Beach and Mitchell misplaced the information processing step in their model. The information processing relevant to solving a particular problem is likely to occur prior to the selection of the strategy (step 3). The strategy will be selected based on the information processed relevant to the problem situation (task evaluation, step 2). Further information processing will be problem-related guided by the strategy selected to solve the problem. This type of information processing is indistinguishable from their strategy implementation step (step 5). Thus, from a conceptual perspective, step 4 in Beach and Mitchell's model cannot be clearly differentiated from steps 2 and 5.

Integrator

The Integrator is used if processing objectives require that a decision must be made based upon two or more different units of information. This can occur when the Encoder/Organizer is unable to interpret and organize information presented in terms of a single concept or abstract representation. It may also occur when the implications of new information about a referent must be considered in relation to previously acquired information that has different implications. Under these circumstances, the Integrator combines these implications to arrive at a single subjective value.

For example, the Integrator is used if two types of information (e.g., favorable and unfavorable) must be used to create a single subjective estimate. It also is used to integrate elements in a situation never before encountered. Over time however, the various rules governing the integration of information become part of the Integrator's library and are automatically activated as directed by the Executor.

In a decision making situation, the Integrator compares different alternatives, or combines information from different attributes into a single judgment. This integration is likely to occur at different phases of the decision process, contingent on the individuals' schema in memory, and decision making strategy which was selected (e.g., compensatory or noncompensatory). For example, in a compensatory decision process the Integrator would work fairly constantly. The Integrator first combines different dimensions of information into a summary judgment of a given alternative. Then it compares the alternative to other alternatives on which judgments had already been formed. This process goes through several iterations until only one alternative remains.

In a noncompensatory decision mode, the Integrator is used at different stages in the decision making process. It is used initially to compare different dimensions and determine which dimension should receive primacy in the decision making process. At this point, the Encoder/Organizer compares pieces of information along the chosen dimension and eliminates alternatives given some criterion. At the end of this iteration, the Integrator chooses the next piece of information for comparisons to be made upon. This process continues until only one alternative remains. Another possibility is that after a number of iterations, once the problem is reduced to a manageable size, the Integrator is called upon to compare the remaining alternatives in a manner similar to the compensatory decision making process describe above (Olshavsky, 1979).

It should be noted that in this model, there is not a separate step in the decision making process in which the choice is made (Beach & Mitchell, 1978, step 6). Choice arises through appropriate implementation of the goal schema, and the various iterations of information processing. The goal schema has within it a criterion against which the choice is made. Once that criterion is reached, then processing stops. However, in this model there is a response step, which will be described next.

Response Selector

As its name suggests, the Response Selector comes into play when an overt response is required. The Response Selector transforms an internally coded mental computation into an overt behavioral response. The response may be a value along a numerical scale, an answer to a yes/no question, a verbal description, a motor act or an utterance in the course of conversation.

In a decision making context, the role of the Response Selector is clear. At the end of internal processing, once the choice has been made, the Response Selector takes the internally coded representation of the choice and translates it into an overt response.

Permanent Storage

The Permanent Storage unit consists of a set of content addressable storage bins. Each bin is identified by a header that defines and circumscribes its contents. There are three types of bins in Permanent Storage, the Semantic Bin, the Referent Bin, and the Goal Bin.

Semantic Bin. The Semantic Bin is a mental dictionary. The contents of the Semantic Bin are used to interpret single pieces of information independently of the particular person, object or event to which they refer. The Semantic Bin is directly accessible by the Comprehender and Executor and typically comes into play at early stages of processing. The retrieval of information from the Semantic Bin (unlike the Referent Bins) is under the direct control of the Comprehender and the Executor. Semantic concepts are not applied to input information by the Comprehender unless they are necessary in order to understand the denotative meaning of this information.

_Referent Bins_. Referent Bins are analogous to a cognitive encyclopedia. Each Referent Bin contains one or more pieces of information about either a particular referent (e.g., Richard Nixon, last Saturday's cocktail party) or general ones (U.S. Presidents, cocktail parties). The Referent Bins contain the knowledge one has accumulated about either particular persons, objects and events or prototypic ones and in combination, serve as an encyclopedia of stored knowledge about ones physical and social world.

_Goal Bins_. The Goal Bins are a specific type of referent bin. They contain various procedures (goal schema) that specify the cognitive steps involved in attaining a particular processing objective. This is the bin which contains most of the problem solving strategies/heuristics which are used by decision makers. Once the problem has been identified as being an instance of a particular type by the Encoder/Organizer, the appropriate problem solving/goal schema is retrieved from the goal bin.

_Headers_. Each bin, regardless of type, has a header consisting of features that identify it, and circumscribe its contents. The headers of Referent Bins consist of a) a name that specifies the referent and b) a set of features that are strongly associated with it. A bin referent may be either general or specific. It may also include nonverbally coded (i.e. visual) representations of what its referent looks like.

Search and Retrieval Processes

There are several features of the search and retrieval processes postulated to occur which must be discussed before specification of the model is complete. First, no more information is retrieved for use in attaining a processing objective than is sufficient to allow the objective to be attained. When this minimal amount is retrieved, the search terminates. This notion is consistent with Christian-Szalanski's (1978) cost-benefit model of decision making. Once a sufficient amount of information is accessed to solve the problem well enough and obtain a desired level of benefit, search terminates.

Second, when information relevant to a processing objective is required, the contents of the Work Space are searched first. This is purely for efficiency of processing usage. Information in active memory is used before additional information is retrieved from long term memory. The search for information in the Work Space is random. The probability of retrieving a given unit of information from it increases with the extensiveness with which the information has been processed.

Thus, the search for information necessary to attain a particular processing objective procedes as follows. First, active memory is searched. If the required information is not contained in active memory, the features of Headers in Permanent Storage are compared to features of the material in the Work Space. Once a match between the features in the Work Space and the features in a bin has been achieved, the search in a bin for information proceeds from the top down. This search is probabilistic and imperfect. It is possible to miss the first piece of information in a bin and retrieve the second. Finally, after information has been used in active memory, the information is redeposited on top of the bin. The more often a piece of information is used, the more copies of that information appear in the bin.

Summary and Conclusions

As noted in the introduction, decision making research has been characterized by a marked lack of theoretical development. Theory that has been developed in this area is simplistic, and does not adequately address the complex information processing activities that occurs in most decision making situations (e.g., Beach & Mitchell, 1978). Utilizing information processing theory drawn from the category accessibility literature in a decision making paradigm clarifies the nature of the processing that occurs when making a decision. The utilization of this theoretical base should assist researchers to predict more accurately the behavior of decision makers. Thus, the model developed in this section is used to drive the development of the hypotheses of this study described in the next section.

## HYPOTHESES

As previously noted, the major variables of interest in this study were chosen for both their practical and theoretical importance. From a practical perspective, it is becoming increasingly important for individuals to make decisions very quickly. These decisions must often be made in rapid succession, switching from problem to problem very rapidly. However, the effects of time constraints and previously processed information (priming) on decision making processes are not clearly understood.

There has been little theoretical development in the decision making literature to clarify the processes involved in decision making situations like those described above. Fortunately, theoretical models recently developed in the social cognition literature using a social judgment paradigm can be utilized in a variety of decision making situations (Wyer & Srull, 1986). Examining decision making utilizing the information processing principles developed in these models furthers the development of theory in the decision making literature. Further, these models have primarily focused on the effects of a memory factor (e.g., a prime) on final choice. Examining search processes and the effects of contextual factors (e.g., time constraints) on these processes contributes to the development of theory in the area of category accessibility.

Given the framework for examining decision making research provided by the Wyer & Srull (1986) model, existing decision making research has typically focused on the process of matching features of the problem situation to various goal schema and the structure of the goal schema. These two themes in decision making research are exemplified by studies examining the type of strategy selected under various contextual conditions (e.g., Payne, 1976) and how those strategies are utilized to make a decision (e.g., Kahneman & Tversky, 1984). It has tended to neglect the importance of the organization of long term memory in the implementation of these schema (Einhorn & Hogarth, 1981). Conversely, research in social cognition has focused on the nature and organization of long term memory without examining the specific heuristics subjects use while attempting to access that information (e.g., Higgins et al., 1984).

It is possible to investigate simultaneously the independent and joint influences of these two factors on the decision making process. The hypotheses of this dissertation reflect an attempt to examine the effects of these two factors in decision making. The hypotheses are organized by dependent variable. First, hypotheses describing the effects of time constraints and category accessibility on search processes (including inter-intra dimensional search, the specific pieces of information examined under various conditions, and the latency for examining each piece of information) are discussed. Then, the hypotheses describing the effects of time constraints and priming on final choice (including the number of times an alternative characterized by a high score on the primed attribute is chosen) are discussed. Not all of the possible relationships among the variables in this study are examined. This study focuses only on the relationships that are supported by empirical research or existing theory.

Search Strategy

Time Constraints. The model (Wyer & Srull, 1986) described in the previous section suggests that when a problem situation is encountered in which there is a time constraint, that feature is placed in the Goal Specification Box, and an appropriate goal schema is selected to be used to solve the problem.

The literature has discussed several types of goal schema subjects use when confronted with time constraints in a decision making context (Miller, 1960). Three of these strategies have received attention in recent years. The first method subjects often use to accommodate to time constraints is acceleration (Ben Zur & Breznitz, 1981). When subjects accelerate processing they try to process all the information available to them in a short period of time. That is to say, they spend less time processing each piece of information.

The second strategy subjects often use to cope with time constraints in a decision making context is filtration (Miller, 1960). When subjects filter information, they process only a subset of the information. Usually this subset is selected because of its importance or the extent to which it should assist the subject to make a final decision (Ben Zur & Breznitz, 1981).

The third strategy subjects often use to deal with time constraints in decision making is to engage in a strategy shift (Payne et al., 1987). The most extreme case of strategy shifting is avoidance, where the subject simply attempts to exit the decision making situation. Less extreme examples of strategy shifts include the use of simple, noncompensatory strategies under conditions of time constraint (Ben Zur & Breznitz, 1981).

The empirical literature provides support for all three mechanisms by subjects when faced with time constraints in a decision making task. This evidence comes from both process tracing and non-process tracing studies. It has been found that under conditions of time constraint, subjects use simpler, easy to implement decision making strategies (Christian-Szalanski, 1980, Smith et al., 1982). In a process tracing paradigm, subjects have been found to move from additive strategies to simpler, noncompensatory strategies (Zakay, 1985, Payne et al., 1987). Subjects also accelerate processing of information, and do less exhaustive searches under conditions of time constraint (Stein, 1981). Finally, there is evidence that subjects first attempt to accelerate processing, then attempt to move to simplification strategies (Payne et al., 1987).

However, the two studies that investigated time constraints on decision making strategy using a process tracing approach both used probabilistic gambles as the decision making task. This represents a very narrow set of the types of decisions people are likely to make. These types of tasks provide subjects with a very limited set of dimensions (e.g., probability win, amount win, probability loose, amount loose). Further, many decisions people make cannot be described in terms of known probabilities with known consequences. To increase the external validity of these findings, a number of other decision making tasks need to be examined (Ebbesen & Konecni, 1980).

This discussion leads to the first of hypothesis in this study:

> Hypothesis 1: A severe time constraint on the search process in a multi-attribute, multi-alternative decision task will result in subjects utilizing a greater incidence of noncompensatory decision making strategies.

Knowledge. Decision maker's knowledge about a subject is likely to have an effect on their search processes. Beach and Mitchell (1978) postulate that subjects high in knowledge are be more likely to use analytic strategies to arrive at decisions. The Wyer & Srull (1986) model suggests that decision maker's high in knowledge have more accessible schema, and more hard wired procedures for processing information on a given subject. Thus, they are be able to process information more efficiently than novice subjects. The increased efficiency in processing allows them to process more information than novice subjects. Thus, it is postulated that:

> Hypothesis 2. Subject knowledge in a decision making domain is positively related to the use of compensatory decision making strategies in that domain.

Factors Influencing the Number of Times the Primed Attribute is Accessed.

Time Constraint. The effects of time constraints on search processes under conditions of priming has not been examined in the literature. However, the Wyer and Srull (1986) model allows for predictions to be made. Under conditions of time constraint, subjects are most likely to utilize a noncompensatory decision making strategy (Payne et al., 1987). The goal schema for solving the decision problem, the primed schema, and other information relevant to the problem are highly accessible in memory. Search through the bins for information to solve a problem is probabilistic in nature. Search through the Work Space is random.

It seems these last two factors, the probabilistic nature of the search process through the bins and the random search of the information in the Work Space will make subjects with well formed schema for making a decision susceptible to category accessibility effects under conditions of time constraint. The model (Wyer & Srull, 1986) indicates that search for information to solve the problem begins in the Work Space, then proceeds to the storage bins. The primed schema exists in the Work Space and is accessed there. Multiple copies of the primed schema exist at the top of the relevant storage bins. Given that search through the Work Space is probabilistic, and search through the storage bins occurs from the top down, this increases the probability that primed schema is accessed in the information search. Under conditions of time constraint, expert subjects may not have time to discriminate between factors identified as relevant by their own problem solving schema, and schema primed in memory. Further, their hard wired routines for solving the problem may have to be discarded under conditions of severe time constraint. There may not be sufficient time to implement the appropriate routines. When searching for a new means of solving the problem, they are likely to access the primed schema, and like novices, utilize it to solve the problem. Thus, it is hypothesized that:

> <u>Hypothesis 3</u>: Under conditions of time constraint all subjects will examine the primed attributes more often than the nonprimed attributes.

<u>Time Constraint and Number of Primes</u>. As noted above, a severe time constraint in a multi-attribute, multi-alternative decision making context may result in the utilization of a noncompensatory, accelerated problem solving strategy. Under conditions of priming, the primed schema is deposited in the Work Space and placed on the top of the appropriate bin(s) in long term memory. The more often the attribute has been primed, the more often it appears in the bin and more salient it becomes in the Work Space. Search through the Work Space for information to solve a problem is random. Thus, the more often a piece of information is represented in the Work Space, the more likely it will be used to solve a problem.

A time constraint restricts the number of pieces of information that are accessed to solve a problem. Further, with accelerated processing, there is less time to discriminate among which pieces of information are utilized in processing. Thus, the first pieces of information accessed from the Work Space and permanent storage are the most likely to be utilized to process incoming information. Increasing the number of primes increases the probability that the primed information will be accessed in memory when making a decision. Thus,

> <u>Hypothesis 4</u>: Subjects will access the primed attribute a greater number of times under conditions of severe time constraint and high priming than under conditions of low time constraint and low priming.

<u>Knowledge and the Number of Primes</u>. Subjects high in knowledge in a given area have well formed, chronically accessible schema, and hard wired routines for processing incoming information on any given topic. Further, expert subjects are more likely to utilize analytic strategies when making decisions than novice subjects (Beach & Mitchell, 1978). Further, experts have well developed schema and hardwired routines that allow them to quickly and efficiently process information. Thus, to some extent, the procedures experts use to make a decision are fixed, based on their existing decision making schema and hardwired procedures. Experts should be relatively uninfluenced by extraneous factors when solving a problem.

Novices do not have well formed schema, and the schema they have relevant to the problem are not likely to be chronically accessible. It is very unlikely that novice subjects have any hard wired routines for the processing of incoming information. As novices do a task, they are likely to have to develop new schema, or adapt existing schema to solve the problem. These schema are developed around schema that are already available in memory and are being used to process incoming information. Priming causes the primed schema to be accessible in memory, and to be used to process incoming information (Wyer et al., 1982). Thus, the primed schema may be used to form the problem solving schema, and play a central role in the solving of any relevant problems. Novice subjects are likely to access the primed schema a disproportionately large number of times relative to other attributes.

Empirical evidence has thus far supported this line of reasoning. Bettman & Sujon (1987) found category accessibility effects on search process only for novices. Expert subjects appeared immune to the effects of category accessibility. It was hypothesized that expert subjects already had well formed schema for making the product selection, and these schema replaced the primed schema in memory during the decision process.

However, in the Bettman and Sujon (1987) study subjects only had four attributes (of which two were related to the primed attribute) upon which to judge the alternatives. It may be that novice subjects evidenced more thoughts related to the primed attribute simply because the primed attribute appeared more often (twice) in the attribute set than non-primed attributes. The priming effect on search processes could have been due to novices trying to be as thorough as possible with a unfamiliar task, as opposed to priming effects. However, the lack of priming effects for experts even though the primed attribute appeared twice in the decision set, is impressive.

Further, as Bettman and Sujon (1987) noted, the cognitive response measures they used potentially provide some insights into processing the contents of memory related to the task. However, such responses are not detailed process-tracing measures which are needed to determine the micro-processing strategies underlying the observed effects.

A much more sophisticated test of the category accessibility hypothesis in decision making is needed. Specifically, the primed attribute needs to be tested against a variety of attributes that are represented equally to determine if it in fact is used more often or not. Bettman and Sujon's (1987) results may have been an artifact of the restricted choice set they used. Further, more sophisticated search process measures need to be utilized in this type of research.

However, even though Bettman and Sujon (1987) did not provide a strong test for the category accessibility hypothesis, their basic reasoning is sound. Experts have chronically accessible, well developed schema for the interpretation of decision problems. Without time constraints, they should not be susceptible to priming effects. Novices, who do not have chronically accessible, well developed schema for interpreting a decision problem, should be susceptible to the effects of priming on the processing of incoming information. Therefore:

> Hypothesis 5: Under conditions of priming, novice subjects will access the primed attribute more often than expert subjects. Under conditions of no priming, expert and novice subjects will access the primed attribute an equal number of times.

Factors Influencing Latency of Search

Time Constraint. The contextual condition of a time constraint will lead subjects to select a noncompensatory, accelerated, problem solving strategy. As subjects accelerate processing, they spend less time examining each piece of information (Ben Zur & Breznitz, 1981; Payne et al., 1987). This hypothesis has been included here primarily to add empirical support to this process.

> Hypothesis 6: Time constraints will lead to each piece of information accessed by subjects to be examined for a relatively short period of time.

Knowledge. Another factor that influences the amount of time subjects examine each piece of information in the search process is knowledge of the relevant domain. Subjects with a high level of knowledge in the relevant domain should have well developed, chronically accessible schema for processing the incoming information. They should also have hard wired routines for processing information in that area. Thus, there is less schematic retrieval time, and greater processing efficiency involved for expert subjects.

Novice subjects need to develop schema to deal with the task as they go through it. This may involve the development of new schema, or the adaptation of existing schema to accomplish the task. Further, these schema will not be as accessible to novice subjects as to expert subjects. Novices will not have hard wired routines to assist processing. Thus, their processing of the incoming information will not be as efficient as expert subjects. This discussion leads to the seventh hypothesis of this study:

> Hypothesis 7: Knowledge in a subject area will be negatively related to the length of time subjects examine each piece of information.

Priming. Priming is another factor that affects latency of search (Fazio et al., 1986). Primed schema are more accessible in memory than non primed schema. They have already been deposited in Working Memory, and also exist on or near the top of the relevant storage bins. Further, the primed schema are currently in use for processing incoming information. Thus, processing information related to the primed schema involves fewer steps and less information search than processing information unrelated to the nonprimed schema. No new information needs to be accessed, and existing schema for processing the incoming information do not need to be modified or adapted in any way to accommodate incoming information. Thus,

> Hypothesis 8: Priming will lead subjects to examine the primed pieces of information for a shorter period of time than nonprimed pieces of information.

## Factors Influencing the Number of Times an Alternative High on the Primed Attribute is Chosen

Time Constraint. As noted previously, time constraints should impact the type of processing strategy chosen by subjects. Further, time constraints are likely to affect which pieces of information are examined, with a disproportionate amount of search on the primed attribute (see Hypothesis 3). In noncompensatory search processes, only a subset of information is examined. If this search process contains a disproportionate amount of information relevant to a particular attribute, that attribute should exert a disproportionate influence on the final decision made by subjects. Thus, given that search processes are likely to center around the primed attribute under conditions of time constraint, it also becomes more likely an alternative high on the primed attribute will be chosen under conditions of time constraint.

> Hypothesis 9: Under conditions of severe time constraint, subjects will select an alternative high on the primed attribute more often than they will under conditions of low time constraint.

Time Constraint and Priming. Time constraints and priming effects are likely to have a joint influence on subject choice. Time constraints result in noncompensatory search processes that increase the amount of search on the primed attribute (see Hypothesis 3). The more often an attribute is primed, the more salient it becomes in the Work Space, and the more often it appears at the top of the bins in Permanent Storage. As the primed attribute is accessed, more copies of the primed schema are placed in the relevant bins. Thus, the primed attribute appears more often in the relevant bins, and it is accessed a disproportionately large number of times relative to other attributes in the decision making process. Therefore, the primed attribute is likely to have a disproportionate influence on the final choice. Thus,

> Hypothesis 10: Under conditions of high time constraint and high priming, subjects will increase the number of times they select an alternative high on the primed attribute.

Knowledge and the Number of Primes. As noted previously, subjects low in knowledge in a subject domain may be more susceptible to priming effects than subjects high in knowledge in a given area. Novice subjects may have to develop new schema to solve a problem, and the development of those schema are likely to revolve around any schema particularly salient in memory. Given that the primed schema is more salient in memory than other schema, the problem solving schema novices develop are more likely to be centered around the primed schema than other schema. Thus, it is likely that they will choose an alternative based to a disproportionate extent on the values of the primed schema.

Empirical research supports this analysis. Bettman and Sujon (1987) found novices choose alternatives high on a primed attribute more often than other available alternatives. This effect was not found for expert subjects. However, as noted previously, there are some difficulties with the methodology utilized by Bettman and Sujon. Specifically, only four dimensions were presented to subjects, and two of these dimensions related to the primed attribute. It is not clear what sort of criteria experts were using to make a judgment. The primed dimension in their study were ease of creative usage and reliability. It may be that different camera afficiandos have different needs in a camera and choose the camera that fit those needs. For example, an outdoor photographer may need a reliable camera that will not break down in the forest while taking pictures of wildlife. An artistic photographer working in a studio may select a camera that allows creativity because if it breaks down, s/he can take it to a shop and have it fixed. Thus, it is not clear if expertise in the area or any of a number of other factors was influencing choice.

Novice subjects may have used a unit weighting scheme when making a decision. They may have chosen an alternative high on the primed attribute simply because there was more information relevant to that attribute in the problem set than there was relevant to any other attribute. The problem set differentially weighted the importance of the primed attribute. It is not clear if the subjects differentially weighted the importance of the attributes. Further, the restricted number of attributes that were presented to subjects makes it difficult to determine the importance of the primed attributes relative to a reasonable number of other attributes. There are very few choices made by subjects that can be adequately described by three attributes. Thus, Bettman and Sujon's findings, while consistent with the model's predictions, are inconclusive. This discussion leads to the last hypothesis of this study:

> Hypothesis 11. Under conditions of high priming, novice subjects will choose an alternative high on the primed alternative a greater number of times than expert subjects. Under conditions of low and zero priming, expert and novice subjects will choose the primed alternative an equal number of times.

## METHOD

Subjects: Subjects ($N$ = 172) were recruited from undergraduate psychology courses. These subjects participated in the study in return for class credit. Two subjects were eliminated from the sample for noticing a relationship between the primes and the Performance Reliability dimension in the problems. Subject averaged 19.41 years of age and had a mean GPA of 2.86. Seventy-eight percent of the sample was female.

Procedure. Subjects were greeted by the experimenter, given a consent form, and asked to read and sign the form (see Appendix A). Then, subjects were seated in front of a Zenith Z-159 personal computer and told that they would be performing six choice problems involving personal computers. They were told that the software program currently loaded on the computer would first provide them with instructions on how to perform the task, and then the experimental trials.

The instructions for using the software to perform the computer decision task contained the primes. The primes were presented in the examples in the instructions. Dimensions conceptually similar to those relevant to personal computer choice were presented to subjects in the context of different types of choice problems. A complete description of the priming procedure is given in the Measures section.

The number of primes given to each subject varied from 0 to 24 across three (0, 12, and 24 primes) conditions. The length of the instructions remained constant across all conditions. The screens that were presented to the subjects in the zero, low, and high priming conditions are shown in Appendices B through D (respectively). A complete list of the dimensions used in the study and the range of possible values for each dimension appears in Appendix E.

In the actual decision trials, subjects were asked to select the best computer from the list of alternatives. They were told that there was no right or wrong answers to the problem, but that we were interested in how they thought about personal computers. The criteria for their choice was in terms of computer quality and personal preference. They were also be told that they should imagine that all the information provided to them in the problem was accurate, and from a credible source. For a complete copy of the task instructions given to subjects see Appendix F.

Subjects then performed 6 decision tasks. Each decision task contained 4 alternatives described by 4 dimensions. It was hypothesized that under conditions of time constraint, subjects would switch from linear to nonlinear decision strategies. Research has shown that with no time constraints and low levels of task complexity (i.e., 2 X 2 or 4 X 4 matrices), subjects utilize compensatory decision making strategies. With high levels of task complexity (i.e., 8 X 8 or 12 X 12 matrices) subjects switch to noncompensatory decision processes (Payne, 1976; Olshavsky, 1979). In order for the time constraint manipulation to cause subjects to switch strategies they had to utilize linear strategies under the no time constraint condition. Low levels of task complexity were used in this study in order to demonstrate that the time constraint condition, not the task complexity level, caused subjects to utilize noncompensatory decision making processes.

Pretesting demonstrated that with problems containing four alternatives and four dimensions and under conditions of low time constraint, subjects primarily utilized linear decision making strategies. At higher levels of task complexity (e.g., 6 x 6 or 8 x 8) subjects utilized nonlinear decision making strategies with and without time constraints. Thus, a low level of task complexity (4 X 4) was used in this study.

This study presented subjects with two conditions of time constraint. Subjects had either 30 seconds (high time constraint) or 5 minutes (low time constraint) in which to perform the problem.

It may be argued that these time constraint conditions are unrealistically low, and that in most real world decisions, people have much more time to make decisions.

However, as previously noted, Mintzberg (1973) found managers spent an average of four minutes on any given decision. Similarly, it would seem that in a number of other cases, i.e., pilots in flight or surgeons in the operating room, it is often necessary to make decisions fairly quickly. Thus, while this study does not faithfully replicate the conditions under which all types of decisions are made, it does replicate the conditions under which an important subset of decisions are made.

Subjects were then given a dimension rating form (see Appendix G). This form asked them to rate the importance of each of the dimensions that appeared in the problems to overall personal computer quality. Then subjects completed a computer knowledge test (see Appendix H). After the test subjects were given a Debriefing Questionnaire that performed two manipulation checks. This questionnaire asked subjects if they noticed any connection between the priming and the experimental trials. It also ask them if they felt more rushed in the high time constraint condition. This questionnaire was also be used to collect relevant demographic data (see Appendix I). Finally, subjects filled out a questionnaire that asked them to rate the conceptual similarity of each of the priming key words in the instructions to the primed dimension. They were also asked to rate the importance of each of the priming keywords to overall product desirability (see Appendix J). After subjects filled out this questionnaire, they were be debriefed (see Appendix K).

Measures

Independent Variables:

Time Constraint. There were two levels of time constraint utilized in this study. Time constraint conditions ranged from 30 seconds (high time constraint condition) to five minutes (low time constraint condition). This was a within subjects variable manipulated by the experimenter. Each subject was run on three trials within each time constraint condition for a total of 6 trials.

Knowledge of Personal Computers. Research has shown priming to have differential effects on novice and expert subjects. Experts are not susceptible to priming effects, while novices tend to be highly susceptible to priming effects. Subject knowledge of personal computers was used as a between subjects factor in the analyses. Knowledge of personal computers was measured using a test developed by the experimenter.

The construct validity of this measure was established in pretesting. The alpha reliability of the test (in pretesting) was .68 ($N$ = 41) with a mean of 12.71 (20 items), a variance of 9.91, and a standard deviation of 3.15. The test was administered to groups of subjects known to be high and low in personal computer knowledge. It was able to significantly discriminate between these two groups (graduate students and undergraduates) ($\underline{T}$ = -6.28, $\underline{p}$ < .001). The test also positively correlated with personal computer ownership ($\underline{r}$ = .58, $\underline{p}$ < .01), the number of hours spent researching the purchase of a personal computer ($\underline{r}$ = .37, $\underline{p}$ < .01), the number of hours per week/month/year spent working on personal computers ($\underline{r}$ = .52, .51, and .46, respectively, all correlations significant at the .01 level), and a self rating of personal computer knowledge ($\underline{r}$ = .58, $\underline{p}$ < .01).

In the final experiment, the alpha reliability of the test was .55. The test mean was 12.35 (20 items), with a variance of 7.93 and standard deviation of 2.82. It significantly correlated with personal computer ownership ($\underline{r}$ = .18, $\underline{p}$ < .05), the amount of time spent researching personal computers ($\underline{r}$ = .32, $\underline{p}$ < .01), the number of hours per week subjects spent working on a personal computer ($\underline{r}$ = .31, $\underline{p}$ < .01), and the self rating of personal computer knowledge ($\underline{r}$ = .42, $\underline{p}$ < .01). See Appendix H for a complete copy of the test.

It is not clear why the reliability of the test dropped in the final experiment. The most likely explanation was the absence of a group of subjects high in personal computer knowledge in the experiment. In pretesting, the graduate student group (high knowledge, $\underline{n}$ = 11) was included in the sample used to compute the reliability of the test. These individuals probably contributed a significant amount of variance to the test scores. The test variance in pretesting was 9.91 compared to 7.93 in the final experiment. The absence of a group of subjects highly knowledgeable in the operation of personal computers in the final experiment probably attenuated the variance in test scores and significantly contributed to the reduction the test reliability.

Priming. The primes were presented in the examples in the computer software instructions. Dimensions conceptually related to Performance Reliability were presented to subjects. These related dimensions appeared in the Dimension Lists and as information relevant to a particular alternative.

For example, subjects were presented with a car choice problem as an example in the instructions. The alternatives were Car A, Car B, Car C, and Car D. The dimensions describing these cars were Gas Mileage, Maintenance Record, Model, and Price. The attribute Maintenance Record should be conceptually related to and prime the personal computer attribute Performance Reliability. The dimensions Model, Mileage, and Price should be unrelated to the dimensions presented to subjects in the computer choice problem.

An instance of priming occurred each time a related dimension appeared in an example dimension list or as a piece of information presented to subjects. Key words related to reliability included warranty, product consistency, maintenance record, stress test results, and tone quality.

Different example problems were used throughout the instructions so that different key words would prime the dimension of interest. Any particular key word may or may not prime the relevant schema for a given subjects. The more relevant the key words presented to subjects, the more likely the schema of interest would be primed (unless the key words are only marginally related to the dimension of interest). Therefore, it was hoped that providing subjects with a number of key words would increase the likelihood of priming the schema of interest.

In a given instruction set, subjects were presented with car, telephone, and processing machine choice examples. The key word dimensions for the personal computer attribute Performance Reliability were Maintenance Record, Durability, and Product Consistency (respectively). Examples of information about the alternative relevant to the primed dimension include "Car A has a very good maintenance record" "Telephone C has very poor durability", "Machine D demonstrate good product consistency". See Appendices B, C, and D for the instructions given to subjects in the zero, low, and high priming conditions.

Theoretically, this type of priming procedure should be more effective than the lexical priming procedures used in previous research. In the lexical priming paradigm, subjects are typically asked to name products described by certain key words, or unscramble sentences containing the key words. According to the model presented here, this type of prime would activate schema in the Referent (product naming) or Semantic Bins (sentence unscrambling). In this context goal schema that place processing priority on the primed attribute would be called by the primed schema from the Referent or Semantic Bins after entering the problem solving situation. Embedding the primes within the problem solving context should directly activate the appropriate schema in the Goal Bin, where the problem solving schema reside. Thus, the intermediate step of calling the schema from the Semantic or Goal Bin and having these schema access the appropriate schema from the Goal Bin is eliminated. This priming procedure was demonstrated in pretesting to be equally effective to the lexical priming procedures.

<u>Dependent Variables</u>:

<u>Linearity of Search</u>. In a noncompensatory search process subjects examine information on a given attribute across all alternatives, and based on that information, eliminate one or more alternatives from further consideration. This process is repeated until only one alternative remains. In a noncompensatory search process, the ratio of information examined to the total amount of information available should be fairly low. This is

consistent with the interpretation of noncompensatory search processes as simplifying decision strategies (Payne, 1982).

In a compensatory search process, subjects examine all the attribute information for a given alternative, and then form a summary judgment of that alternative. The judgment is held in memory while a judgment about a second alternative is formed. The alternatives are compared, and one is discarded. This process is repeated until only one alternative remains. Thus, in a compensatory search process, all or nearly all the available information in the alternative - attribute matrix should be examined by the subject.

In this study, a revised version of the Doherty (1987) measure was used to determine the linearity of subject search. In this version of the measure, subjects' responses are mapped out as in Figure 3. In Figure 3, boxes containing 1's denote attribute information about an alternative that was accessed by a subject. The empty boxes denote pieces of information that were not accessed by the subject.

To obtain a subject's linearity score, first delete all alternatives that were completely unexamined by subjects from the alternative/attribute matrix. Then, count the number of boxes not examined by the subject and divide that number by the total number of boxes in the matrix minus the

| DIMENSIONS | ALTERNATIVES A | B | C | D | E |
|---|---|---|---|---|---|
| A | 1 | | | 1 | 1 |
| B | | 1 | | 1 | |
| C | 1 | | | 1 | 1 |
| D | 1 | 1 | | 1 | 1 |
| E | 1 | | | 1 | |
| TOTALS (No. of boxes not examined) | 1 | 3 | | 0 | 2 |

Linearity Score = $\dfrac{1+3+0+2}{20-4}$

(The number of boxes not examined)
(The total number of boxes in the matrix minus the number of remaining alternatives)

$= .38$

*Figure 3*. An example of how to compute a linearity score.

number of alternatives in the matrix (after eliminating the unexamined alternatives).

Thus, this measure ranges from 0 (a totally linear search) to 1 (a totally nonlinear search). Note that if a subject did not examine any information regarding an alternative (e.g., alternative C), all the boxes in that column are deleted from the matrix. If a subject eliminates an alternative without examining any of the information in the matrix regarding that alternative, a criteria unknown to the experimenter is being used, and the case becomes invalid. For example, if a subject chooses not to examine any information for a given alternative or consider that alternative, it may be because of a criteria known only to the subject. Thus, the subject is using a nonlinear decision strategy, and the boxes should be counted in the matrix. However, the subject may simply have been tired, and not felt like examining the given alternative. Or the subject may have simply forgotten to examine the alternative. The strategic implications of these situations are unclear. Since clear inferences cannot be made regarding the role of these alternatives in the search process, the alternatives were eliminated from the analysis.

<u>Number of Times the Primed Attribute is Accessed</u>. This measure was a percentage. The number of times each subject examined the primed attribute on each trial was divided by the total number of pieces of information examined by the

subject on the trial. A percentage measure was used to compare how often the primed attribute was accessed across time constraint conditions.

In high time constraint conditions, subjects are not able to access a large amount of information. Thus, in a high time constraint condition, the primed attribute may be the central focus of the search strategy even though it was accessed a fewer number of times than in a low time constraint condition in which the primed attribute was <u>not</u> the focus of the search strategy. Therefore, to control for the total amount of information searched across time constraint conditions, a ratio measure was used to assess how frequently the primed attribute was accessed in a given trial.

Cohen & Cohen (1982) caution against the use of ratio variables when examining relationships between the ratio and other variables of interest. Their primary concern is that the relationship between a variable (X) and the ratio (A/B) will depend on the relationship between X and A, X and B, and A and B. Correlations between X and A/B may be uninterpretable, or spurious. This problem is exacerbated when ratios are taken of variables that are not true ratios.

In the proposed ratio, both the numerator and denominator are true ratio variables. A zero value means a complete absence of that variable. The numerator and denominator should also be highly correlated in this ratio.

Cohen and Cohen note that a high correlation between the numerator and denominator in a ratio variable can help to overcome the problem of spurious relationships resulting from ratio variables.

Latency of Information Examined (the amount of time each piece of information is examined). This measure was provided by the computer's internal clock. The software program used to perform the problem records the amount of time the subject examines each piece of information they access.

Number of Times an Alternative High on the Primed Dimension was Chosen. This measure was a simple frequency count of the number of times a subject picks an alternative high on the primed attribute. It will range from 0 - the total number of trials containing a primed attribute.

Manipulation Checks:

Dimension Ratings. This form asks subjects to rank the importance of each dimension to personal computer selection. Appendix G contains a complete copy of this form.

Priming Awareness. This form asks subjects the extent to which they were aware of the effect of the primes on the experimental trials. Subjects scoring excessively high on this measure will have their data removed from the study. See Appendix I for a complete copy of this questionnaire.

Time Constraint. In the same form that contains the priming awareness questions, subjects were asked if they felt more pressure in the high time constraint conditions than in the low time constraint conditions. This measure will check the validity of the time constraint manipulation. See Appendix I.

Dimension Similarity. This questionnaire asked subjects to rate the conceptual similarity of each of the priming keywords to the primed dimension. These ratings may then be used as covariates in the analyses if the hypotheses do not turn out. This form also asks subjects to rate the importance of each of the keywords to overall product desirability. See Appendix J.

## ANALYSES

This section, like the Hypotheses, is organized by dependent variable. First, the analyses for the hypotheses with linearity of search as the dependent variable are described followed by the analyses for the number of times the primed attribute is accessed. Then, the analyses for latency of access and the number of times an alternative high on the primed attribute was chosen are described.

The hypotheses of this study were tested using either correlational or multiple regression analyses (Cohen & Cohen, 1982). Relationships between two variables (e.g., time constraints and linearity of search, Hypothesis 1) were tested with correlational analyses. The two-tailed significance level for the correlation from the SPSSX printout was used to test the hypothesis. Where appropriate, follow-up *T* tests were performed to determine mean differences among groups.

More complex hypotheses (e.g., those involving interaction effects) were tested using multiple regression procedures. Each trial was treated as a separate case in the regressions to increase statistical power. The *F* tests from the SPSSX printouts for the incremental $R^2$ of the variable of interest were used to test the hypotheses. Where appropriate, follow-up tests were done using the protected *T* procedure described in Cohen and Cohen (1982).

Linearity of Search

Time Constraint. The first hypothesis posited that a time constraint on the search processes in a multi-alternative, multi-attribute decision task would result in subjects utilizing a greater incidence of noncompensatory decision making strategies. This hypothesis was tested using a correlation between time constraint condition and linearity of search.

Knowledge. The second hypothesis of this study stated that subject knowledge in a decision making domain would be positively related to the use of a compensatory decision making strategy in that domain. This hypothesis was tested using a correlation between Personal Computer Knowledge Test score and linearity of search.

The Number of Times the Primed Attribute was Accessed

Time Constraint. The third hypothesis of this study stated that under conditions of time constraint, all subjects would examine the primed attribute more often than the nonprimed attributes. This hypothesis was tested using a correlation between time constraint condition and the number of times the subject accessed the primed attribute on each trial.

Time Constraint and Priming. The fourth hypothesis of this study stated that subjects would access the primed attribute a greater number of times under conditions of severe time constraint and high priming than under conditions of low time constraint and low priming. This hypothesis was tested using a multiple regression procedure. The dependent variable in the regression was the number of times the primed attribute was accessed on each trial. The independent variables were (in order): Trial (to control for practice effects), Time Constraint condition, Priming Condition, the Time X Prime moderator, and the Test X Prime moderator (this term was needed to test Hypotheses 5). This hypothesis was tested using the $\underline{F}$ test for incremental $\underline{R}^2$ of the Time X Prime moderator term.

Knowledge and the Number of Primes. The fifth hypothesis of this study posited that under conditions of priming, novice subjects would access the primed attribute more often than expert subjects. Under conditions of no priming, expert and novice subjects would access the primed attribute an equal number of times. The *F* test for the incremental $R^2$ of the Prime X Test moderator entered into the regression equation described above to test Hypothesis 4 was used to test this hypothesis.

Access Latency

Time Constraints. The sixth hypothesis of this study stated that time constraints would lead to each piece of information accessed by subjects to be examined for a relatively short period of time. This hypothesis was tested using a simple correlation between time constraint condition and access latency.

Knowledge. The seventh hypothesis of this study stated that knowledge in a subject area would be negatively related to the length of time subjects examined each piece of information. This hypothesis was tested using a correlation between Knowledge Test Score and Access Latency.

Priming. The eighth hypothesis of this study stated that priming would lead subjects to examine the primed pieces of information for a shorter period of time than nonprimed pieces of information. This hypothesis was tested using a regression analysis. The dependent variable in the regression equation was the mean difference between the access latencies for the nonprimed pieces of information and the primed pieces of information (nonprimed latency - primed latency) on each trial. The independent variables in the equation were (in order): Trial (to control for practice effects) and Priming. The _F_ test for the incremental $\underline{R}^2$ of the priming variable was used to test this hypothesis.

The Number of Times an Alternative High on the Primed Attribute was Chosen.

Time Constraint. The ninth hypothesis of this study stated that under conditions of severe time constraint, subjects would select an alternative high on the primed attribute more often than they would under conditions of low time constraint. This hypothesis was tested using a correlation between time constraint condition and choice (yes or no) on each trial.

Time Constraint and Priming. The tenth hypothesis of this study stated that under conditions of high time constraint and high priming, subjects would increase the number of times they selected an alternative high on the primed attribute. A regression was run using each trial as a case. The variables entered into the equation were (in order): Trial (to account for practice effects), Time Constraint, Priming, the Time X Prime moderator and the Prime X Test moderator (this variable was entered into the equation to test Hypothesis 11). The _F_ test for the incremental $\underline{R}^2$ of the Time X Prime moderator was used to test this hypothesis.

Knowledge and the Number of Primes. The eleventh hypothesis of this study posited that under conditions of high priming, novice subjects would choose an alternative high on the primed alternative a greater number of times than expert subjects. Under conditions of low and zero priming, expert and novice subjects would choose the primed alternative an equal number of times. The $F$ test for the incremental $R^2$ of the Prime X Test moderator entered into the regression equation described above to test Hypothesis 10 was used to test this hypothesis.

Summary of Analyses

A total of six correlations were computed and three regressions were run. The correlations were:

1. Time Constraint Condition and Linearity Score (Hypothesis 1).
2. Knowledge Test Score and Linearity Score (Hypothesis 2).
3. Time Constraint Condition and the Number of Times Subjects Accessed the Primed Attribute (Hypothesis 3).
4. Time Constraint Condition and Access Latency (Hypothesis 6).
5. Test Score and Access Latency (Hypothesis 7).
6. Time Constraint Condition and Choice (Hypothesis 9).

The regressions were run as follows:

1. Access = Trial + Time Constraint + Prime + Time X Prime + Prime X Test (Hypotheses 4 and 5).

2. Nonprimed Latency - Primed Latency = Trial + Prime (Hypothesis 8).

8. Choice = Trial + Time Constraint + Priming + Time X Prime + Prime X Test (Hypotheses 10 and 11).

# RESULTS

The results of this study are organized by dependent variable. First, the results of the analyses on the effects of time constraint and knowledge on linearity of search are presented (Hypotheses One and Two). Then the results of the effects of time constraint, priming, and knowledge on the number of times the primed attribute was accessed are presented (Hypotheses Three through Five). This is followed by a presentation of the results of the analyses on the effects of time constraint, knowledge, and priming on access latency (Hypotheses Six through Eight). Finally, the results of the analyses on the effects of time constraint, priming, and knowledge on the number of times an alternative high on the primed dimension was chosen are presented (Hypotheses 9 through 11). See Table 1 for the means and standard deviations of the major variables in this study. The correlations among these variables are presented in Table 2.

## Search Strategy

Time Constraints. The first hypothesis of this study posited that a severe time constraint on the search process in a multi-alternative, multi-attribute decision task would result in subjects utilizing a greater incidence of

Table 1

MEANS AND STANDARD DEVIATIONS OF THE MAJOR VARIABLES IN THE STUDY

| | MEAN | STANDARD DEVIATION |
|---|---|---|
| DEMOGRAPHICS | | |
| AGE | 19.41 | 2.49 |
| SEX[1] | .78 | .41 |
| GPA[2] | 2.86 | .47 |
| INDEPENDENT VARIABLES | | |
| PRIME[3] | 1.00 | .82 |
| KNOWLEDGE[4] | 12.32 | 2.82 |
| TIME[5] | .50 | .50 |
| DEPENDENT VARIABLES | | |
| LINEARITY[6] | .53 | .36 |
| ACCESS[7] | 4.01 | 3.09 |
| RELATIVE ACCESS[8] | .36 | .25 |
| LATENCY[9] | 3.04 | 1.11 |
| CHOICE[10] | .49 | .50 |

[1] Coded 0=Male, 1=Female.
[2] Grade point average (0.00 - 4.00).
[3] Coded 0=No prime condition, 1=Low prime condition, 2=High prime condition.
[4] Score on Knowledge of Personal Computer Test (0-20).
[5] Coded 0=Low time constraint, 1=High time constraint.
[6] The Linearity of Search measure ranges from 0-1.00. High scores on the linearity measure indicate a highly nonlinear search.
[7] Mean number of times subjects accessed the primed attribute on each trial.
[8] Relative number of times subjects accessed on primed attribute on each trial.
[9] Mean number of seconds subjects examined each piece of information on each trial.
[10] Mean number of times per trial subjects choose the alternative rated most highly on the primed attribute.

Table 2

Correlations Among the Independent and Dependent Variables

| | Time | Prime | Knowledge | Linearity | Access | Latency | Choice | R. Access |
|---|---|---|---|---|---|---|---|---|
| Time[1] | 1.00 | | | | | | | |
| Prime[2] | .00 | 1.00 | | | | | | |
| Knowledge[3] | .00 | .06* | 1.00 | | | | | |
| Linearity[4] | .77** | -.02 | -.02 | 1.00 | | | | |
| Access[5] | -.64** | .05 | -.01 | -.64** | 1.00 | | | |
| Latency[6] | -.13** | .02 | -.09** | .10** | .03 | 1.00 | | |
| Choice[7] | -.07* | .03 | .01 | -.03 | .20** | -.06 | 1.00 | |
| R. Access[8] | .77** | .16** | .01 | .29** | .24** | .03 | .32 | 1.00 |

$N$ = 1020.
[1]Coded 0=Low time constraint, 1=High time constraint.
[2]Coded 0=No prime condition, 1=Low prime condition, 2=High prime condition.
[3]Score on Knowledge of Personal Computer Test (0-20).
[4]The Linearity of Search measure ranges from 0-1.00. High scores on the linearity measure indicate a highly nonlinear search.
[5]Mean number of times subjects accessed the primed attribute on each trial.
[6]Mean number of seconds subjects examined each piece of information on each trial.
[7]Mean number of times per trial subjects choose the alternative rated most highly on the primed attribute.
[8]Relative Access. The relative number of times subjects accessed the primed attribute on each trial.
*$p < .05$, **$p < .01$, two-tailed.

noncompensatory decision making strategies. As can be seen in Table 2, this hypothesis was supported ($\underline{r}$ = .77, $\underline{p}$ < .01). Time constraints accounted for 59% of the variance in linearity of search. The mean linearity of search score for subjects under conditions of time constraint was .80 (SD = .21) versus .26 (SD = .25) under conditions of low time constraint (a high score on the linearity of search measure indicates a strongly nonlinear search process). Under conditions of time constraint subjects switched from linear to nonlinear search strategies.

Knowledge. The second hypothesis of this study posited that subject knowledge in a decision making domain would be positively related to the use of noncompensatory decision making strategies in that domain. This hypothesis was not supported ($\underline{r}$ = -.02, ns.). The mean linearity score for subjects low in knowledge was .54 (SD = .37). For subjects that were moderate and high in knowledge, the mean linearity scores were .53 (SD = .35) and .52 (SD = .35) (respectively). There was no significant relationship between subject computer knowledge test scores and linearity of search.

### Factors Influencing the Number of Times the Primed Attribute was Accessed

Time Constraints. The third hypothesis of this study posited that under conditions of time constraint, subjects would examine the primed attribute more often than the nonprimed attribute. The test for this hypothesis was significant, but the correlation was not in the expected direction ($r$ = -.64, $p$ < .01). Subjects accessed the primed attribute an average of 6.08 (SD = 2.90) times/trial under conditions of low time constraints, and 2.02 (SD = 1.66) times/trial under conditions of high time constraint (see Table 3).

This finding was probably due to the reduction in the absolute number of times subjects were able to access any information (including primed information) under conditions of time constraint. Thus, this hypothesis was tested using a percentage measure (percentage of the time subjects accessed the primed attribute on each trial) to control for the absolute number of times they were able to access information under conditions of time constraint. When tested in this manner, this hypothesis was supported ($r$ = .16, $p$ < .01). Subjects accessed the primed attribute 31% (SD = .12) of the time under conditions of low time constraint and 40% (SD = .32) of the time under conditions of high time constraint (see Table 4).

It may be that subjects accessed the primed attribute a greater number of times under conditions of time constraint due to some idiosyncratic feature of the primed attribute (e.g., attribute importance). To test this alternative hypothesis, subject importance ratings of the primed attribute were entered into a regression equation prior to

Table 3

Mean Absolute Access/Trial of the Primed Attribute

| | Zero Prime | Low Prime | High Prime | |
|---|---|---|---|---|
| Low Time Constraint | 5.62<br>(2.79)[1] | 6.33<br>(3.14) | 6.08<br>(2.74) | 6.01<br>(2.90) |
| High Time Constraint | 1.79<br>(1.54) | 2.10<br>(1.68) | 2.18<br>(1.73) | 2.02<br>(1.66) |
| | 3.70<br>(2.96) | 4.21<br>(3.29) | 4.12<br>(3.00) | |

[1] Numbers in parentheses represent standard deviations.

Table 4

Mean Relative Access/Trial of the Primed Attribute

| | Zero Prime | Low Prime | High Prime | |
|---|---|---|---|---|
| Low Time Constraint | .31<br>(.13)[1] | .31<br>(.11) | .33<br>(.13) | .31<br>(.12) |
| High Time Constraint | .39<br>(.34) | .40<br>(.32) | .41<br>(.32) | .40<br>(.32) |
| | .35<br>(.26) | .35<br>(.24) | .37<br>(.25) | |

[1]Numbers in parentheses represent standard deviations.

time constraint. However, when tested in this manner, the results did not change ($F$ (3,1016) = 28.58, $p$ < .01). The incremental $R^2$ for the effect of time constraints on access, both when controlling and not controlling for importance ratings, was .03.

Time Constraint and Priming. The fourth hypothesis of this study posited that subjects would access the primed attribute a greater number of times under conditions of severe time constraint and high priming than under conditions of low time constraint and low priming. This hypothesis was not supported using either an absolute access criterion ($F$ (6,1013) = 0.10, $p$ < .92) or a relative access criterion ($F$ (6,1013) = .004, $p$ < .95). There was no interaction between the time constraints and priming on the number of times the primed attribute was accessed by subjects (see Tables 3 and 4).

It should be noted that there was a significant main effect of priming on the number of times the primed attribute was accessed ($F$ (3,1016) = 5.60, $p$ < .02). Under conditions of zero priming, subjects accessed the primed attribute and average of 3.70 ($SD$ = 2.90) times/trial. Under conditions of low and high priming, subjects accessed the primed attribute an average of 4.21 ($SD$ = 3.29) and 4.12 ($SD$ = 3.00) times/trial (respectively).

An examination of the cell means illustrates the main effects of time constraints and priming on access and the lack of a significant interaction. Absolute access increases under conditions of priming (see Table 3) and relative access increases under conditions of time constraint (see Table 4). There is no differential change in access under conditions of high time constraint and priming. Thus, while time constraints and priming have main effects on search processes, there is no evidence in this study for interactive effects between these two variables on search processes.

Knowledge and the Number of Primes. The fifth hypothesis of this study posited that under conditions of priming, novice subjects would access the primed attribute more often than expert subjects. Under conditions of no priming, expert and novice subjects would access the primed attribute an equal number of times. This hypothesis was not supported ($F$ (5,1014) = .02, $p < .88$). There was also no main effect for knowledge ($r = .01$, *ns*.) on access.

Factors Influencing Latency of Search

Time Constraints. The sixth hypothesis of this study posited that time constraints would lead to each piece of information accessed by subjects to be examined for a relatively short period of time. This hypothesis was supported ($r = -.13$, $p < .01$). Mean access times were 2.92 ($SD$ = 1.13) seconds under conditions of high time constraint and 3.20 ($SD$ = 1.07) seconds under conditions of low time constraint.

It should be noted that trial was significantly related to access latency ($r = .34$, $p < .01$) and accounted for 22% of the within subject variance in access latency. While time constraint accounted for only 2% of the within subject variance after controlling for practice, this finding provides further support for the process of acceleration of search under conditions of time constraint.

Knowledge. The seventh hypothesis of this study posited that knowledge in a subject area would be negatively related to the length of time subjects examined each piece of information. Thus, subjects high in personal computer knowledge should access information for a relatively short period of time compared to novices. This hypothesis was supported ($r = -.09$, $p < .01$). Mean access time for subjects high in knowledge was 2.79 ($SD = 1.12$) seconds, for subjects with moderate knowledge 3.06 seconds ($SD = 1.12$), and for subjects low in knowledge 3.20 ($SD = 1.07$) seconds. The moderate and high knowledge groups differed significantly from the low knowledge group ($t(648) = 2.80$, $p < .01$, $t(556) = 4.25$, $p < .01$, respectively). The difference in access latency between the moderate and high knowledge groups approached significance ($t(822) = 1.86$, $p < .06$).

Priming. The eighth hypothesis of this study posited that priming would lead subjects to examine the primed pieces of information for a shorter period of time than the nonprimed pieces of information. This hypothesis was supported ($\underline{r}$ = .07, $\underline{p}$ < .05). See Table 5 for the mean access times for primed and nonprimed pieces of information under conditions of zero, low, and high priming.

<u>Factors influencing the Number of Times an Alternative High on the Primed Attribute was Chosen</u>

<u>Time Constraint</u>. The ninth hypothesis of this study posited that under conditions of severe time constraint, subjects would select an alternative high on the primed attribute more often than they would under conditions of low time constraint. This hypothesis was not supported. While the correlation was significant ($\underline{r}$ = -.07, $\underline{p}$ < .01), the sign of the correlation was in the opposite of the expected direction. Under conditions of time constraint, subjects selected an alternative high on the primed attribute 46% ($\underline{SD}$ = .50) of the time. Under conditions of no time constraint, they selected an alternative high on the primed attribute 52% ($\underline{SD}$ = .50) of the time. Thus, there was a negative relationship between time constraints and the number of times subjects chose an alternative rated highly on the primed attribute.

<u>Time Constraint and Priming</u>. The tenth hypothesis of this study stated that under conditions of time constraint and priming, subjects would increase the frequency with which they choose an alternative rated highly on the primed attribute. This hypothesis was not supported ($\underline{F}$ (5,1014) =

Table 5

Mean Access Latency/Trial (in seconds)

| | Zero Prime | Low Prime | High Prime |
|---|---|---|---|
| Primed Attribute | 3.16/1.23[1] (*n*=298) | 2.88/1.23 (*n*=308) | 3.08/1.28 (*n*=307) |
| Nonprimed Attributes | 3.07/1.04 (*n*=311) | 2.90/1.06 (*n*=325) | 3.23/1.33 (*n*=322) |

[1] Mean/Standard Deviation.

.82, *p* < .36). An examination of Table 6 shows that while the results are generally in the hypothesized direction, they are not strong enough to reach statistical significance. Under conditions of time constraint and no priming, there is a reduction in the mean choice/trial of an alternative rated highly on the primed attribute (41%). Under conditions of high time constraint and low priming, and high time constraint and high priming, subjects chose an alternative rated highly on the primed attribute an average of 48% of the time. Thus, under conditions of time constraint, it appears that there is a tendency for subjects to select an alternative rated highly on the primed attribute. However, this effect is not as strong as expected.

Knowledge and the Number of Primes. The last hypothesis posited that under conditions of high priming, novice subjects would choose an alternative high on the primed attribute a greater number of times than expert subjects. Under conditions of low and zero priming, expert and novice subjects would choose the primed alternative an equal number of times. While the *F* test for this hypothesis was significant, the effect was in the opposite of the expected direction ($F$ (6,1013) = 4.25, $p < .05$). There were no main effects for either priming ($r = .03$, *ns*.) or knowledge ($r = .01$, *ns*.) on choice.

Table 6

Mean Percentage of Choice/Trial by Time Constraint and Prime

| | Zero Prime | Low Prime | High Prime | |
|---|---|---|---|---|
| Low Time Constraint | .512 (.50)[1] | .526 (.50) | .512 (.50) | .516 (.50) |
| High Time Constraint | .411 (.49) | .480 (.50) | .477 (.48) | .456 (.50) |
| | .462 (.50) | .503 (.50) | .495 (.50) | |

[1]Numbers in parentheses represent standard deviations.

As can be seen in Table 7, priming led to an increase in the percentage of choice of an alternative rated highly on the primed attribute for subjects rated moderate to high in knowledge. For subjects rated low in knowledge, there was a decrease in choice of an alternative rated highly on the primed attribute.

Table 7

Mean Percentage of Choice/Trial by Knowledge and Priming

| | Zero Prime | Low Prime | High Prime |
|---|---|---|---|
| Low Knowledge (Test ≤ 11) | .50/.50[1] ($n$=150) | .46/.50 ($n$=96) | .47/.50 ($n$=120) |
| Moderate Knowledge (Test 11-14) | .45/.50 ($n$=132) | .54/.50 ($n$=198) | .48/.50 ($n$=132) |
| High Knowledge (Test ≥ 15) | .39/.50 ($n$=54) | .44/.50 ($n$=48) | .56/.50 ($n$=90) |

[1]Mean/Standard Deviation.

# DISCUSSION

This dissertation examined the effects of time constraints and category accessibility on decision making processes and final choice. While a number of hypotheses were not supported, the results of this study add some clarity to a number of complex issues in the decision making literature. Further, this study discovered several ambiguities in the nature of the priming mechanism described in the Wyer and Srull (1986) information processing model. However, the results also highlight the utility of the Wyer and Srull (1986) information processing model as a heuristic for hypothesis generation.

A major limitation of this study was the unreliability of the knowledge measure ($\alpha$ = .55). Because of this difficulty, a new construct was developed utilizing the variables ownership of a personal computer, whether the individual had considered purchasing a personal computer, the amount of time spent researching personal computers, the amount of time spent by the individual working on computers each week, and the self rating of computer knowledge. This construct was called Experience Working with Personal Computers. It had a standardized alpha reliability of .72.

The results of the study were reanalyzed using the Experience construct.

Overview

The first section of this chapter summarizes the results of the study and presents the analyses for the Experience construct in detail. Further, the results for the Experience and Knowledge constructs are compared. The second section discusses the implications of the results for decision making research and theory. The third section integrates the findings of the study into the information processing framework proposed by Wyer and Srull (1986). The following section of this chapter delineates several limitations of the study. This chapter ends with a discussion of future research directions suggested by the study.

## RESULTS SUMMARY

The first set of hypotheses addressed the effects of time constraints and subject knowledge on subject utilization of linear and nonlinear decision making strategies. It was found that under conditions of severe time constraints subjects significantly increased their utilization of nonlinear decision making strategies.

The second hypothesis of this study posited that subject knowledge in a decision making domain would be positively related to the use of noncompensatory decision making strategies in that domain. There was no relationship between subject knowledge of personal computers and linearity of search ($\underline{r}$ = -.03, ns.). Similarly, there was no relationship between subject experience and linearity of search ($\underline{r}$ = .01, ns.). This study found no relationship between subject expertise and linearity of search.

The second set of hypotheses addressed the impact of time constraints, priming, and knowledge on the number of times subjects accessed the primed attribute. Time constraints were found to negatively impact the total number of times subjects accessed the primed attribute. However, if the total amount of information subjects were able to access on each trial was controlled using a percentage of search per trial measure, it was found that time constraints increased the probability that subjects would access the primed attribute. There was no interaction between priming and time constraints on the number of times the primed attribute was accessed.

The fifth hypothesis of this study posited that under conditions of priming, novice subjects would access the primed attribute more often than expert subjects. Under conditions of no priming, expert and novice subjects would access the primed attribute an equal number of times. Knowledge and the number of primes did not interact to impact the number of times the primed attribute was accessed

($\underline{F}$ (5,1014) =.02, $\underline{p}$ < .88). When reanalyzed with the Experience construct, the $\underline{F}$ test for this hypothesis was significant ($\underline{F}$ (5,1014) = 4.98, $\underline{p}$ < .05). However, the beta weight was in the opposite of the expected direction.

As can be seen in Table 8, under conditions of zero priming, highly experienced subjects accessed the primed attribute significantly less than novices. Under conditions of low priming, subjects with moderate levels of experience significantly increased the number of times they accessed the primed attribute. Under conditions of high priming, highly experienced subjects significantly increased the number of times they accessed the primed attribute. Novices also increased their access, but not significantly. There was no significant main effect of Experience on the number of times the primed attribute was accessed ($\underline{F}$ (4,1015) = 2.41, $\underline{p}$ < .12).

It should be noted that priming had a significant effect only on the absolute number of times the primed attribute was accessed. There was no significant relationship between experience and the number of primes on the amount of relative access of the primed attribute ($\underline{F}$ (5,1014) = .08, $\underline{p}$ < .78).

The next set of hypotheses of the study addressed the impact of time constraints, knowledge, and priming on access latency. Time constraints were found to significantly

Table 8

Mean Access Per Trial by Experience and Priming

| | Priming Condition | | | |
|---|---|---|---|---|
| Experience | Zero | Low | High | |
| Low | 3.93[a] (3.06)[1] | 4.01[a] (2.96) | 4.19 (2.99) | 4.04 (3.00) |
| Moderate | 3.57[b] (2.87) | 4.94[a b] (4.08) | 4.00 (2.89) | 4.18 (3.30) |
| High | 3.04[a b] (2.64) | 3.74[a] (2.76) | 4.26[b] (3.46) | 3.68 (2.95) |
| | 3.70 (2.96) | 4.21 (3.29) | 4.12 (3.00) | |

[1]Numbers in parentheses represent standard deviations.
[a]Means with similar superscripts in a column differ significantly at $p < .01$.
[b]Means with similar superscripts in a row differ significantly at $p < .01$.

reduce the amount of time subjects spent examining each piece of information. Further, priming was found to significantly reduce the amount of time subjects examined the primed attribute.

The seventh hypothesis of this study posited that knowledge in a subject area would be negatively related to the length of time subjects examined each piece of information. This hypothesis was supported ($r = -.09$, $p < .01$). This hypothesis was also supported when reanalyzed using the Experience construct ($r = -.16$, $p < .01$). Highly experienced subjects had a mean access latency of 2.71 ($SD$ = 1.08) seconds. Subjects low to moderate in knowledge had mean access latencies of 2.97 ($SD$ = 1.05) and 3.21 ($SD$ = 1.13) seconds (respectively). Differences in access latencies among all groups were significant at $p < .05$.

The last set of hypotheses of this study addressed the effects of time constraints, priming, and knowledge on subject choice. Time constraints were negatively related to the number of times subjects chose an alternative rated highly on the primed attribute. Time constraints and priming did not interact to impact final choice.

The last hypothesis of this study posited that under conditions of priming, novice subjects would choose an alternative high on the primed attribute a greater number of times than expert subjects. Under conditions of low and zero priming, expert and novice subjects would choose the primed alternative an equal number of times. When analyzed using the knowledge construct, the $\underline{F}$-test for this hypothesis was significant, but the results were in the opposite of the expected direction. When reanalyzed with the Experience construct, this hypothesis was not supported ($\underline{F}$ (6,1013) = .39, $\underline{p}$ < .53). There was no interaction between subject experience and priming on the number of times subjects selected an alternative high on the primed attribute. Further, there was no main effect of experience on choice ($\underline{F}$ (4,1015) = .05, $\underline{p}$ < .83).

## THE RESULTS

This section is organized by dependent variable. First, the results of the effects of time constraints and experience on linearity of search are discussed. Then, the effects of time constraints, priming, and experience on the number of times the primed attribute was accessed are discussed. Third, the effects of time constraints, experience and priming on access latency are discussed. Fourth, the effects of time constraints, priming, and experience on the number of times an alternative rated highly on the primed attribute was selected are discussed.

Linearity of Search

Time Constraints. Under conditions of time constraints, subjects switch from linear to nonlinear decision making strategies. This is an extremely powerful effect accounting for 59% of the variance in linearity of search. It is likely subjects switch from linear to nonlinear strategies to simplify the problem and allow them to make to best possible decision under time constraint conditions. This study supports the conclusion of Payne et al. (1987) that subjects are aware of the differential effectiveness of decision making strategies under various contextual conditions, and adopt their behavior to maximize their outcomes in a given situation.

Experience. In this study, there was no relationship between subject experience or knowledge within an area and the linearity of search. Experienced and novice subjects accessed equal amounts of information across trials. These results lend some clarity to the debate over linearity of search and strategy complexity. It has generally been assumed that because linear strategies involve the processing of greater amounts of information, they are more complex than nonlinear strategies (Payne, 1976; 1982). Nonlinear decision processes have been described as simplifying strategies that reduce the amount of cognitive load under adverse conditions (such as a very large problem or time constraint).

It may be argued that nonlinear search strategies are more complex than linear strategies. Expert subjects may restrict their search to a subset of critical information and ignore noncritical information. This subset may be determined a priori based on knowledge or previous experience. This subset may also be determined interactively. Expert subjects may access a given piece of information and based on an evaluation of that piece of information, select the next piece. They may reiterate this process until they make their decision. In this manner they avoid the necessity of examining the entire alternative - attribute matrix. Restricted and interactive search are examples of complex nonlinear decision making strategies.

Novice subjects do not know the difference between pertinent and nonpertinent information. They are also unlikely to completely understand the implications of one piece of information and allow those implications to determine their selection of the next piece of information. Thus, to make the best decision under conditions of low time constraint, novices may examine all the available information in a decision problem. Under conditions of high time constraint they may attempt to determine the most important attribute, and based on a simple comparison of the alternatives on that attribute, make a decision. This is an example of a simple nonlinear decision making strategy.

This study found no significant differences in the search strategies of expert and novice subjects. Under conditions of low time constraint, expert and novice subjects both utilized linear decision making strategies. Expert subjects did not use sophisticated nonlinear decision making strategies to reduce processing load. Under conditions of high time constraint, both experienced subjects and novices utilized nonlinear decision making strategies to simplify the problem and reduce processing load.

However, there may be differences in expert and novice search strategies that were not measured in this study. For example, expert and novice subjects may examine different pieces of information. Further, they may examine that information in different orders. Finally, they may also weight and combine information differently to arrive at a decision.

Finally, these results are consistent with the cost-benefit model proposed by Christensen-Szalanski (1978; 1980). Processing information requires more effort (is more costly) for novices than experienced subjects. Novice subjects must expend more effort than experts to reach some minimal level of decision quality and obtain a similar minimum level of desired benefit. Expert subjects may view tasks their area of expertise as an opportunity to rest after or prior to processing information in an area in which they lack expertise.

## Factors Influencing the Number of Times the Primed Attribute was Accessed

Time Constraints. This study found a significant effect of time constraint on the relative number of times subjects accessed the primed attribute. This result did not change after controlling for factor importance. Though this result is consistent with the predictions of the Wyer and Srull (1986) model, it does not rule out the possibility that an idiosyncratic feature of the primed attribute caused it to be accessed a disproportionately large number of times under conditions of time constraint. For example, under conditions of time constraint subjects may behave in a loss aversive manner (Wright, 1977; Wright & Weitz, 1978). Subject search focused on the Performance Reliability (the primed attribute in this study) dimension may have reflected a loss aversive strategy. They may have reasoned that if they had to select a computer very quickly, it may be best to select one that works.

This potential alternative explanation could have been negated by a significant Time Constraint X Prime interaction. A significant Time Constraint X Prime interaction would indicate that priming was causing experienced subjects to focus on the primed attribute under conditions of time constraint regardless of any idiosyncratic features of the primed attribute.

Time Constraints and Priming. There was no significant interaction between time constraints and priming on the number of times subjects accessed the primed attribute. Time constraints impacted which pieces of information subjects accessed across decision trials. However, time constraints did not cause subjects to focus to a greater extent on the information currently primed in memory.

It may be the feature 'time constraint' causes subjects to select a problem solving strategy or goal schema that influences both search strategy and processing priorities. Examples of processing priorities are minimize loss (a loss aversive strategy) or maximize gain (a high risk strategy). The processing priorities of the goal schema cause subjects to focus on certain subsets of information and ignore information primed in memory.

Both expert and novice subjects are likely to have goal schema that they use under conditions of time constraint. In today's rapidly changing world there are very few people that escape the necessity of having to make decisions very rapidly. Thus, the routines for solving strategies under conditions of time constraint may be well rehearsed, and impervious to the effects of priming.

Experience and the Number of Primes. This study found that under conditions of priming, experts significantly increased the number of times they accessed the primed attribute. Novices did not increase their search on the primed attribute under conditions of priming. Further, experts examined the primed attribute significantly less often than novices under conditions of zero priming.

The mechanism underlying this effect is not entirely clear at this time. Expert subjects may have a large number of goal schema in their Goal Bins that allow them to place processing primacy on any number of potentially relevant factors (including the primed dimension). The possession of these goal schema may be a necessary condition for priming to have an impact on search processes. If a subject does not possess these schema, there is nothing for the prime to make more accessible in memory. Thus, expertise may cause individuals to be susceptible to a large variety of potential biasing factors.

Experts may be likely to consider a larger number of factors than novices when making a decision. This hypothesis is supported by the difference in expert and novice access of the primed attribute under conditions of zero priming. Experts are likely to have experience making decisions in a particular area. They are also likely to have observed situations in which placing processing priority on any of a number of factors resulted in a good decision. Thus, experts are likely to have developed a large number of goal schema to solve problems in their area of expertise. Given a large number of goal schema available to solve a problem, expert subjects may have difficulty in choosing among them. Thus, any stimuli that predisposes them to process information in any particular manner may have a powerful influence on their thinking.

However, there may be a level of expertise at which individuals are so well versed in their particular field that they cannot be influenced by extraneous biasing factors. These individuals would know exactly what type of information processing is required for any particular problem. Subjects at this level of expertise may not be susceptible to priming.

Thus, priming and expertise may have a inverted U relationship with decision making processes. Novices and very expert subjects may not be susceptible to priming effects. Novices lack the goal schema that must be activated for priming to occur. Very expert subjects ignore the effects of priming and automatically implement processing procedures that provide them with the best judgment in the given situation. Only those with moderate levels of experience in an area may be susceptible to priming. These individuals posses the goal schema that place a disproportionate emphasis on a number of factors in a decision and allow them to be susceptible to priming.

However, they also lack the experience and knowledge to ignore extraneous contextual features of the situation and implement the optimal problem solving strategy.

This study also found a significant main effect for priming on the number of times the primed attribute was accessed. There was a significant increase in the number of times the primed attribute was accessed under conditions of low and high priming. Bettman and Sujon (1987) did not find a main effect for priming on access.

This study and the Bettman and Sujon (1987) study differed in the method of measuring search process. Bettman and Sujon recorded subject written descriptions of their problem solving strategy. This study used a process tracing method. It may be that process tracing measures capture a number of cognitive comparisons made by subjects that were not measured in the Bettman an Sujon study. Bettman and Sujon indicated that their search process measure was only moderately adequate, and process tracing measures were needed to more accurately record subject search patterns.

These two studies also differed in the way subjects were primed. Bettman and Sujon used a lexical priming procedure. This study imbedded the primes in the problem instructions. Pretesting demonstrated the equivalence of these two priming procedures. However, the priming procedures are likely to differentially impact subject cognitive processes.

In the lexical paradigm, priming activates schema in the Referent or Semantic Bins. Goal schema that place processing priority on the primed attribute are called by the primed schema from the Referent or Semantic Bins after entering the problem solving situation. Embedding the primes within the problem solving context should directly activate the appropriate schema in the Goal Bin. Thus, in the priming procedure used in this study, the intermediate step of calling the schema from the Semantic or Goal Bin and having these schema access the appropriate schema from the Goal Bin is eliminated. The utilization of a priming method that directly impacts the selection of the goal schema used to solve the problem may result in a stronger effect for priming on search processes.

Thus, it is unclear if priming has a simple main effect, an interactive effect (with experience), or both main and interactive effects on the search processes of subjects. However, neither this study or that of Bettman and Sujon can be considered definitive regarding this question. Both studies were early attempts to utilize information processing theory from social psychology in a decision making paradigm. More research needs to be done to determine the impact of priming and experience on subject search processes.

Factors Influencing Latency of Search

Time Constraints. Time constraints led subjects to examine each piece of information for a relatively short period of time. This finding is consistent with the predictions of the model and previous research and theory. Time constraints represent a salient contextual feature of the problem. Under conditions of time constraint, subjects accelerate processing to process a reasonable amount of information relevant to the decision, and maximize possible gain. The feature 'accelerate processing' is matched to the goal schema in the Goal Bin. Then the appropriate goal schema (based on the best match) is selected to solve the problem within the time constraint condition.

Experience. Experienced and knowledgeable subjects processed information more quickly than novices. This result is consistent with the predictions of the model. Experts have chronically accessible schema and automatized processing routines that allow them to process information more quickly than novices. The small effect size observed in this study may be due to recruiting subjects of insufficiently extreme levels of expertise.

Priming. Priming also had a significant main effect on access latency. This result is consistent with the predictions of the Wyer and Srull (1986) model and previous research (Fazio et al., 1986). Priming causes schema to be more accessible in memory. Primed information can be processed more quickly due to its availability in memory. To process information not related to the primed schema, the appropriate schema needs to be accessed from memory and placed in the Work Space. Processing information related to the primed schema does not require this intermediate step and should proceed more quickly than processing nonprimed information.

### Factors Influencing the Number of Times an Alternative High on the Primed Attribute was Chosen

Time Constraint. This study found a significant effect of time constraints on choice, but the effect was in the opposite of the hypothesized direction. The reduction in choice of an alternative high on the primed attribute under conditions of time constraint was probably due to subject error. Research has shown that under conditions of time constraint, the quality of subject decisions is reduced (Zakay & Wooler, 1984). In the present study, subjects may have intended to select an alternative high on the primed attribute, but were unable to search through all the alternatives within the time constraint condition to find that alternative. Subjects accessed the primed attribute an average of only twice per trial under conditions of time constraint.

If subjects found the appropriate alternative, they may have made mistakes in either a) remembering which alternative it was, or b) executing their response. It is likely that these two types of error increased under conditions of time constraint. Thus, subjects may have intended to select an alternative high on the primed attribute, but may not have been able to execute that intention.

It may be that under conditions of time constraint subjects engaged in satisficing behavior (Simon, 1957; Simon & Newell, 1970). Instead of attempting to make the best possible decision, subjects may have attempted to make a decision that was adequate. They may have examined the alternatives on the primed attribute until they found an alternative that was not rated poorly or very poorly on that dimension. Their logic may have been 'the alternative is rated highly enough on this dimension'. Then, they may have moved to the next most important dimension and in the remaining time, attempted to find an alternative rated as highly as possible on that dimension. Their choice may have been based on an evaluation of the alternatives on these two dimensions.

Time Constraints and Priming. The Time Constraint X Priming interaction was in the expected direction, but did not reach statistical significance. There were a significant effects of priming on access and time constraints on relative access. Access was significantly related to choice. This suggests that priming and time constraints impact the manner in which subjects process information. However, these two factors do not interact to impact search processes.

Experience and the Number of Primes. In this study, priming did not have direct or interactive effects on choice. However, priming and experience interacted to influence access. Access, in turn, had a significant relationship with choice. Thus, the results of this study indicate that priming and experience interact to influence search processes and through this mechanism, impact on final choice. The implications of these findings for decision making theory are discussed in detail in the next section of the Discussion.

Model

The hypotheses of this study predict the model illustrated in Figure 4. Because of the emphasis in the social cognitive literature on analysis of variance designs and the impact of discrete independent variables on a restricted set of dependent variables, the hypotheses do not create a coherent picture when examined in this manner. Further, this paradigm does not encourage an examination of the relationships among the dependent variables. Thus, the model ignores the possibility of significant relationships among the dependent variables. This limitation significantly reduced the ability of the model and this study to predict decision making processes.

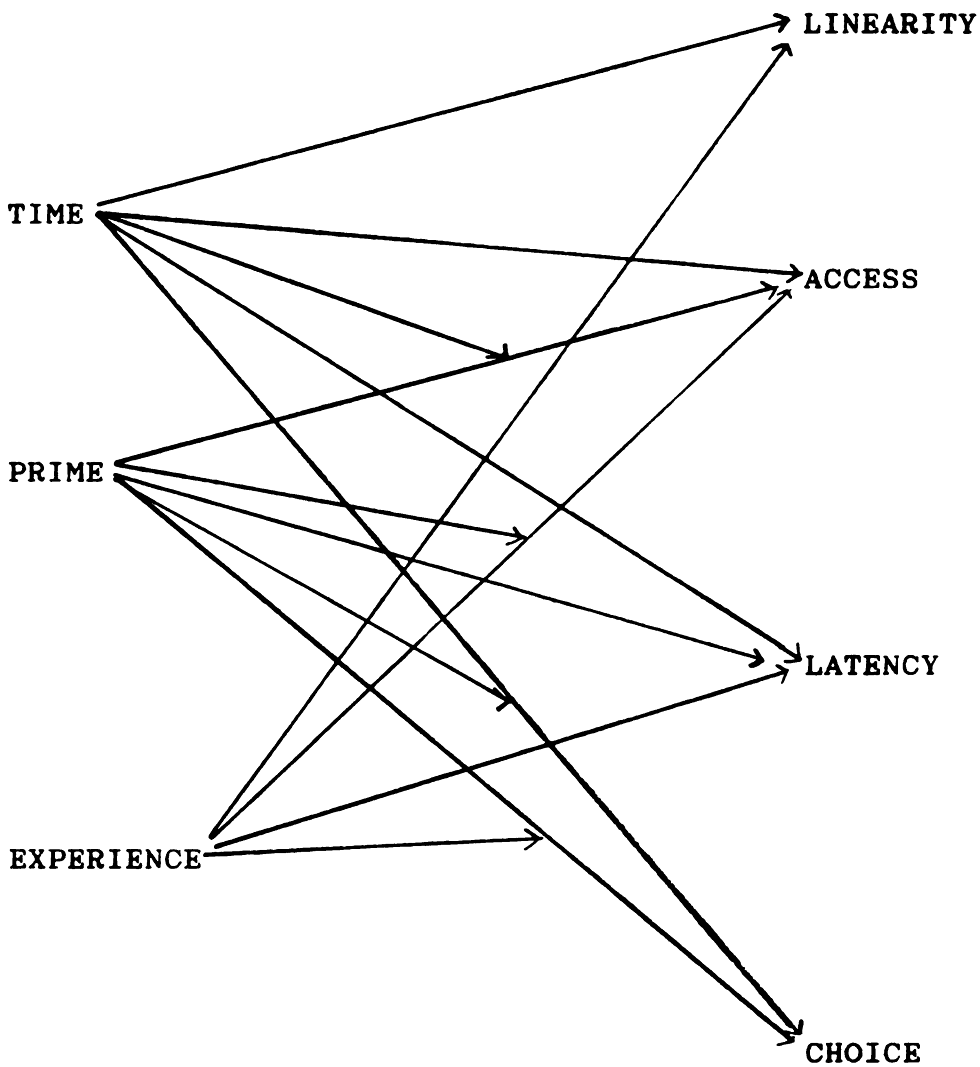



Figure 4. The model predicted by the hypotheses.

The results of this study suggest the model illustrated in Figure 5. As can be seen in Figure 5, the major independent variables (time constraint, priming, and experience) in the study are precursors to the process variables (linearity, access, and latency). Significant relationships exist among the process variables and predictors. It appears that priming, time constraints, and experience influence the process variables and the process variables are the most significant predictors of final choice.

This model was generated through a series of stepwise multiple regression analyses. First, all the variables in the model were regressed on choice. Then, each of the process variables (linearity, access, and latency) were entered as dependent variables in regression equations with the remaining two process variables and the independent variables as predictors. The variables in the model account for 49% of the variance in Access, 65% of the variance in Linearity and 25% of the variance in Latency. Unfortunately, only 6% of the variance in choice could be accounted for by both the process and independent variables considered in this study.

In the model, input variables (time constraints, priming, experience), process variables (latency, access, and linearity) and the outcome variable (choice) are placed

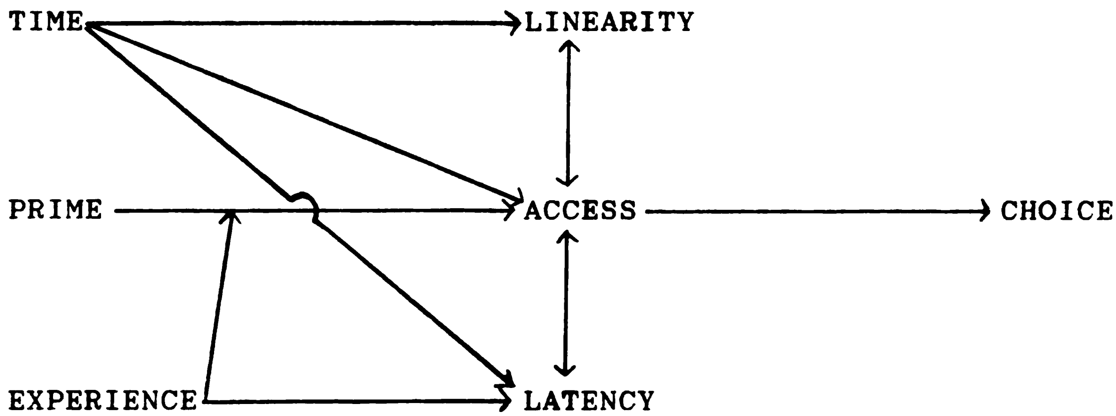



Figure 5. The revised model based on study findings.

in a logical and coherent framework. The model represents a much more sophisticated integration of the traditional decision making and social cognitive literatures than was originally formulated in this study. Unfortunately, the model does not address the complex role of information processing theory in decision making. However, information processing models can be used in this framework to determine the linkages among the variables in the model.

## IMPLICATIONS FOR THE WYER AND SRULL (1986) INFORMATION PROCESSING MODEL

This study to utilized the Wyer and Srull (1986) information processing model in a decision making context. It attempted to more clearly delineate the nature of the priming mechanism and its impact on decision making processes. This study investigated the effects of various contextual conditions (i.e., time constraints) on the effectiveness of the priming mechanism. The following discussion is an attempt to integrate the findings of this study into the theoretical framework provided by Wyer and Srull (1986). It must be noted that the conclusions drawn here are largely tentative and require verification in subsequent research.

The results of this study have implications for four facets of the Wyer and Srull (1986) model. The results address the impact of the decision context on the goal schema selected by subjects on each decision making trial. They also clarify the effects of priming on search processes. The results of this study lend some clarity to the interactions among the goal schema, processing procedures and their impact on choice. Finally, the results of this study raise a number of questions regarding the nature of the priming mechanism.

## Decision Context

This study indicated that subjects consistently utilize nonlinear, accelerated decision making strategies when faced with the contextual condition of time constraints. This finding is consistent with the predictions of the Wyer and Srull (1986) information processing model. The model predicts that the feature "time constraint" is placed in the Goal Specification Box (e.g., solve this problem in 30 seconds). This feature is then matched to schema in the Goal Bin. Then, a schema for solving the problem is selected from the Goal Bin that maximizes the probability of reaching the goal(s) placed in the Goal Specification Box. Thus, subjects consistently accelerate processing and implement nonlinear decision making strategies when faced with time constraint conditions.

## The Effect of Priming on Search Processes

This study indicated that under conditions of priming, goal schema are selected that cause an increase in the access of the primed attribute. This effect is stronger for experienced subjects than for novice subjects. This is probably because experts have schema in memory that can be made more accessible by priming. Novices are not likely to have these schema and should therefore be relatively unaffected by priming.

The Interaction of the Goal Schema, Processing Procedures and their Impact on Final Choice

This study (and the results of other studies, e.g., Bettman & Sujon, 1987) provide evidence for an interaction between experience and priming on the number of times the primed attribute was accessed. In this study, priming also had a main effect on the number of times the primed attribute was accessed. However, there was no main or interactive effects of priming and experience on final choice. Based on these findings, some tentative conclusions about the nature of the goal schema and the processing procedures that are called by the goal schema can be made.

The selection of the goal schema is affected by priming. Priming increases the probability that goal schema will be selected that focuses search on the primed attribute. However, the lack of main or interactive effects for priming and experience on choice implies priming does not directly impact information processing. If priming directly impacted information processing there should be a main effect of priming on choice. However, the effects of priming and experience on choice were mediated through access.

This finding suggests that search process and information processing are separate steps in the decision making context. If these two steps were integrated, then the information accessed as well as the processing of the information should be affected by priming. In this case, priming would directly impact choice and the effect would not be mediated through access. Thus, it appears that the goal schema determine linearity of search and search process. Information processing is done by the procedures called by the goal schema.

The Nature of the Priming Mechanism

There are a number of unanswered questions regarding the nature of the goal schema and processing procedures. Unlike studies done from a social information processing paradigm, there was no main effect for priming on final choice. Thus, it is not clear how or if priming affects the processing of incoming information.

In the social judgment paradigm, ambiguous information was presented to subjects (Higgins & Bargh, 1987). Ambiguous information presented in this type of paradigm is susceptible to priming at three different phases of information processing. First, priming may affect the initial evaluation of the information (from low to high along the primed dimension). Priming may also impact the formation of the information into concise dimensions for more efficient storage and processing. Priming may cause the formation of one or more dimensions that are closely related to the primed dimension. Finally, priming may impact the final compilation of the data into a summary judgment. Priming may cause the primed dimension to be given a relatively large weight.

In this study, the pieces of information presented to subjects were not ambiguous. The information was clearly anchored along a scale from very poor to very good. The information presented to subjects was assigned a priori to dimensions that allowed them to form reasonable holistic impressions of the targeted products. Processing speed, internal memory capacity, performance reliability, and documentation are very important and reasonably comprehensive descriptors of personal computer quality. Thus, the dimensions along which the information varied were well specified. The only place the priming had the potential to have an impact on information processing was in the weighting of the information in the formation of the final judgment. It may be that for priming to influence information processing, it must be allowed to impact all three phases of information processing.

This analysis allows for a partial resolution of the inconsistency between the results of this study and previous research from a social judgment paradigm. To function normally in society, individuals must be able to make simple social judgments. Nearly all individuals in the social judgment studies had a number of goal schema in their Goal Bins that allowed them to process information relative to social judgments. Some of these procedures may give any particular piece of social information greater weight in a given situation. Thus, these subjects possessed the schema in their goal bins that made them susceptible to priming.

Second, because of the ambiguity of the stimuli, it is likely that the priming had a greater impact on information processing in the social judgment studies than was apparent in this study. Thus, subject possession of the goal schema needed to be susceptible to priming and the ambiguity of the stimuli probably worked together to increase the probability that subjects accessed the primed attribute a large number of times. Because access and choice are related, this caused the observed main effect of priming on final judgment.

## Conclusions

The results of this study highlight one of the major strengths of the Wyer and Srull model. It allows for the generation of specific hypotheses that test various aspects of the model. Further, the model has the flexibility necessary to incorporate the findings of both supportive and contradictory empirical studies. For example, a number of the findings in this study supported some basic predictions of the model (e.g., the impact of time constraints on linearity of search). This study also highlighted a number of ambiguities and possible logical inconsistencies with the priming mechanism postulated by Wyer and Srull. However, the basic model retains its viability. As the findings of this and other studies are integrated into the model, it could become a powerful tool for predicting decision making behavior.

The primary weakness of the model lies not in the model itself, but in the nature of the research done to generate and verify the model. The vast majority of the research done to date on the model has revolved around the nature of the priming mechanism and outcomes. More research needs to be done on the effects of contextual variables on priming, and the role of process variables in the decision making process.

The model also suffers from a lack of research in a number of other areas. The nature of the priming mechanism needs to be more clearly delineated. Further, the nature of the goal schema should be described in greater detail. The clarification of these two aspects of the model will allow for the testing and delineation of the nature of the proposed processing mechanisms and storage bins in the model.

## STUDY LIMITATIONS

This section addresses limitations of the study. First, the possibility that the task utilized in this study lacked sufficient ambiguity to be susceptible to priming is explored. Then, the unreliability and lack of extreme scores on the knowledge test is discussed. Third, potential difficulties with the time constraint manipulation are discussed. Fourth, two potential weaknesses in the linearity measure are discussed; its inability to accurately reflect subject thought processes and its inability to accurately describe the linearity of subject search. Finally, the possibility that the latency measure did not accurately measure processing latency for each piece of information is discussed.

Task Ambiguity. Priming is hypothesized to impact the judgment of neutrally valenced or ambiguous descriptions of target individuals (Higgins et al., 1977; Srull & Wyer, 1979; 1980; Higgins et al., 1982, 1985; Wyer et al., 1984). In this study, study priming was allowed to impact only one step in the processing of the incoming information. This may have attenuated the effects of priming in this study. If the priming manipulation had been more powerful, it may have been possible to draw firmer conclusions regarding the nature of the goal schema, processing procedures, and effects of priming on information processing. It remains unclear whether priming impacts search processes alone or both search processes and information processing. More research needs to be done on the impact of priming on information processing under various task conditions.

Test Reliability. In this study, the reliability of the Personal Computer Knowledge Test was low ($\alpha$ = .55). For this reason, the Experience construct was developed and used to retest the hypotheses. However, the correlation between Experience and Knowledge was .42. Knowledge and Experience are related but reasonably independent constructs. The study was designed to investigate the effects of Knowledge on decision making processes. Thus, the unreliability of the Knowledge construct is a major limitation of the study.

It is likely that subjects of insufficiently extreme ability levels were recruited for the study. The subjects in this study were primarily 18-19 year old psychology and business majors. There may not have been a great enough difference in computer expertise between the high and low knowledge subjects to make a significant difference in the analyses. It may be necessary to recruit some subjects that are extremely high in knowledge in an area (e.g., graduate students or faculty in computer science) to observe differences in information processing among groups.

<u>Time Constraints</u>. The time constraint manipulation used in this study was so powerful that it may have obfuscated the impact of other factors on a number of dependent variables of interest. For example, time constraints accounted for 59% of the variance in linearity of search. Thus, there was little variance left to be accounted for by other factors.

It would be interesting to examine the effects of less extreme values of time constraint on decision making processes. For example, future research may wish to determine at what level of time constraint subjects begin to switch from linear to nonlinear decision making strategies. Further, with a less extreme time constraint manipulation, linearity of search could be impacted by other variables of interest, such as experience.

<u>Linearity Measure</u>. The results indicate that under conditions of time constraint, subjects switch from linear to nonlinear decision making strategies. However, it should be noted that process tracing measures are not perfect replications of subject search patterns. Further, the linearity measure used in this study does not perfectly indicate the degree of alternative (linear) or attribute (nonlinear) based processing in which subjects engaged.

Process tracing measures can indicate only which pieces of information are accessed by subjects and the order in which that information is accessed. Any inferences to subject processing, storage, and retrieval of the accessed information from process tracing measures are tenuous. Search processes can <u>indicate</u> the manner in which subjects are thinking, but they do not <u>replicate</u> subject thought processes. Subjects may access information in one order while performing a completely different set of cognitive comparisons or integrations of the data. The technology does not currently exist that could provide a perfect record of subject though processes while they are engaged in a decision making task.

The linearity of search measure used in this study imperfectly indicated the extent subjects utilized dimension or alternative based processing (linear vs. nonlinear processing). The measure used in this study indicated how much of the information available to subjects was examined. It does not provide an indication of the order in which the information was examined. Under conditions of no time constraint, a subject may have examined all the available information using a perfect nonlinear (dimension centered) search process. In this case the search would have received a score of 0.00 indicating a perfectly linear search. However, while coding the search patterns of subjects, it was clear that this situation occurred very rarely. Further, if a subject engaged in this type of search early in the decision trials, it was usually abandoned for a more alternative centered search process on subsequent low time constraint trials. Thus, it appeared that linearity of subject search was measured adequately in this study.

Latency Measure. It is not clear the extent to which the latency measure accurately reflected the amount of time subjects spent processing a each piece of information. Subjects may have accessed a piece of information, processed and stored it. They may also have accessed the piece of information, and performed one or more cognitive comparisons with that piece of information. These comparisons may or may not have been performed when subsequent pieces of information were accessed. Thus, the latency measure imperfectly indicated the amount of time spent processing each piece of information.

## FUTURE RESEARCH DIRECTIONS

Based on this study, some suggestions for future research can be given. Future research should 1) attempt to more clearly delineate the nature of the goal schema and the processing units, 2) clarify how priming impacts information processing, 3) address the complexity of linear and nonlinear decision making strategies under a variety of contextual conditions and with different subject populations, 4) clarify which pieces of information are accessed by novice and experienced subjects under conditions of priming, and 5) examine the relationships among input, process, and outcome variables from an a priori determined theoretical framework.

The Nature of the Goal Schema and Processing Procedures

There are a number of issues regarding the nature of the goal schema and processing procedures that need to be resolved. For example, under conditions of time constraint, subjects use nonlinear decision making processes and accelerate processing. It is not clear if the same processing procedures are called by the goal schema under conditions of low and high time constraint.

If the same procedures are used, acceleration of processing is a feature of the goal schema. If different procedures are used, acceleration of processing is a feature of the processing procedures. Speed of processing may be an inherent feature of these processing procedures. It is not clear if it is possible to process information quickly the same way it could have been processed if more time had been available. The act of processing information quickly may change the way the information is processed.

This question could be addressed by research that attempts to discover if there are inherent, qualitative differences in the way information is processed under conditions of time constraint and no time constraint. If there are inherent differences in the way information is processed under conditions of time constraint, it is likely different processing procedures are being accessed.

Policy capturing studies could be done that utilized time constraint conditions as a moderator. If the dimension beta weights in the problems significantly differ in the low and high time constraint conditions, it is likely that different processing procedures are called under different time constraint conditions. This would indicate the feature acceleration of processing is not part of the goal schema. If the beta weights do not differ, then the same procedures may be used, simply at an accelerated pace. This would indicate that acceleration of processing was a feature of the goal schema, and not the processing units.

There are a number of remaining questions regarding the nature of the goal schema and the processing units that should be addressed by future research. For example, it is not clear if processing objectives (e.g., under conditions of time constraint, behave in a loss aversive manner) are features of the processing units or goal schema. However, studies of the type described above would be a first step in the delineation of their function.

<u>The Nature of the Priming Mechanism</u>

The nature of the priming mechanism is probably more complex than originally posited by Wyer and Srull (1986) and of should be clarified by future research. A first step would be to determine the phase of information processing that is impacted by priming. Future research should systematically vary the ambiguity of information presented to subjects, and observe the effects of priming on decision making processes and final choice. For example, subjects could be presented with ambiguous information, but be given dimension categories for the information and a weighing scheme for the final evaluation of the information. They could also be given reasonably well anchored information, but the no indication of how to combine the information into a final judgment.

This research should include both novice and expert subjects. In the present study, novices were relatively unaffected by priming. However, if novices were forced to evaluate incoming information, form dimensions to summarize the information, and determine a weighting scheme for summarizing the information into a final judgment they may also form the processing procedures that would allow them to be susceptible to priming effects.

The Complexity of Linear and Nonlinear Decision Making Strategies.

This study indicated that linear decision making strategies were more complex than nonlinear decision making strategies. However, this conclusion may be different in studies in which there are correct and incorrect answers to the decision problems. It may also be different in studies in which subject expertise is defined more stringently.

If decision trials have absolute right and wrong answers, it may be possible for experts to use complex nonlinear decision making strategies to provide them with correct answers to the problems. They may be able to use these nonlinear decision making strategies to obtain correct answers with a frequency equal to or greater than novice subjects using linear decision making strategies. Certain types of questions with correct answers may have certain factors that provide strong indications of which answer is be correct. This information may constrain the variance of other factors making it unnecessary to examine them. Thus, previously accessed information would determine which pieces of information needed to be accessed next. Further, the performance decrement for experienced subjects under conditions of time constraint should be smaller than the decrement for novices. Experienced subjects should know which subset of information is most pertinent and therefore utilize their time more efficiently than novices.

Novice subjects may not know which factors indicate the correctness of a decision or understand the implications of one piece of information on other pieces. They may need to examine all the information in the alternative - attribute matrix. Further, they would not know how to utilize their time efficiently under conditions of time constraint and should evidence a large performance decrement under conditions of time constraint. A study with this pattern of results would indicate that nonlinear decision making strategies would be more complex than linear decision making strategies.

Another problem that needs to be addressed by future research is how much experience is required before subjects begin to utilize complex, nonlinear strategies. The test used in this study allowed for the identification of subjects that were relatively high, moderate, and low in personal computer experience. However, the subjects in this study were all likely to be very low in personal computer knowledge and experience. It may be that subjects need to be extremely high in experience in a particular area before they begin to utilize complex nonlinear decision making strategies.

Factors Influencing Which Pieces of Information are Accessed by Subjects

Priming and Experience. The results of this study and those of Bettman and Sujon (1987) on the effects of priming on search processes are in conflict. The present study found a main effect of priming on access. It was also found that experienced subjects increased the number of times they accessed the primed attribute under conditions of priming. Novices did not significantly increase the amount of access under conditions of priming.

As previously noted, different process tracing measures were used in the two studies. Further, this study used a different priming mechanism. The differences in the priming mechanism and/or the process tracing measures could account for the differences in the results of the two studies. More research should be done utilizing a number of process tracing measures and priming procedures to determine the precise nature of the effects of priming on search processes.

Input, Process Variables, and Decision Outcomes

Future research should combine inputs in the decision making process (e.g., time constraints, priming), process variables (e.g., latency, access, linearity), and outcomes (e.g., final choice, rating accuracy) within a single theoretical framework and integrated body of hypotheses. Large portions of the decision making process remain in a "black box". It is not clear if all of the relevant variables in the process have been identified. Perhaps most importantly, the interactions among the variables in the process remain unclear. Different relationships among inputs, process variables, and choice lead to very different conclusions regarding the nature of each variable. Thus, it will be very difficult for future research to understand and predict decision making processes without examining the process as a whole.

For example, the first recommendation of this section was that future research should clarify the nature of the goal schema and processing units. One method for addressing this issue is to further investigate the impact of priming on search processes and final choice. If priming is found to have a direct main effect on choice after controlling for access, this indicates that different procedures exist to process information under conditions of priming and no priming. Thus, an important feature of the goal schema is that is calls different processing procedures under various priming conditions.

If priming does not directly affect choice after controlling for access, it is logical to conclude that the same processing procedures are used under conditions of priming and no priming. This pattern of results would indicate that an important feature of the goal schema is that it directly impacts search strategy. However, the goal schema may or may not affect the processing procedures called to solve the problem. Differences in choice under various conditions of priming are likely to be due to the differential access of information by the goal schema under conditions of priming. The nature of the goal schema and processing procedures is unclear at this time. However, given this example it should be clear that studies attempting to clarify their nature must examine the relationships among input, process, and outcome variables.

Future research of the type described above should also examine the effects of priming on the quality of final choice. The findings of this study provide some direction for future research. It would seem that the effects of priming on the quality of final choice would depend on the contextual features of the situation and subject expertise. If there were clear right and wrong answers to the questions in the problem, experienced subjects may be less influenced by priming effects than they would be if there were not correct answers to the questions. The presence of correct and incorrect answers also implies that there are correct and incorrect means of attaining those answers. If subjects have clear, set problem solving strategies for addressing the problem, they should be less likely to be influenced by the effects of priming. Further, they could go back and check the accuracy of their answers. If an answer seems biased or incorrect due to the undue influence of a particular factor in the problem, they could recompute their answer.

Under conditions of time constraint, the responses of experienced subjects may be influenced by priming even if the problems had correct answers. They may not have time to select and implement the appropriate problem solving strategy. Further, experienced subjects may not have time to check their answers and uncover biases in their problem solving strategy due to priming effects.

Novice responses are relatively uninfluenced by priming. However, it is unlikely that the presence of correct answers to decision trials would differentially influence their level of susceptibility to priming. Novices do not have the needed experience or expertise to obtain cues from the problem that would counteract the effects of priming. There should be no change in novice susceptibility to priming effects across tasks with and without correct answers to the trials.

## FINAL COMMENTS

This study attempted to utilize the Wyer and Srull (1986) information processing theory to clarify the nature of decision making processes. This attempt was partially successful. The model allowed for the generation of a number of specific hypotheses for testing the model and provided a number of insights into decision making processes. However, several predictions made by the model were not supported. Further, this study discovered some important ambiguities in the nature of the priming mechanism. These issues, and other hypotheses testing various facets of the model's operation in a decision making paradigm, should be investigated by future research.

**APPENDICES**

# APPENDIX A

## CONSENT PROCEDURE AND FORM

## CONSENT PROCEDURE

The experimenter will greet the subject, and the subject will be given the Consent Form. The subject will be asked to read the form, and told that if they agree to participate in the experiment under the conditions specified in the Consent Form, to please sign it. The experimenter will also verbally inform the subject before they read the form that they may refuse to participate or stop participation at any time during the experiment with no penalty. They will also be told that the method of data recording will not allow them to be identified either directly or through identifiers. Their data will be identified in the data set only by a 4 digit random number.

## CONSENT FORM

I understand that I will be participating in a study in which I will asked to make personal computer judgments based on various pieces of information that describe the computers. I am also aware that I will be asked to fill out 3 questionnaires, and one paper and pencil test. My participation in this study will take no longer than 1 hour.

My participation in this study is voluntary. I understand that I may refuse to participate now or at any point during the collection of data without penalty. The procedures utilized in this study have been previously tested, and have been shown not to have any harmful effects to subjects. However, if I feel any discomfort due to the time constraint conditions, computer task, or test, I may stop participation with no penalty.

The method of recording data in this study will not allow me to be identified either directly or through identifiers. My data will be identified in the data set only by a 4 digit random number. My participation in this study will remain strictly confidential. Reports of the results of the study will not identify any participant.

I may obtain the results of this study from the experimenter by the end of the Spring quarter, 1988.

________________________________

Signature

# APPENDIX B

## ZERO PRIME INTRODUCTION

## WELCOME

This exercise is a simulation of a particular type of decision faced by computer programmers in some organizations. Today, you will be taking the role of a computer programmer and be asked to make a series of decisions regarding the purchase of a personal computer for your own work related use.

When a programmer purchases a new personal computer, there are number of factors to be considered. As a competent employee, you will want to consider some of these factors before you make your decision. For example, assume you wanted to buy a car, and you had several cars to choose from. You would probably want information about each cars' model, cost, stereo, and color. You would make a decision based upon your analysis of these factors. This is the same type of decision process you will be making in these problems.

If you have any questions, reread the previous page or ask the experimenter for help. If you do not have any questions, press the RETURN button and you will receive more specific instruction about your task.

To aid you in the search process, you will be presented two lists. One list contains several computers. These computers will always be labelled COMPUTER A, COMPUTER B, COMPUTER C, ...etc.". This list is labelled ALTERNATIVES. The second list contains a number of different factors that you might want to consider in evaluating the different ALTERNATIVES. This list is labelled DIMENSIONS. To continue with the car purchase example, you might encounter a screen of information such as:

| ALTERNATIVES | DIMENSIONS |
|---|---|
| 1=CAR A | 1=MODEL |
| 2=CAR B | 2=STEREO |
| 3=CAR C | 3=COST |
| 4=CAR D | 4=COLOR |

As you can see, each ALTERNATIVE and each DIMENSION are identified by a number. To begin searching for information, you will be asked two questions: (1) the ALTERNATIVE number about which you would like information and (2) the DIMENSION number about which you would like information. Using the number keys on the row above the typewriter keypad, simply type the number corresponding to the ALTERNATIVE you would like and then type the number corresponding to the DIMENSION you would like.

PRESS THE RETURN BUTTON TO CONTINUE

CONFUSED? Let's go through a problem in detail.

| ALTERNATIVES | DIMENSIONS |
|---|---|
| 1=CAR A | 1=MODEL |
| 2=CAR B | 2=STEREO |
| 3=CAR C | 3=COST |
| 4=CAR D | 4=COLOR |

To begin the search process, you will choose one ALTERNATIVE and one DIMENSION of information describing that ALTERNATIVE. You will continue this procedure until you have enough information to choose, or you run out of time. Then you will type the number corresponding to your choice.

PRESS THE RETURN BUTTON TO CONTINUE

To see how this procedure works, let's begin with the following lists:

| ALTERNATIVES | DIMENSIONS |
|---|---|
| 1=CAR A | 1=MODEL |
| 2=CAR B | 2=STEREO |
| 3=CAR C | 3=COST |
| 4=CAR D | 4=COLOR |

The following message will appear below the ALTERNATIVES and DIMENSIONS:

ENTER THE NO. OF THE ALTERNATIVE AND HIT RETURN ?

ENTER THE NO. OF THE DIMENSION AND HIT RETURN ?

Lets assume that you are interested in CAR A's STEREO. You would press 1 for CAR A and then 2 for STEREO. The present screen will disappear and the requested information will be shown on the next screen as follows:

PRESS THE RETURN BUTTON TO CONTINUE

CAR A HAS AN AM/FM CASSETTE STEREO

PRESS THE RETURN BUTTON TO CONTINUE

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At this point, the computer will print the following message:

ENTER 1: IF YOU WANT MORE INFORMATION

2: IF YOU WANT TO MAKE A FINAL DECISION

Let's assume that you are not ready to make a decision and would like more information. You would press 1 and the RETURN button. The computer will then reprint the original menu on the next screen.

PRESS THE RETURN BUTTON TO CONTINUE

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| ALTERNATIVES | DIMENSIONS |
|---|---|
| 1=CAR A | 1=MODEL |
| 2=CAR B | 2=STEREO |
| 3=CAR C | 3=COST |
| 4=CAR D | 4=COLOR |

ENTER THE NO. OF THE ALTERNATIVE AND HIT RETURN ?

ENTER THE NO. OF THE DIMENSION AND HIT RETURN ?

Now let's suppose you want to know the COST of CAR D.

You would type in a 4 for CAR D and a 3 for COST.

PRESS THE RETURN BUTTON TO CONTINUE

Now the computer prints the following message:

CAR D COSTS $8,000

PRESS THE RETURN BUTTON TO CONTINUE

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At this point, the computer will print the following message:

ENTER 1: IF YOU WANT MORE INFORMATION

2: IF YOU WANT TO MAKE A FINAL DECISION

Again, let's assume that you are not ready to make a final decision. After pressing the 1 key for more information, the computer will reprint the original menu on the next screen.

PRESS THE RETURN BUTTON TO CONTINUE

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**Let's try another problem. This time, let's assume you are a chief executive officer in an organization, and you are trying to decide which of several employees to promote. You have had your personnel people perform several tests on the candidates, and you have the pertinent information before you.**

| ALTERNATIVES | DIMENSIONS |
|---|---|
| 1=PERSON A | 1=COMMUNICATION SKILLS |
| 2=PERSON B | 2=MOTIVATION |
| 3=PERSON C | 3=INTERPERSONAL SKILLS |
| 4=PERSON D | 4=ORIGINALITY |

Let's assume you want to know about the INTERPERSONAL SKILLS of PERSON B.

You would type a 2 for PERSON B and a 3 for INTERPERSONAL SKILLS.

PRESS THE RETURN BUTTON TO CONTINUE

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The computer will print the following message:

PERSON B HAS GOOD INTERPERSONAL SKILLS

ENTER 1: IF YOU WANT MORE INFORMATION

2: IF YOU WANT TO MAKE A FINAL SELECTION

At this point, let's assume that you are ready to make a final decision. You would type a 2 then hit the RETURN BUTTON.

PRESS THE RETURN BUTTON TO CONTINUE

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The computer will now reprint the set of ALTERNATIVES as follows:

ALTERNATIVES
1=PERSON A
2=PERSON B
3=PERSON C
4=PERSON D

ENTER <N> IF YOU ARE NOT READY TO MAKE A DECISION
ENTER <Y> IF YOU ARE READY TO MAKE A DECISION

Since you are ready to make a decision, you would press the Y key. The computer will then ask you to enter your decision in the following manner:

ENTER THE NO. OF THE ALTERNATIVE YOU WISH TO CHOOSE AND HIT RETURN ?

Let's assume that you have decided to choose PERSON D. You would type in a 4 and hit the RETURN button.

PRESS THE RETURN BUTTON TO CONTINUE

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The computer will now print the following message:

YOUR FINAL DECISION IS PERSON D

This concludes the instructions for the decision problem. Please tell the experimenter that you are ready to proceed to the next portion of the study.

# APPENDIX C

## LOW PRIME INTRODUCTION

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## WELCOME

This exercise is a simulation of a particular type of decision faced by computer programmers in some organizations. Today, you will be taking the role of a computer programmer and be asked to make a series of decisions regarding the purchase of a personal computer for your own work related use.

When a programmer purchases a new personal computer, there are number of factors to be considered. As a competent employee, you will want to consider some of these factors before you make your decision. For example, assume you wanted to buy a car, and you had several cars to choose from. You may want information about each cars' maintenance record, stereo, model, and cost. You would make a decision based upon your analysis of these factors. This is the same type of decision process you will be using in these problems.

If you have any questions, reread the previous page or ask the experimenter for help. If you do not have any questions, press the RETURN button and you will receive more specific instruction about your task.

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To aid you in the search process, you will be presented two lists. One list contains several computers. These computers will always be labelled COMPUTER A, COMPUTER B, COMPUTER C, ...etc. This list is labelled ALTERNATIVES. The second list contains a number of different factors that you might want to consider in evaluating the different ALTERNATIVES. This list is labelled DIMENSIONS. To continue with the car purchase example, you might encounter a screen of information such as:

| ALTERNATIVES | DIMENSIONS |
|---|---|
| 1=CAR A | 1=MAINTENANCE RECORD |
| 2=CAR B | 2=STEREO |
| 3=CAR C | 3=COST |
| 4=CAR D | 4=COLOR |

As you can see, each ALTERNATIVE and each DIMENSION are identified by a number. To begin searching for information, you will be asked two questions: (1) the ALTERNATIVE number about which you would like information and (2) the DIMENSION number about which you would like information. Using the number keys on the row above the typewriter keypad, simply type the number corresponding to the ALTERNATIVE you would like and then type the number corresponding to the DIMENSION you would like.

PRESS THE RETURN BUTTON TO CONTINUE

CONFUSED? Let's go through a problem in detail.

| ALTERNATIVES | DIMENSIONS |
|---|---|
| 1=CAR A | 1=MAINTENANCE RECORD |
| 2=CAR B | 2=STEREO |
| 3=CAR C | 3=COST |
| 4=CAR D | 4=COLOR |

To begin the search process, you will choose one ALTERNATIVE and one DIMENSION of information describing that alternative. You will continue this procedure until you have enough information to choose, or you run out of time. Then you will type the number corresponding to your choice.

PRESS THE RETURN BUTTON TO CONTINUE

To see how this procedure works, let's begin with the following lists:

| ALTERNATIVES | DIMENSIONS |
|---|---|
| 1=CAR A | 1=MAINTENANCE RECORD |
| 2=CAR B | 2=STEREO |
| 3=CAR C | 3=COST |
| 4=CAR D | 4=COLOR |

The following message will appear below the ALTERNATIVES and DIMENSIONS:

ENTER THE NO. OF THE ALTERNATIVE AND HIT RETURN ?

ENTER THE NO. OF THE DIMENSION AND HIT RETURN ?

Lets assume that you are interested in CAR A's MAINTENANCE RECORD. You would press 1 for CAR A and then another 1 for MAINTENANCE RECORD. The present screen will disappear and the requested information will be shown on the next screen as follows:

PRESS THE RETURN BUTTON TO CONTINUE

CAR A HAS A VERY GOOD MAINTENANCE RECORD

PRESS THE RETURN BUTTON TO CONTINUE

At this point, the computer will print the following message:

ENTER 1: IF YOU WANT MORE INFORMATION

2: IF YOU WANT TO MAKE A FINAL DECISION

Let's assume that you are not ready to make a decision and would like more information. You would press 1 and the RETURN button. The computer will then reprint the original menu on the next screen.

PRESS THE RETURN BUTTON TO CONTINUE

| ALTERNATIVES | DIMENSIONS |
|---|---|
| 1=CAR A | 1=MAINTENANCE RECORD |
| 2=CAR B | 2=STEREO |
| 3=CAR C | 3=COST |
| 4=CAR D | 4=COLOR |

ENTER THE NO. OF THE ALTERNATIVE AND HIT RETURN ?

ENTER THE NO. OF THE DIMENSION AND HIT RETURN ?

Now let's suppose you want to know the COST of CAR D.

You would type in a 4 for CAR D and a 3 for COST.

PRESS THE RETURN BUTTON TO CONTINUE

Now the computer prints the following message:

CAR D COSTS $8,000

PRESS THE RETURN BUTTON TO CONTINUE

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At this point, the computer will print the following message:

ENTER 1: IF YOU WANT MORE INFORMATION

2: IF YOU WANT TO MAKE A FINAL DECISION

Again, let's assume that you are not ready to make a final decision. After pressing the 1 key for more information, the computer will reprint the original menu on the next screen.

PRESS THE RETURN BUTTON TO CONTINUE

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Let's try another problem. This time, let's assume you are a chief executive officer in an organization, and you are trying to decide which of several new processing machines to buy. You have had your people research the question, and you have the pertinent information before you.

| ALTERNATIVES | DIMENSIONS |
|---|---|
| 1=MACHINE A | 1=PRODUCT CONSISTENCY |
| 2=MACHINE B | 2=ENERGY COST |
| 3=MACHINE C | 3=WARRANTY |
| 4=MACHINE D | 4=LABOR COST |

Let's assume you want to know about the PRODUCT CONSISTENCY OF MACHINE C.

You would type a 3 for MACHINE C and a 1 for PRODUCT CONSISTENCY.

PRESS THE RETURN BUTTON TO CONTINUE

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The computer will print the following message:

MACHINE C HAS VERY GOOD PRODUCT CONSISTENCY

ENTER 1: IF YOU WANT MORE INFORMATION

2: IF YOU WANT TO MAKE A FINAL SELECTION

At this point, let's assume that you are ready to make a final decision. You would type a 2 then hit the RETURN BUTTON.

PRESS THE RETURN BUTTON TO CONTINUE

The computer will now reprint the set of ALTERNATIVES as follows:

ALTERNATIVES
1=MACHINE A
2=MACHINE B
3=MACHINE C
4=MACHINE D

ENTER <N> IF YOU ARE NOT READY TO MAKE A DECISION
ENTER <Y> IF YOU ARE READY TO MAKE A DECISION

Since you are ready to make a decision, you would press the Y key. The computer will then ask you to enter you decision in the following manner:

ENTER THE NO. OF THE ALTERNATIVE YOU WISH TO CHOOSE AND HIT RETURN ?

Let's assume that you have decided to choose MACHINE D. You would type in a 4 and hit the return button.

PRESS THE RETURN BUTTON TO CONTINUE

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The computer will now print the following message:

YOUR FINAL DECISION IS MACHINE D

This concludes the instructions for the decision problem. Please tell the experimenter that you are ready to proceed to the next portion of the study.

# APPENDIX D

## HIGH PRIME INTRODUCTION

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WELCOME

This exercise is a simulation of a particular type of decision faced by computer programmers in some organizations. Today, you will be taking the role of a computer programmer and be asked to make a series of decisions regarding the purchase of a personal computer for your own work related use.

When a programmer purchases a new personal computer, there are a number of factors to be considered. As a competent employee, you will want to consider some of these factors before you make your decision. For example, assume you wanted to buy a car, and you had several cars to choose from. You would probably want information about each cars' maintenance record, stereo, warranty, and cost. You would make a decision based upon your analysis of these factors. This is the same type of decision process you will be using in these problems.

If you have any questions, reread the previous page or ask the experimenter for help. If you do not have any questions, press the RETURN button and you will receive more specific instruction about your task.

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To aid you in the search process, you will be presented two lists. One list contains several computers. These computers will always be labelled COMPUTER A, COMPUTER B, COMPUTER C, ...etc. This list is labelled ALTERNATIVES. The second list contains a number of different factors that you might want to consider in evaluating the different ALTERNATIVES. This list is labelled DIMENSIONS. To continue with the car purchase example, you might encounter a screen of information such as:

| ALTERNATIVES | DIMENSIONS |
|---|---|
| 1=CAR A | 1=MAINTENANCE RECORD |
| 2=CAR B | 2=STEREO |
| 3=CAR C | 3=WARRANTY |
| 4=CAR D | 4=COST |

As you can see, each ALTERNATIVE and each DIMENSION are identified by a number. To begin searching for information, you will be asked two questions: (1) the ALTERNATIVE number about which you would like information and (2) the DIMENSION number about which you would like information. Using the number keys on the row above the typewriter keypad, simply type the number corresponding to the alternative you would like and then type the number corresponding to the DIMENSION you would like.

PRESS THE RETURN BUTTON TO CONTINUE

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CONFUSED? Let's go through a problem in detail. Let's assume you were considering the purchase of a telephone.

| ALTERNATIVES | DIMENSIONS |
|---|---|
| 1=TELEPHONE A | 1=COLOR |
| 2=TELEPHONE B | 2=STRESS TEST RESULTS |
| 3=TELEPHONE C | 3=TONE QUALITY |
| 4=TELEPHONE D | 4=WARRANTY |

To begin the search process, you will choose one ALTERNATIVE and one DIMENSION of information describing that alternative. You will continue this procedure until you have enough information to choose, or you run out of time. Then you will type the number corresponding to your choice.

PRESS THE RETURN BUTTON TO CONTINUE

To see how this procedure works, let's begin with the following lists:

| ALTERNATIVES | DIMENSIONS |
|---|---|
| 1=TELEPHONE A | 1=COLOR |
| 2=TELEPHONE B | 2=STRESS TEST RESULTS |
| 3=TELEPHONE C | 3=TONE QUALITY |
| 4=TELEPHONE D | 4=WARRANTY |

The following message will appear below the alternatives and dimensions:

ENTER THE NO. OF THE ALTERNATIVE AND HIT RETURN ?

ENTER THE NO. OF THE DIMENSION AND HIT RETURN ?

Lets assume that you are interested in TELEPHONE A's WARRANTY. You would press -1- for TELEPHONE A and then -4- for WARRANTY. The present screen will disappear and the requested information will be shown on the next screen as follows:

PRESS THE RETURN BUTTON TO CONTINUE

TELEPHONE A HAS A ONE YEAR UNCONDITIONAL WARRANTY

PRESS THE RETURN BUTTON TO CONTINUE

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At this point, the computer will print the following message:

ENTER 1: IF YOU WANT MORE INFORMATION

2: IF YOU WANT TO MAKE A FINAL DECISION

Let's assume that you are not ready to make a decision and would like more information. You would press 1 and the RETURN button. The computer will then reprint the original menu on the next screen.

PRESS THE RETURN BUTTON TO CONTINUE

| ALTERNATIVES | DIMENSIONS |
|---|---|
| 1=TELEPHONE A | 1=COLOR |
| 2=TELEPHONE B | 2=STRESS TEST RESULTS |
| 3=TELEPHONE C | 3=TONE QUALITY |
| 4=TELEPHONE D | 4=WARRANTY |

ENTER THE NO. OF THE ALTERNATIVE AND HIT RETURN ?

ENTER THE NO. OF THE DIMENSION AND HIT RETURN ?

Now let's suppose you want to know the STRESS TEST RESULTS for TELEPHONE D.

You would type in a 4 for TELEPHONE D and a 2 for STRESS TEST RESULTS

PRESS THE RETURN BUTTON TO CONTINUE

Now the computer prints the following message:

THE STRESS TEST RESULTS FOR TELEPHONE D WERE VERY POOR

PRESS THE RETURN BUTTON TO CONTINUE

At this point, the computer will print the following message:

ENTER 1: IF YOU WANT MORE INFORMATION

2: IF YOU WANT TO MAKE A FINAL DECISION

Again, let's assume that you are not ready to make a final decision. After pressing the 1 key for more information, the computer will reprint the original menu on the next screen.

PRESS THE RETURN BUTTON TO CONTINUE

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L
C

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**Let's try another problem. This time, let's assume you are a chief executive officer in an organization, and you are trying to decide which of several new processing machines to buy. You have had your people research the question, you have the pertinent information before you.**

| ALTERNATIVES | DIMENSIONS |
|---|---|
| 1=MACHINE A | 1=MAINTENANCE RECORD |
| 2=MACHINE B | 2=WARRANTY |
| 3=MACHINE C | 3=LABOR COST |
| 4=MACHINE D | 4=PRODUCT CONSISTENCY |

Let's assume you want to know about the PRODUCT CONSISTENCY OF MACHINE C.

You would type a 3 for MACHINE C and a 4 for PRODUCT CONSISTENCY.

PRESS THE RETURN BUTTON TO CONTINUE

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The computer will print the following message:

THE PRODUCT CONSISTENCY FOR MACHINE C IS GOOD.

ENTER 1: IF YOU WANT MORE INFORMATION

2: IF YOU WANT TO MAKE A FINAL SELECTION

At this point, let's assume that you are ready to make a final decision. You would type a 2 then hit the RETURN BUTTON.

PRESS THE RETURN BUTTON TO CONTINUE

The computer will now reprint the set of ALTERNATIVES as follows:

ALTERNATIVES
1=MACHINE A
2=MACHINE B
3=MACHINE C
4=MACHINE D

ENTER <N> IF YOU ARE NOT READY TO MAKE A DECISION
ENTER <Y> IF YOU ARE READY TO MAKE A DECISION

Since you are ready to make a decision, You would press the "Y" key. The computer will then ask you to enter you decision in the following manner:

ENTER THE NO. OF THE ALTERNATIVE YOU WISH TO CHOOSE AND HIT RETURN ?

Let's assume that you have decided to choose MACHINE D. You would type in a 4 and hit the return button.

PRESS THE RETURN BUTTON TO CONTINUE

The computer will now print the following message:

YOUR FINAL DECISION IS MACHINE D

This concludes the instructions to the decision problem. Please tell the experimenter that you are ready to continue with the next portion of the study.

# APPENDIX E

## DIMENSION VALUES

## DIMENSION VALUES

1. Processing Speed
    a. Very Poor
    b. Poor
    c. Fair
    d. Good
    e. Very Good

2. Working Memory Capacity
    a. Very Poor
    b. Poor
    c. Fair
    d. Good
    e. Very Good

3. Performance Reliability
    a. Very Poor
    b. Poor
    c. Fair
    d. Good
    e. Very Good

4. Documentation
    a. Very Poor
    b. Poor
    c. Fair
    d. Good
    e. Very Good

# APPENDIX F

## TASK INSTRUCTIONS

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## TASK INSTRUCTIONS

While performing these tasks, please imagine that you are a computer programmer working for an organization. Your task is to select the best computer from the given set of alternatives for your own work-related use. Please also imagine that all the information provided in each problem is accurate, and from a credible source.

# APPENDIX G

# DIMENSION RATING FORM

## DIMENSION RATINGS

Please rate the importance to overall personal computer quality of each of the following dimensions using the following scale: 1=Critically Important; 2=Very Important; 3=Important; 4=Of Some Importance; 5=Not Important. Circle the appropriate number.

| | Critically Important 1 | 2 | Important 3 | 4 | Not Important 5 | Do Not Know 6 |
|---|---|---|---|---|---|---|
| 1. Processing Speed | 1 | 2 | 3 | 4 | 5 | 6 |
| 2. Documentation | 1 | 2 | 3 | 4 | 5 | 6 |
| 3. Performance Reliability | 1 | 2 | 3 | 4 | 5 | 6 |
| 4. Working Memory Capacity | 1 | 2 | 3 | 4 | 5 | 6 |

# APPENDIX H

## PERSONAL COMPUTER KNOWLEDGE TEST

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to each

1. The
devices:
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A.
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*C.
D.

2. The
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3. The
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4. The

5. A

6.

## Personal Computer Knowledge Test

Please circle the letter that corresponds to the best answer to each question.

1. The basic computer system consists of three separate devices: the computer, the keyboard, and the video monitor. The computer:
   A. Inputs the information into the keyboard.
   B. Displays the information for the user.
   *C. Contains the command programs and disk drives.
   D. Prints the information from the screen.

2. The keyboard:
   *A. Enters the work instructions into the computer.
   B. Displays the information for the user.
   C. Contains the disk drives.
   D. Contains the command programs.

3. The video monitor:
   A. Enters the work instructions into the computer.
   *B. Displays information being processed by the computer.
   C. Copies the information from the hard disk to the floppy disk.
   D. Contains the command programs and disk drives.

4. The cursor:
   A. Connects the keyboard to the internal hard disk.
   B. Reads and writes data to the hard disk.
   C. Executes commands within the computer.
   *D. Indicates the user's position on the Video Screen.

5. A disk drive:
   A. Is a collection of programs used to run the computer.
   B. Is a device that allows the computer to run at variable speeds.
   *C. A device used to read data from and write data onto disks.
   D. An electronic device that glows when current flows through it.

6. A monochrome video monitor is capable of:
   *A. a single color display.
   B. a double color display.
   C. a triple color display.
   D. a multiple (more than 3 colors) color display.

7. Which of the following processors is NOT usually found in an IBM compatible personal computer?
A. 8088
B. 8086
C. 80386
*D. 68881

8. Which of the following clock speeds is the fastest?
A. 4.77 Mhz
B. 6.00 Mhz.
C. 8.00 Mhz.
*D. 10.00 Mhz.

9. RAM:
A. Is the speed at which your computer can process information.
*B. Temporarily stores information that changes very rapidly.
C. Is a permanent memory structure.
D. Memory that changes in access speed over time.

10. MS DOS has a RAM limit of:
A. 256k
B. 360k
C. 512k
*D. 640k

11. A serial port is:
A. faster than a parallel port.
*B. a port that transmits information a bit at a time.
C. a port that transmits information in groups of bits.
D. A and C

12. Which of the following will probably be a faster computer?
A. 8086 processor, 4.77 Mhz clock
B. 8088 processor, 6.00 Mhz clock
C. 80286 processor, 6.00 Mhz clock
*D. 80286 processor, 10.00 Mhz clock

13. A bit is:
A. A printed circuit board.
B. A means of transmitting information from one point to another.
*C. A binary digit.
D. A type of connector.

14. A bus is:
    A. The process of loading an operating system into a computer.
    B. A method of altering a floppy disk capacity to equally that of a hard disk.
    *C. A circuit or line used to carry data or power between two or more locations.
    D. A group of programs used to store large pieces of information.

15. The computer's central processing unit (CPU) is:
    A. A circuit or line used to carry data or power between two or more locations.
    B. A binary digit code.
    *C. The circuitry that processes and controls the data.
    D. A connector having the shape of the capital letter D.

16. Formatting a disk entails:
    A. Connecting it to a parallel port.
    *B. Organizing the surface of a disk to accept information.
    C. Outputting the contents of the disk to a printer.
    D. Displaying the information from the disk on the video monitor.

17. A sector is:
    *A. A portion of a disk track.
    B. The results of computer operation.
    C. The computer's primary processing unit
    D. A code that represents data in some form to the computer.

18. "Booting" the computer entails:
    A. Printing the material on the screen through a parallel port.
    *B. The process of loading an operating system into the computer.
    C. Placing material in RAM into permanent storage on a hard disk.
    D. Sending the computer to Nicaragua

19. A hard disk is:
    A. A form of high density, transferrable disk storage.
    B. A form of low density, transferrable disk storage.
    *C. A form of high density, fixed-disk storage.
    D. A form of low density, fixed-disk storage.

20. The power supply is important, particularly with reference to:

A. The speed of your machine.
*B. The expandability of your computer.
C. The density of the disk drives.
D. The size of the data path.

## APPENDIX I

## DEBRIEFING QUESTIONNAIRE

## SUBJECT DEBRIEFING FORM

Please fill in the requested information in the appropriate blanks.

1. AGE:____________________

2. SEX:____________________

3. MAJOR:______________________________

4. GPA:____________________

5. CLASS STANDING:_____________________

For the next five questions (Questions 6-10), please circle the correct answer.

6. Do you own a personal computer?

Yes No

7. Have you ever considered buying a personal computer?

Yes No

8. If the answer to 7 was Yes, how many hours did you spend researching personal computers?

| Zero | 1-2 hrs. | 3-4 hrs. | 5-10 hrs. | 11 or more hrs. |
|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 |

9. How many hours a week do you work on personal computers?

| Zero | 1-2 hrs. | 3-4 hrs. | 5-10 hrs. | 11 or more hrs. |
|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 |

10. Please indicate your best estimate of your own level of personal computer knowledge. Circle the best answer.

| 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|
| No Know-lege | Some Knowledge | Conver-sational | Informed | Well Informed |

Please answer the following questions as accurately as possible. Circle the best answer to each question.

1. To what extent do you feel the problem instructions and examples were useful to you as you performed the experimental task?

| To a Great Extent | To Some Extent | Very Little | Not at All |
|---|---|---|---|
| 1 | 2 | 3 | 4 |

2. Did you feel more rushed when you had to make a decision in 30 seconds than when you had to make a decision in 5 minutes?

| Yes, Much More Rushed | Yes, More Rushed | A Little More Rushed | No Real Difference |
|---|---|---|---|
| 1 | 2 | 3 | 4 |

3. To what extent did you feel more confident in the decisions your made in 5 minutes than the decisions you made in 30 seconds?

| To a Great Extent | To Some Extent | Very Little | Not at All |
|---|---|---|---|
| 1 | 2 | 3 | 4 |

4. Did you notice a similarity between the dimensions in the examples in the instructions and the dimensions describing the alternatives in the experimental task? How were they similar?

# APPENDIX J

# CONCEPTUAL SIMILARITY AND IMPORTANCE QUESTIONNAIRE AND PROCEDURE

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## DIMENSION SIMILARITY INSTRUCTIONS

In the study you just completed, you were asked to compare several similar alternatives, and choose one of the alternatives. This is the first step of the current research project. In the next step, we will be asking subjects to make a choice among several dissimilar alternatives. To help us design this task, we need to obtain some additional information from you.

Most of the dimensions that described the computers in the problems you just completed were fairly specific to computers and computer products. For example, there are very few products other than computers for which the dimension working memory capacity is a major concern. However, the dimension Performance Reliability is applicable to a number of products. We would like to find out how people think about the dimension Performance Reliability.

We would like to know what factors comprise the Performance Reliability dimension, and how important each of those factors is to overall product desirability. We will use this information to design the tasks for future experiments. We will attempt to design different choice tasks comprised of dissimilar alternatives described by common dimensions. The information you provide us here will help us construct problems that have similar dimensions, and be confident that the dimensions make sense for each set of involved products. For example, it doesn't make sense to talk about the performance reliability of a work table, though the durability of the table may be important. We want to be able to compare the relative importance of this dimension across several products.

## DIMENSION SIMILARITY

Please rate the conceptual similarity of each of the listed dimensions to PERFORMANCE RELIABILITY using the following scale: 1=Identical; 2=Very Similar; 3=Similar; 4=Not Similar; 5=Completely Different. Please circle the correct answer

| | Identical 1 | Very Similar 2 | Similar 3 | Not Similar 4 | Completely Different 5 |
|---|---|---|---|---|---|
| 1. Product Life Expectancy | 1 | 2 | 3 | 4 | 5 |
| 2. Maintenance Record | 1 | 2 | 3 | 4 | 5 |
| 3. Durability | 1 | 2 | 3 | 4 | 5 |
| 4. Warranty | 1 | 2 | 3 | 4 | 5 |
| 5. Predictability | 1 | 2 | 3 | 4 | 5 |
| 6. Stress Test Results | 1 | 2 | 3 | 4 | 5 |
| 7. Dependability | 1 | 2 | 3 | 4 | 5 |
| 8. Tone Quality (e.g., telephone tone quality | 1 | 2 | 3 | 4 | 5 |
| 9. Credibility | 1 | 2 | 3 | 4 | 5 |
| 10. Product Consistency | 1 | 2 | 3 | 4 | 5 |

## IMPORTANCE RATINGS

Now, please rate the importance of each of the following dimensions to <u>OVERALL PRODUCT DESIRABILITY</u> using the following scale: 1=Critically Important; 2=Very Important; 3=Important; 4=Of Some Importance; 5=Not Important. Please circle the correct answer.

| | Critically Important 1 | 2 | Important 3 | 4 | Not Important 5 |
|---|---|---|---|---|---|
| 1. Product Life Expectancy | 1 | 2 | 3 | 4 | 5 |
| 2. Maintenance Record | 1 | 2 | 3 | 4 | 5 |
| 3. Durability | 1 | 2 | 3 | 4 | 5 |
| 4. Warranty | 1 | 2 | 3 | 4 | 5 |
| 5. Predictability | 1 | 2 | 3 | 4 | 5 |
| 6. Stress Test Results | 1 | 2 | 3 | 4 | 5 |
| 7. Dependability | 1 | 2 | 3 | 4 | 5 |
| 8. Tone Quality (e.g., telephone tone quality) | 1 | 2 | 3 | 4 | 5 |
| 9. Credibility | 1 | 2 | 3 | 4 | 5 |
| 10. Product Consistency | 1 | 2 | 3 | 4 | 5 |

# APPENDIX K

# DEBRIEFING FORM

## DEBRIEFING FORM

In this study, we are interested in the effects of time constraints and memory structure on decision making processes and subsequent choice. It is hypothesized that time constraints will affect the way subjects search through alternatives and attributes when making decisions. It is also hypothesized that priming certain constructs in memory will impact the types of information subjects look at, and their final choice. The most interesting hypotheses of this study examine the interaction of these two factors on decision making processes. These interactions are discussed in more detail below.

Research has shown that imposing time constraints on decision making tasks causes subjects to use simplifying decision making strategies. In other words, subjects attempt to simplify the decision by examining only a subset of the available information that they judge as being relatively important. Priming certain constructs in memory has been shown to bias choice in the direction of the primed constructs in a number of decision making contexts (e.g., social judgment, problem solving, consumer behavior). The impact of priming on search process is currently unclear.

The results of this study should replicate previous research on the effects of time constraints on decision processes and priming effects on final choice. The results are also expected to demonstrate that time constraints and priming have an interactive effect on search process and final choice. Time constraints should result in a significant effect of priming on search processes and final choice. This affect should remain constant across all subjects, including those known to be highly knowledgeable in the relevant subject area.

DO YOU HAVE ANY QUESTIONS?

THANK YOU FOR PARTICIPATING IN OUR EXPERIMENT

Brian M. Hults
355-2171

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