Time Pressure and Task Adaptation

Alternative Perspectives on Laboratory Studies

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Introduction

Given the tremendous importance of time as an organizing principle for behavior, it is surprising how little attention it has been given as a factor in decision making and choice. Indeed, by definition, to decide means to arrive at a conclusion or make up one's mind. Thus, decision making is rooted in the concept of time, and time is one of the primary resources that decision making and choice draw upon.

Inherent in the relationship between time and choice is the notion that better choices require more time. "Considered judgment," "careful deliberation," and "a timely conclusion" imply that the quality of one's decisions and judgments are reflected in the time afforded the process, carry the image of incubation in which information and values are carefully evaluated, and appropriate tradeoffs are made.

In contrast with the notion of time as a resource that facilitates decision making and choice, is time as a scarce commodity to be used wisely. The decision maker, for example, who uses too much time in making up his/her mind is labeled indecisive, implying a deficiency in decision-making skills; a wasting of time that perhaps could be better used for other purposes.

Thus a conflict arises: A good and prudent individual consciously allocates time to making decisions and choices, but not too much time. The establishment of a clear frame of time is an important element of "good" decision making, and a good decision maker manages time as an allocatable resource.

Given this model, all decisions and choices occur under time pressure, within a time frame that has a deadline, either self-imposed by an individual, or established by the external context in which the behavior occurs. The time frame is initiated by internal events (e.g., a perceived need to make a decision), external events (e.g., task demands of an occupation), or by both.

Despite the importance of understanding the relationship between decision making and temporal context, relatively few empirical studies are available that have directly addressed the effects of time pressure on judgment and choice. As will be discussed below, these studies have largely demonstrated time pressure effects in the context of laboratory tasks, but have provided little basis for distinguishing between alternative models of decision making that embody chronometric elements. This chapter explores alternative theoretical perspectives that may be useful in accounting for the time pressure effects that have been observed and presents a preliminary model for how transitory time pressure effects may occur as part of an individual's adapting to changes in task demands brought on by constraining time availability.

Manipulations of Time Pressure

Experimental studies form the core of what we know about the effects of time pressure on judgment and choice. It is important, therefore, to examine what constitutes time pressure in the context of laboratory studies.

We do not have a theory that chronometrically decomposes decision or choice processes. Experimental studies that examine time pressure effects have difficulty establishing how much to constrain time for the observation of task degradation. Usually, the time constraints needed are established through trial and error. The procedures used for four such studies are reproduced here to give the reader a clearer sense of how time pressure conditions have been established.

> During the design of the experiment various time constraints on the problem were tested. It was determined that a subject could obtain the optimum solution within a five minute time limit. (This was determined to be true expost given that approximately half of the subjects within the five minute treatment attained a performance of 99% of the optimum solution or better). Less time, e.g. 2 to 3 minutes, appeared to induce excessive strain and seriously impair performance. (Benbasat & Dexter, 1986) Subjects took about 50 seconds, on average, when under no time pressure in the pilot studies. Those pilot studies revealed that 15 seconds represented substantial time pressure for the subjects. (Payne, Bettman, & Johnson, 1988)
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> The first group made the 36 decisions without any time pressure, while the second group was allowed only 20 seconds for each decision (20 seconds having been found in a pilot study to constitute severe time pressure). (Zakay, 1985)
>
> The choice of these durations was based on a pilot study which showed that average time taken for completing the experimental task by means of the MAU model was 6o s. (Zakay & Wooler, 1984)

Other important studies documenting time pressure effects do not specify how the time intervals were chosen, but also do not provide a theoretical rationale. For example,

> For time pressure manipulation three time values were chosen: 8 sec (High), 16 sec (Medium), and 32 sec (Low). (Ben Zur & Breznitz, 1981)
>
> The time pressure treatment required the subject to respond to each problem within 6 s. (Rothstein, 1986)

Thus, "time pressure" is the time constraint placed on a task that makes people feel time pressured. Although the effects that have been observed using this experimental paradigm are important, the lack of a time-based theoretical rationale for decision and choices processes is discomforting.

An alternative is to justify a time pressure manipulation on the basis of theory, as well as previous research results. The following rationale from Wright and Weitz (1977) provides an excellent example.

> Insight on how the 10-seconds or 40-seconds per option compares with natural decision times consumers display is gained from introspection and from experiments on decision times. First try introspecting. The stimulus profiles in this study had three attributes, so consider a decision among four such products. At 10 seconds per product, a person has 40 seconds to evaluate each one and

> choose. The reader can sit quietly for 40 seconds to determine how much deliberation is possible in that period. At 40 seconds per product, he has two minutes, 40 seconds to decide. A reader who tries thinking about a four-option, three-attribute problem steadily for that period will appreciate how liberal it is. The times subjects took in experiments on complex choices are also relevant. Kiesler's (1966) children took from 3 to 11 seconds to choose between two or four branded candy bars. Hendrick et al.'s (1968) young men took from 5 to 15 seconds per necktie in choosing from sets of four neckties. Pollay (1970) had men choose between four R & D projects for a firm. Excluding reading times, they took from 60 to 85 seconds per project, depending on how many attributes were displayed. Jacoby et al. (1974) found that women average from 14 to 40 seconds per concept in deciding between four-attribute packaged food concepts, depending on how many were available. So the time conditions used in the current study seem to represent points within the range of times people invest on everyday decisions of many types. (Wright & Weitz, 1977, Footnote 4)

Taxonomic work is not generally considered one of the more attractive research areas in the behavioral and cognitive sciences. Unfortunately, however, without taxonomies we have no systematic means of knowing how to interpret abroad range of experimental studies. The same is true of research on time pressure: Without a taxonomy to serve as a map of the temporal framework underlying decision and choice processes, we are easily left with a collection of laboratory effects that are difficult to translate into specific predictions about the conditions under which time constraints will degrade decision processes and in what ways.

Constructed Decisions

One speculation is that time pressure effects are the result of accelerated information processing. Some years ago, Miller introduced the notion that information overload plays an important role in the quality of adaptation between an organism and its environment (Miller, 1960). He proposed that systems, including biological and social systems, respond to the demands of information overload by increasing their processing rate. At a point where further acceleration is not possible, the system employs several mechanisms to manage the overload. The mechanisms he identified included omission (temporary nonprocessing), error (processing information incorrectly), queing (delaying processing of some information), filtering, cutting categories (responding in more general ways), multichannel processing, and escape. It is important to recognize that Miller was attempting to account for decrements in information processing under overload across a broad range of system levels, from single cells to social systems.

His set of mechanisms were proposed as "adjustments" that a system makes to allow it to continue responding to incoming stimuli. In a sense, Miller proposed that a speed versus precision tradeoff occurs in which an organism accelerates its response rate at the cost of a higher error rate or, perhaps, incomplete information processing. This leads to the hypothesis that accelerating information processing, such as through time pressure, overloads one's capacity and introduces errors and omissions that result in systematic biases.

Although Miller's concepts are attractive explanations of the time pressure effects that have been observed in the laboratory, the acceleration hypothesis assumes that decision making is constructive and that people decompose decision problems into smaller, more manageable subtasks that are organized in time. Although some theories of judgment and choice have proposed staged models (e.g., Goldstein & Einhom, 1987; Kahneman & Tversky, 1979), details of the temporal organization of the strategies people use to solve decision and choice problems remains unclear. People may simply work faster and do a poorer job, rather than work faster but complete only part of the task.

Events as Time Pressure Cues

Various theories of time perception have proposed that the passage of time is judged on the basis of the number of intervening events during an interval (e.g. , Fraisse, 1963; Ornstein, 1969). The larger the number of events that occur within a given time period, the longer the period is judged to be. By implication, anything that increases the perception that a number of events have transpired will also increase one's perception of the length of the time period of those events. More simply put, when many events take place, a large amount of time must have passed.

Events, then, can serve as a cue for how rapidly time is passing. This could be extended to include cognitive events, such as the processing of information relevant to a decision or choice. If cognitive events are used as a basis for judging the passage of time, then increasing cognitive activity should increase the amount of time that an individual will perceive as passing (e.g., Block, 1978; Block & Reed, 1978). Under conditions where a fixed amount of time is allowed for decision making, increased cognitive activity may exacerbate a perception that time is being consumed. Thus, the time-pressured individual experiences an increase in the perception of time pressure due to the increase in the number of cognitive events taking place.

Time pressure, in this sense, is experienced as a disturbance in one's internal clock or ability to judge the passage of time. Urgency is exacerbated by mental activity; the more the processing of information is accelerated, the greater the sense of time pressure. This hypothesis predicts that the perception of time pressure is not linear with veridical time but increases exponentially as deadlines draw near.

An alternative viewpoint, directly derived from the study of cognitive workload, is that time pressure effects are the result of the overload people experience associated with having to keep track of time (see Zakay, this volume). The concept of workload has been used to account for decrements in task performance when individuals are given multiple tasks to perform (see Wickens, 1991, for a review). One way in which cognitive workload can be assessed is "primary task interference" (e.g., Moray, 1979). In this paradigm, performance on a primary task degrades in quality as the demands of a secondary task are imposed.

If people are attempting to monitor time availability when the demand to do so is created, motivated either by themselves or the demands of a context, then keeping track of time is a secondary task that may compete for cognitive resources with the primary task. Unfortunately, we know relatively little about the chronology of most decision-making tasks, and so it is difficult to make predictions about how temporal demands would induce monitoring and effect decision task performance, though we can use a primary-secondary task model to explain time pressure effects after they are observed.

Time and Task Adaptation

Empirical studies to date on time-pressured decision making and choice have focused on the perturbations in these processes when time constraints are relatively severe (e.g., Ben Zur & Breznitz, 1981; Rothstein, 1986). Indeed, the analysis presented in this chapter has argued that time pressure as conceptualized in the majority of laboratory studies is a condition under which an individual will adopt a steady-state strategy for managing a decision task that is different from the strategy they would use if more time was available. These strategies include, for example, conservatism and preference for negative information (Ben Zur & Breznitz, 1981) and underutilization of cues in a multicue judgment context (Rothstein, 1986). A key element in producing time pressure effects is that they must be persistent and observed repeatedly. Thus, if an individual is able to reestablish a compensatory strategy, for example, after the imposition of a particular degree of time constraint, then a time pressure effect is taken not to be present.

An alternative conceptualization of time pressure is that degradation in decision and choice processes occurs under lesser degrees of time constraint, at transitions in task tempo. Tempo transitions occur when performance demands are changed in a very short time frame, much as occurs in a supervisory control context where an operator spends large amounts of time monitoring information but must shift rapidly into responding to sudden changes in the state of a system (e.g., Sheridan & Ferrell, 1981). Consider the model shown in Figure 1.

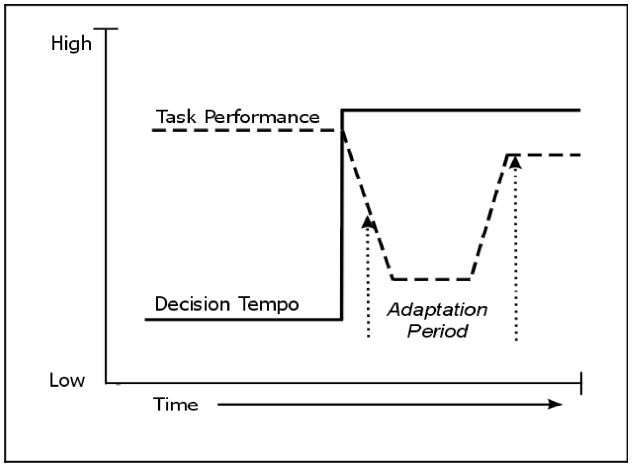

Figure 1. Hypothesized model of tempo transition effect on decision task performance.

During an initial time period, decision task tempo is fairly low, and an individual responding to task requirements will have adapted to this tempo. Task demands will be met with strategies that are most effective, or for which the individual has received training. In Figure 1, this is characterized as "high task performance". This can be measured by one of several indices depending on the task, including error rate, precision or accuracy, departures from optimality, and choice of task strategy. With a sudden transition to a new task tempo, a period of performance degradation occurs during which the strategies and information- processing demands appropriate for the initial tempo are inappropriate and/or ineffective. As performance falls, new task strategies are adopted to cope with the change in task tempo. This is an adaptation period, during which task efficiency increases as a function of how well the individual is able to identify and implement new response strategies. Task efficiency will return to its previous level according to several factors, including (a) the amount of change in task tempo, (b) the amount of time over which the change in tempo occurs, and (c) the availability of alternative response strategies.

This model assumes that people are capable of adaptation to changes in the amount of time they have to perform decision and choice tasks. Miller's model of adaptation to information overload (1960), for example, is rooted in the notion that people recognize, though perhaps at an unconscious level, when temporal resources are scarce and alter their information processing. Other research, more directly related to decision making, has found that sensitivities of preferences to time availability are brought about by changes in information-processing strategies (e.g., Svenson & Edland, 1987).

The acceleration model of information processing under time constraints (Miller, 1960) suggests that, within some limited boundaries, people should be able to return to a prior strategy after initially adopting an alternative strategy in response to time pressure. Thus, it is possible that a compensatory strategy of decision making, for example, may be returned to under some time pressure conditions, after a noncompensatory strategy was selected for reasons of urgency.

Alternatively, once a strategy shift is made, the new strategy may be adhered to without reconsideration. For example, if an individual uses a compensatory strategy without time pressure, and a noncompensatory strategy is employed once time constraints are imposed, will they continue to use the noncompensatory strategy if time constraints are now relaxed? If the choice of a response strategy is a function of the time available for using it, then we would expect a return to the prior strategy. This assumes that people engage in some type of meta-analysis of the information-processing strategies they use for solving decision and choice problems. The overwhelming conclusion from research on human judgment and decision making is that people have a tendency to rely on relatively simple cognitive strategies (e.g., Kahneman, Slovic, & Tversky, 1982). This suggests that they would not return to a more complex strategy after adopting a more simple one in response to time pressure.

The potential for time pressure to act as a cue for response strategy selection is a critical issue in applied settings where time constraints vary widely. Ideally, an individual in such environments would adopt the best strategy he/she could given the time available and would return to a better strategy as time restraints were relaxed. However, anchoring on a response strategy that was adaptive for a relatively high-time-pressure situation may result in poor performance during subsequent time intervals that would permit the use of a different strategy. Whether people are reflexive when adopting decision and choice strategies in response to time pressures remains open to question.

Discussion

One way to determine the parameters or components of an unknown system is to expose it to increasing degrees of stress and observe how it degrades or changes its operation. Presumably, the more fragile elements of the system fail or change how they operate first, followed by the more resilient ones until the system ceases to function to any meaningful degree. The research to date on time pressure has been carried out much in this spirit; human decision makers have had imposed on them increasing time constraints such that their ability to act in the same way they would if they had more time for deliberation is so compromised as to be observable in their performance. What we have found so far is evidence that decision processes are perturbed by increasing degrees of time pressure. It is probably fair to say that this is not a surprising finding, though it does confirm our ideas that information processing associated with decision and choice is adaptive to task characteristics.

Ideally, our future research into the impact of time pressures on decision making would develop along at least two potential lines. The first is a better understanding of the chronology associated with decision processes. Though we have demonstrations that time pressure effects occur, we have no good theory that describes the temporal characteristics of decision processes. Such a theory would allow us to make better predictions of the components of decision making that are most likely to be effected by constraining the amount of time that decision makers have for information processing and strategy construction. Bettman, Johnson, and Payne (1990) have used componential analysis to identify the relative effort associated with subtasks that are a part of decision strategies. This paradigm could be used to study the chronometric properties of decision making as well, perhaps leading to a linkage between the effort required of decision task components and the effects of time pressure on component utilization in decision strategy selection.

A second line of research might lead to a better understanding of the links between time pressure effects and higher-order psychological processes. In an elegant speculative analysis of the psychological experience of time, Toda (1975) noted that an important role of a functioning cognitive system is the preservation or continuation of the individual in his/her environment. According to Toda, cognition is the means by which our identity is preserved over time. If

this is so, then temporal resources are important not only for the information processing associated with decision task performance but also for psychodynamic functioning. Thus, the anxiety associated with time-pressured decision making may be in part due to the potential inability to achieve one's goals in a situation and to the (partial) loss of ability to maintain one's identity. This suggests that individual differences in psychodynamic functioning and tolerance for stress may play an important role in mediating the effects of time pressure on decision making.

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