Communications of the Association for Information Systems

Volume 23 Article 22

10-2008

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Recommended Citation

Djamasbi, Soussan; Tulu, Bengisu; Loiacono, Eleanor; and Whitefleet-Smith, JoAnn (2008) "Can a Reasonable Time Limit Improve the Effective Usage of a Computerized Decision Aid?," *Communications of the Association for Information Systems*: Vol. 23 , Article 22.
DOI: 10.17705/1CAIS.02322
Available at: https://aisel.aisnet.org/cais/vol23/iss1/22

Communications of the Association for Information Systems

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Can a Reasonable Time Limit Improve the Effective Usage of a Computerized Decision Aid?

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Abstract:

This study examines the impact of a reasonable time limit on the effective usage of a computerized decision aid. Using current decision making models, a theoretical argument about decision aid usage is developed. This argument is then investigated via two lab experiments. The first experiment determines a reasonable time limit for the task used in the study. The second experiment investigates users' behavior and heart rate variability under this time limit. The results of our study indicate that the reasonable time limit determined in the first study improved effective utilization of the computerized decision aid. The analysis of heart rate variability provides evidence that the given time constraint improved users' cognitive coherence.

Keywords: computerized decision aids, decision making, heart rate variability (HRV), coherence, judgments, accuracy, effort, information utilization, adaptive decision making

Volume 23, Article 22, pp 393-408,, October 2008

Communications of the Association for Information Systems

I. INTRODUCTION

Today's competitive business environment forces organizations to process information more quickly [Blanton et al. 1992]. Consequently, computerized decision aids have become an integral part of organizations to aid decision making [Nissen et al. 2006]. Literature, however, provides evidence that decision makers often do not use their computerized decision tools effectively [Todd et al. 1991; Todd et al. 1992; Todd et al. 1993; Todd et al. 1994]. For example, they often use decision aids to reduce their cognitive effort rather than to maximize their decision accuracy. Given the importance of computerized decision aids in today's business environment, examining ways to increase the effective usage of these tools is of great importance. Thus, in this study, we investigate the effect of time constraints on effective information system (IS) usage. Grounded in decision-making literature, we develop a theoretical argument predicting that a *reasonable* completion time for a task may enhance two user measures that have been the focus of many effective IS usage studies [Bettman et al. 1990; Djamasbi 2007; Shugan 1980; Todd et al. 1992]: decision maker effort (the quantity of utilized information that is provided by a computerized aid to the user) and accuracy (the quality of the decisions made by a person using a computerized aid). We also hypothesize that this time limit will result in a shorter task-completion time and a clearer and more focused cognitive state in the users [McCraty et al. 2006]. We define a *reasonable* completion time as one that is achieved by a majority of users and explain users' behaviors under such a time constraint through their cognitive processes [Eppler et al. 2004; Payne et al. 1993; Schroder et al. 1967] as well as their heart rate variability [McCraty et al. 2006].

In this study, we use a computerized decision aid that supports a complex business decision [Remus 1996]. Because computerized decision aids play a central role in business decisions [Clark et al. 2007; Hess et al. 2006; Remus 1984; Remus et al. 1987], and because investing in IS is both expensive and risky [Verton 2002; Violino 1997], it is of great theoretical and practical value to investigate how these tools can be used more effectively. In addition to providing a suitable context, the decision aid used in our study has the virtue of having been extensively studied in prior IS research [Davis et al. 1995; Djamasbi 2007; Djamasbi et al. 2008a; Kottemann et al. 1989; Lim et al. 2005; Remus 1984; Remus et al. 1987]. In particular, the same decision aid was used in a prior study that examined effective IS usage [Djamasbi 2007].

To examine our predictions, we conduct two laboratory studies using the same computerized decision aid and the same task. In the first study, we determine a *reasonable* completion time for our task by analyzing the completion times of users who had no time limit or deadline for finishing the task. As mentioned earlier, a reasonable completion time in this study refers to a completion time that is achieved by a majority of users. Thus, the objective of the first study is to determine one such completion time. In the second study, we first confirm that the completion time determined in the first study is indeed reasonable (i.e., a majority of users are able to complete the task within this *reasonable* time span). Next, we investigate the impact of this *reasonable* completion time on people's effective usage of the computerized decision aid by comparing the behavior of users who were randomly assigned to either a treatment with no time limit or to a treatment that required them to complete the task within the given time limit (i.e., the reasonable completion time determined in the first study). We compare differences between these two treatments in (1) the amount of time they take to complete the task; (2) the amount of information they utilized to make a decision; and, finally, (3) the accuracy of their judgments. To provide physiological evidence for the effects of a time limit on users' behavior, we analyze subjects' heart rate variability (HRV). This biological evidence is shown to be highly correlated with cognitive coherence, a psychophysiological state marked by enhanced cognitive clarity and acuity [McCraty et al. 2006].

The results of our study have important theoretical and practical implications. From a theoretical point of view, our study provides evidence that including a *reasonable* time limit could be a productive avenue for further research and theory development in Information Systems (IS) research. From a practical viewpoint, the results of this study provide organizations with possible avenues for increasing returns on their Information Technology (IT) investments through improving the effectiveness of IT usage. In the following section, we provide the theoretical background and our hypotheses. Next, we describe the task used in both studies and give a detailed explanation of each study, including the methodology and results. Our discussion is followed by the conclusion, where we highlight both the theoretical and practical implications of this study.

II. LITERATURE REVIEW

One way to improve decision performance is to use all the available relevant information provided. Many studies, however, show that decision makers use only a subset of information available to them [Brehmer et al. 1988; Slovic et al. 1971], even when they are provided with computerized decision aids [Benbasat et al. 1996; Djamasbi 2007; Todd et al. 1992]. This behavior is attributed to individuals' limited cognitive capacities [Fiske et al. 1984], which leads them to place a higher value on reducing their cognitive effort than on maximizing their decision quality [Todd et al. 1991; Todd et al. 1992]. According to this point of view, IT usage leads to more efficient but not necessarily more accurate decision making. Supporting this point, studies show that influencing effort can lead to a more effective use of IT [Todd et al. 1991; Todd et al. 1992; Todd et al. 1993; Todd et al. 1994]. Hence, in this study, we examine whether a reasonable time limit can influence a user's effort when utilizing a computerized decision aid. An increase in a user's effort is reflected through an increase in that user's usage of system provided information [Djamasbi 2007], as well as an increase in that user's decision accuracy [Djamasbi et al. 2008a].

Our theoretical argument is grounded in prior research that examines the relationship between time and performance. The time-performance relationship has been studied from many different perspectives, such as an individual's response time [Luce 1986], flexibility in adapting to a decision environment [Payne et al. 1998], cognitive load [Schroder et al. 1967], and motivation [Hwang 1995; Peters et al. 1984]. These studies show that time has a significant impact on an individual's performance. Response time literature suggests a tradeoff between speed and accuracy. For example, when detecting and/or matching signals, short response times result in higher inaccuracy rates, which, in turn, result in longer response times [Luce 1986]. Similarly, adaptive decision-making studies suggest a relationship between time and accuracy. Rather than focusing on response time, however, these studies examine individual's ability in adjusting their decision strategies according to the available time. Two other major theories that examine time-accuracy relationship are information overload and time pressure theories, which suggest that time has both a positive and a negative impact on accuracy, thus proposing a bell shaped relationship between the two constructs.

As discussed in the preceding paragraph, the relationship between time and accuracy has been studied in previous research; however, little work has been done to examine how a time limit influences the effective use of information systems (IS) that support decision making. In this study, we argue that if people are given a reasonable amount of time to complete a task, they will use the information that is provided by their IS (cues and feedback) more effectively. Because we focus on the amount of system provided information that is utilized by a user as opposed to the speed at which a user reacts to system provided information, we do not include response time literature in our review. In the following sections, we provide a brief discussion of adaptive decision making [Payne et al. 1998], information overload [Schroder et al. 1967], and time pressure theories [Hwang 1995; Peters et al. 1984].

Adaptive decision making theory [Payne et al. 1998] suggests that people tend to adjust the way they go about making a decision according to restrictions imposed by the decision environment. Decision makers behave that way because they are flexible—that is, they recognize the demands of the environment and adjust their policies to make reasonably accurate judgments. For example, when a time limit is imposed, people attempt to meet the deadline first by accelerating their processing, i.e., trying to do what they normally do but faster. If acceleration is not enough to accommodate the time limit, they try to adjust to the limited time by focusing only on a subset of the available information. If that change in behavior still is not enough to accommodate the time limit, then they change their decision strategy to a more efficient one [Payne et al. 1998].

Similar to adaptive decision making theory, information overload theory describes behavior in relationship to environmental factors and explains behavior through cognitive processes (i.e., information processing capability). According to the information overload theory, environmental constraints that increase one's information load (such as time limit) can stimulate cognitive functioning and thus facilitate better information processing [Schroder et al. 1967; Streufert et al. 1978] and improve performance. This is true, however, only up to a point. Once information load passes this point (e.g., environmental constraints become extreme) it affects performance negatively [Eppler et al. 2004]. In other words, performance has an inverted U-shape relationship with environmental constraints [Schroder et al. 1967; Streufert et al. 1978]. In this study, we examine the effect of a *reasonable* time limit, which we predict will improve the effective usage of a decision aid and thus the performance of a user. This prediction suggests that the *reasonable* time limit used in this study would be at least as long as the optimal time. This is because any time limit shorter than the optimal time according to the bell-shaped curve of the information overload theory should result in worse (not better) performance.

Time pressure studies [Hwang 1995; Peters et al. 1984],also suggest an inverted U-shape relationship between the available time to complete a task and performance. While time pressure studies support both adaptive decision making and information overload theories, which explain behavior through cognitive processes, they are unlike them in that they often use a goal-setting process to explain the relationship between the available time and performance [e.g., Hwang 1995; Peters et al. 1984; Rothstein 1986; Svenson et al. 1993]. For example, time pressure studies suggest that a time limit leads to setting more difficult goals and increasing one's commitment to achieve such goals, which, in turn, results in better performance [Locke 1968; Wofford et al. 1992]. When the time limit is long, shortening it results in setting more difficult goals. When the time limit becomes extremely short, however, willingness to set difficult goals (e.g., completing a task under severe time limits) decreases [Hwang 1995; Peters et al. 1984].

The literature discussed earlier suggests that time limit may be a factor in affecting how well people use IT to complete a task (i.e., how much of the information provided by the system will be used and how the system provided information is combined into more accurate decisions). The adaptive decision making and information overload theories provide cognitive explanations for performance under time constraints, while time pressure studies provide goal setting explanations for the same behavior. Because effective IT usage is grounded in cognitive models of behavior [e.g., Djamasbi et al. 2007], in this study, we explain users' behavior through their cognitive processes. Hence, in the following section we use the adaptive decision making and information overload theories to form our hypotheses.

III. THEORETICAL BACKGROUND AND HYPOTHESES

Decision makers adjust their effort levels to accommodate the amount of time available to accomplish the task at hand [Payne et al. 1998; Payne et al. 1993]. Since effort is an important factor in effective IT usage [Djamasbi 2007; Todd et al. 1994], time limits may indeed be an important influence on how effectively computerized decision aids are used. In this paper, we distinguish between the constructs "time limit" and "time pressure." The former represents an environmental constraint external to users, whereas the latter represents a cognitive state internal to users. While a user's cognitive state (e.g., time pressure) is likely to be influenced by environmental constraints, a time limit may or may not result in time pressure for a user.

In this section, we develop a theoretical argument about why a *reasonable* completion time for a task, when set as a time limit, can improve how effectively computerized decision aids are used. We define a *reasonable* completion time for a task as the time under which a majority of individuals, who do not have a time limit, finish the task. We then argue that such a time constraint can help users to become more focused and, consequently, more effective decision makers. That is, we expect this time limit to facilitate a shorter completion time, greater utilization of information cues provided by the IT and better quality decisions made while using the IT. We expect to find physiological evidence for the effects of a time limit on subjects' mental states.

Reasonable Time Limit and Effective IS Usage

Individuals' first reaction to a time limit is to speed up what they would normally do—they increase their processing speed [Payne et al. 1998]. Because the time limit in our study provides sufficient time for a majority of users to complete the task even if they do not increase their processing speed, we expect such acceleration in processing speed to help subjects under the time limit treatment complete their tasks faster than their counterparts. Hence, we hypothesized that:

H1) Compared to average completion times for subjects in the treatment with no time limit, average completion times will be lower for subjects in the time limit treatment.

Users can improve their effective utilization of an IT by using more information cues provided by the IT [Djamasbi 2007]. In other words, an increase in users' cognitive efforts results in their better IT utilization [Djamasbi 2007]. Because users' first reactions to time limits is to increase their effort (i.e., increase their processing speed or amount of information they process per unit of time) [Payne et al. 1998], it is likely that the time limit in our study will increase users' effort in using more of the information that is provided to them by the computerized decision aid. Therefore, we hypothesize that:

H2) Compared to their control counterparts, subjects in the time limit treatment will use more information cues provided by the decision aid.

Decision making literature suggests that mild time limits may enhance one's information processing because such time limits can lead to faster decision making without a loss in decision accuracy [Payne et al. 1998; Payne et al. 1993; Peters et al. 1984]. The adaptive decision making theory explains this behavior by arguing that people are flexible decision makers and, thus, they try to adjust to their task environment. According to this theory, when the time limit is not extreme, decision makers can adjust to the decision environment by speeding up their processing without compromising their decision quality [Payne et al. 1993]. Such an improved performance under longer time limits is also explained by the information overload theory. According to this theory, the improved performance is due to more stimulated cognitive functioning, which is triggered by the time constraint. Since the time limit in our study is a *reasonable* time limit, it is likely to facilitate the same reaction as a mild time limit would provoke. Thus, it is likely that the time limit in our study will enhance the information processing of our subjects and, as a result, will help them to combine the provided information by their IS (cues and feedback) into more accurate decisions. Therefore, we hypothesize that:

H3) Compared to their control counterparts, subjects in the time limit treatment will make more accurate decisions.

Reasonable Time Limit and Heart Rhythm Coherence

Heart rhythm coherence is a psychophysiological mode of functioning (i.e., it can be explained both psychologically and physiologically). Psychologically, heart rhythm coherence denotes a high degree of stability in mental processes experienced during this mode. Physiologically, it refers to the harmonious interactions of our body's subsystems, particularly the increased synchronization between the heart and brain [McCraty et al. 2006]. People in a coherent state tend to be more alert and responsive, and tend to enjoy more enhanced cognitive functioning, such as improved auditory and visual acuity [Bradford et al. 2005; Nunn et al. 1974; Rice et al. 1989].

Grounded in previous research, our study argues that the reasonable time limit used in our study promotes the effective utilization of computerized decision aids, i.e., it facilitates an increase in the amount of information used and the accuracy of judgments made in a shorter period of time. To be able to achieve this, we argue that decision makers have to increase their mental focus and clarity, i.e., become more coherent. Thus, we expect subjects in the time limit treatment to have a heart variability pattern that reflects higher levels of coherence. Therefore, our final hypothesis is as follows:

H4) Compared to their control counterparts, subjects in the time limit treatment will be more coherent.

IV. EXPERIMENTAL TASK

In this section, we describe the task utilized in both of our studies. We used a judgment task that was based on Holt, Modigliani, Muth, and Simon's [1960] model of the production-scheduling problem. In this task, the subjects are asked to make a decision regarding the amount of units to produce given a number of information cues. This production-scheduling problem was selected because it is a cognitively complex decision problem [Remus 1996] calibrated with actual data [Holt et al. 1956] and used in many prior IS studies [Davis et al. 1995; Djamasbi et al. 2008a; Djamasbi et al. 2008b; Kottemann et al. 1989; Lim et al. 2005; Remus 1984; Remus et al. 1987], including a study that examines effective IT usage [Djamasbi et al. 2007]. The equation modeling for a production-scheduling decision is represented by Equation 1:

Production Decision = b0 + b1 * (work force last month) - b2 * (inventory on hand) + b3 * (the current month's demand) + b4 * (the demand for next month) + b5 * (the demand for two months ahead). (1)

The above decision rule describes a perfect world with no fluctuations in the information. To imitate the real world in an experimental setting, an error term is generally added to the above equation. Through this error term, the predictability or difficulty of the task is manipulated as shown in Equation 2:

Production Decision = b0 + b1 * (work force last month) - b2 * (inventory on hand) + b3 * (the current month's demand) + b4 * (the demand for next month) + b5 * (the demand for two months ahead) + e (2)

The coefficients in the above equation were estimated for the production-scheduling decision at a glass factory [Holt et al. 1956]. The coefficients estimates were b0=148.5, b1=1.005, b2=0.464, b3=0.464, b4=0.239, and b5=0.113. The error term (e) added to this task was normally distributed with a mean of zero and a standard deviation of 100. Task predictability or difficulty, measured through the correlation between the values of the production decision in Equation 1 and production decision in Equation 2, was moderate (Re = 0.75).

The experiments in this study included 40 trials of the task described above. Each trial provided the subjects with five information cues: the current month's demand, the demand for next month, the demand for two months ahead, current work force size, and the inventory on hand. The participants were required to use these five cues to set the current production level. All the cues for these experiments were randomly generated and normally distributed with the following mean and standard deviations: current month (Mean = 2500, SD = 200), next month (Mean = 2500, SD = 200), two months ahead (Mean = 2500, SD = 400), work force (Mean = 440.92, SD = 17.64), and inventory on hand (Mean = 300, SD = 100).

Participants in both studies were asked to complete the given task on laptop computers assigned by the researchers using a computerized decision aid. As shown in Figure 1, a computerized decision aid provided the cues on top of the screen. A sliding bar below the cues was utilized by the participants to make judgments throughout the task. Once the subjects were satisfied with their judgments, they submitted their decision by clicking on the button labeled "I am satisfied with my current decision." After that, the last 10 finalized judgments were listed in the second half of the screen with the optimal judgment (the value of the production decision calculated through Equation 2) and the percentage error as outcome feedback for each decision. A message was provided on the right-hand side of the screen to remind subjects to perform their best. After each finalized decision, this message was replaced by the optimal value for the last decision in a large font and participants were asked to click a button labeled as "OK to Continue." This action triggered the presentation of a new set of cues on top of the screen, which indicates a new trial. The decisions made by clicking the button "I am satisfied with my decision" was not reversible to eliminate the possibility of subjects viewing the optimum solution and then going back to change their judgment.

Figure 1. Computerized Decision Aid Screen Shot for TL treatment. Subjects in NTL treatment had the same screen but without the timer.

V. STUDY 1: DETERMINING A REASONABLE COMPLETION TIME [TIME LIMIT]

The objective of our first study was to determine a "reasonable" completion time for the given task. This time limit was calculated based on the analysis of subjects' task completion times. Since the participants in this first study were under no time limit to complete the task, a completion time achieved by the majority of the subjects was recognized as a reasonable time expectation for completing this task. A detailed description of the sample and the experimental procedure is provided below, followed by the study results.

Sample

Twenty-four undergraduate business students in a major university in the U.S. participated in this study. The participants were recruited from a third-year course required for all business majors. The subjects received class credit for their participation in this study. While all subjects were proficient in using computers, none had prior experience with the decision aid used in this study.

Experimental Procedure

On the day of the experiment, the participants gathered in their classroom. Subjects were informed that this experiment investigated managerial decision making. They were told that the decision aid they were about to use was designed to assist in decision making. To motivate subjects to do their best, they were told that by doing their best to make a decision, whether accurate or not, they would provide invaluable input for our investigations and would help us to improve the decision aid. The subjects were given a short tutorial of the task. After the tutorial, the subjects were asked to go to their designated computers in a computer lab. After finishing the task, the subjects were debriefed and asked to leave the room. While no time pressure was given the entire procedure did not exceed one hour.

Results

As mentioned earlier, we consider a *reasonable* completion time for a task to be *a completion time that is doable by a majority of users*. In order to calculate a reasonable completion time, we analyzed the completion times of all subjects. As displayed in Table 1, the minimum and maximum completion times were around 9 minutes and 28 minutes respectively. Both the mean and the median for completion time were about 17 minutes. The median completion time showed that 50 percent of our subjects were able to finish the task in less than 17 minutes. Among those 50 percent of subjects who took longer than this median time to complete the task, the majority (55 percent) took approximately 18 minutes or less to finish the task. In other words, our analysis showed that 78 percent (50 percent +50 percent *55 percent) of subjects finished the task in about 18 minutes. Since completion time in this study is similar to many prior studies using the same task [Djamasbi et al. 2008a; Djamasbi et al. 2008b; Lim et al. 2005], we considered 18 minutes to be a reasonable completion time for this task (one that can be accomplished by a majority of subjects) and thus used it as the time limit in the next study.

Table 1. Descriptive Statistics for the Completion Time

Completion Time (minutes)			
Mean (sd.)	Median	Minimum	Maximum
16.83 (5.13)	16.70	9.07	28.31

VI. STUDY 2: REASONABLE COMPLETION TIME AS TIME LIMIT

The objectives of our second study were, first, to confirm the reasonable completion time from study 1 and, second, to examine whether this time limit could facilitate 1) a shorter completion time; 2) a more effective use of a computerized decision aid; and 3) a more coherent mental state. The effect of time limit on completion time, IS usage, and coherence has important implications for IS research. Investigating the effect of time limit on completion time and how a decision aid is used helps to identify factors that can potentially improve efficient and effective IT usage. Examining the effects of time limits on decision makers' psychological states can provide a more complete picture of their behaviors while under time constraints. In particular, measuring decision makers' psychological states through coherence is more comprehensive than self-report instruments since heart rate variability is collected continuously throughout the task. Moreover, since heart rate variability is a physiological measure, it provides an objective assessment of one's psychological state.

Sample and Study Design

Similar to the first study, subjects were recruited from a major university in the U.S. Participation was again voluntary; however, in the second study, subjects received course credit as well as a five dollar gift certificate for their participation. A total of 32 students, 19 percent females and 81 percent males, participated in the experiments for the second study. The average age of the participants was 20.9 years, ranging from 18 to 23 years of age. Most of the participants, 81.3 percent, rated their familiarity with the computer 5 or above on a 7-point Likert scale. A majority of the participants, 99.6 percent, reported that they used the Internet for various reasons on a daily basis. These descriptive results indicate that the sample for the second study was composed of people who were quite familiar with computers and computer applications [Table 2]. As in the previous study, none of the subjects had any prior experience with the decision aid used in the study.

Table 2. Summary of Users' Demographic Information in Study II

Number of participants	32
Gender distribution	19% females 81% males,
Age range	18-23 (mean 20.9)
High familiarly with computers	81.3%
Daily Internet usage	99.6%,

In the second study, we randomly assigned the 32 subjects into two groups: one with no time limit (NTL) and the other with the reasonable completion time determined in study one as the time limit (TL). Each group had 16 subjects; the descriptive properties of each group were as follows. Out of 16 subjects in the NTL, 25 percent were female, 93.5 percent used the Internet on a daily basis, and 75 percent rated their familiarity with the computer 5 or above on a 7-point Likert scale. Out of 16 subjects in the TL group, 12.5 percent were female, 100 percent used the Internet on a daily basis, and 87.5 percent rated their familiarity with the computer 5 or above on a 7-point Likert scale. The average age for both groups was also 20.9.

Experimental Procedures

The experiments were conducted in a biology laboratory. After their arrival to the laboratory, subjects were directed to their designated seats, equipped with a laptop computer. To ensure a quiet setting, subjects were required to wear a pair of headphones during the experiment. At this point, each subject was asked to watch an introduction video in which the experimental details were explained. If they agreed to continue the experiment, they then signed a consent form and informed the lab instructor. Next, they wore the heart rate monitoring device on their fingers, which was secured using Velcro bands. The heart rate monitor collected subjects' physiological data (pulse) continuously during the whole procedure. Since the decision making task was completed using the mouse of the computer only, the heart rate monitoring device, which was attached to fingers of their idle hand, did not introduce any difficulty in completing the task (Figure 2). A short tutorial of the experimental task (approximately 10 minutes) was presented on their computers and, for each subject, a baseline pulse data was collected during this time. After the tutorial, subjects completed two practice trials and then moved onto the actual experimental task that consisted of 40 trials.

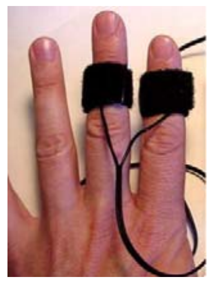

Figure 2. Heart Rate Monitoring Device (Velcro bands)

Subjects were randomly assigned to either a time limit (TL) or no time limit (NTL) treatment. Subjects in the NTL treatment had no time limits; they could take as long as they wished to complete the task. Those who were in the TL group had 18 minutes to complete the task. The computerized decision aid in the TL treatment had a timer, which counted down from 18 minutes and did not let the subjects make any decisions after their 18 minutes were up. After completing the task, subjects were thanked for their participation, received their gift certificates, and were asked to leave the laboratory. The entire procedure did not exceed an hour.

Measurements

Effort. In decision-making studies, effort (i.e., the amount of information used) is determined by examining subjects' captured decision policy [e.g., Chewning et al. 1990; Djamasbi 2007; Tuttle et al. 1999]. This is achieved by counting the number of statistically significant beta weights (alpha = 0.05) in each subject's captured decision policy. The decision policy for a subject is captured by regressing subject's decisions against the provided cues in the task. The results of this regression provide a set of coefficients (beta weights) and their corresponding p-values for each cue. If the p-value for a cue is less than 0.05 (i.e., statistically significant), it is assumed that the cue is used by the subject [e.g., Chewning et al. 1990; Djamasbi 2007; Tuttle et al. 1999]. As in prior research [Djamasbi 2003; Djamasbi et al. 2007] we used this method to measure users' efforts.

Accuracy. Accuracy of a judgment was also measured, consistent with prior research, through calculating subjects' achievement [Bonner 1994; Cooksey 1996a; Djamasbi et al. 2004]. Achievement is determined by the correlation between subjects' judgments and the actual criterion. Hence, to calculate the achievement for each subject, the correlation between the subject's judgments (decision values entered into the computerized decision aid by the subject) and the actual criterion (production decision values calculated by the linear model in Equation 2) was determined. This measure was then used to compare the accuracy of decisions between the two treatment groups.

Coherence. Heart rhythm coherence, which is represented as stable heart rate variability (HRV), can be measured by analyzing the HRV power spectrum [McCraty et al. 2006]. In order to measure coherence, we followed the methods provided in McCraty et al. [2006] and illustrated in Figure 3. In order to utilize the HRV power spectrum calculations, the pulse signals collected in the time domain (every 50 milliseconds) during the experiments were first filtered to eliminate motion artifacts (such as arm motion), then converted into the frequency domain (see Figure 2). After each subjects' coherence values were calculated for their baseline period and full task period, a ratio of these two coherence values were calculated to eliminate personal differences. This way, we were able to compare coherence of subjects in TL and NTL groups by using the measure of how much subjects diverged from their baseline during the task.

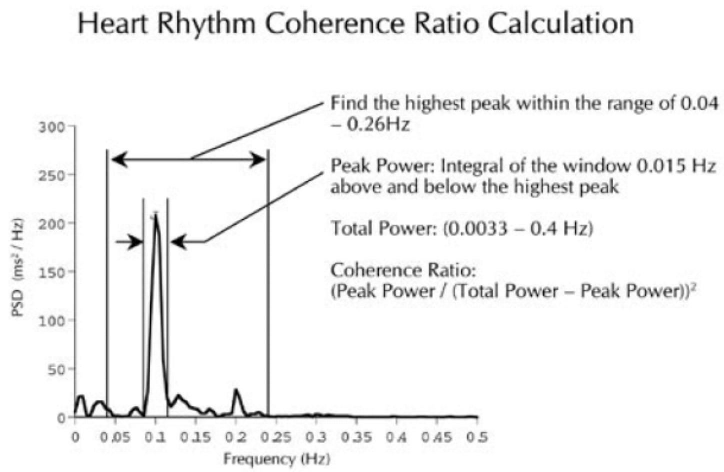

Figure 3. Heart Rhythm Coherence Calculation [McCraty et al. 2006, p. 8]

Results

The second study subjects received additional incentive (a gift card in addition to the course credit offered in the first study), but, as in the first study, these incentives were offered for participation as opposed to performance. Hence, we did not expect to see any significant differences in performance between the subjects in the first study and subjects in the second study, who, similar to participants in the first study, did not have a time limit (subjects in the NTL treatment). We confirmed this expectation by comparing the completion times as well as accuracy of decisions between these two groups (subjects in study one and subjects in the NTL treatment in study two). The results of the t-test confirmed our expectation, i.e., there were no significant differences in performance between these two groups (see Table 3).

Table 3. Results of the T-Tests for User Performance between The Two Studies

	Completion Time (minutes)	Accuracy
Study I	16.83 (5.13)	0.48 (0.18)
Study II (no time limit treatment)	16.39 (4.15)	0.47 (0.19)
	df= 38, t Stat= 0.28, p=0.78	*df= 38, t Stat= 0.27, p=0.79*

Next, we confirmed that the time limit used in this study was indeed a reasonable completion time for the subjects in study two. That is, we examined whether an 18-minute time limit was enough for a majority of the subjects in the second study to complete the task. To separate the effects of time limit (avoid confounding the results), this analysis was performed on the data from subjects in the NTL group only (the group with no time limit). Our analysis showed that the majority of subjects (80 percent) in the NTL treatment took approximately 18 minutes or less to finish the task. These results, which support the results of study one, confirm that 18 minutes was enough time for a majority of subjects (in the NTL treatment) in the second study to complete the task. Hence, it showed that 18 minutes was also a reasonable completion time in the second study. Next, we examined whether the same phenomenon was also present in the TL group (time limit treatment). Our analysis showed 100 percent of the subjects in the TL group completed the task in less than 18 minutes (the maximum completion time for the TL group was 17.75 minutes). These results indicated that the reasonable completion time determined in the first study was indeed a reasonable time expectation (a reasonable time limit) in the second study. The descriptive statistics for completion time in both treatments are shown in Table 4.

Table 4. Descriptive Statistics for the Completion Time

	Completion Time (minutes)			
Treatments	Mean (sd.)	Median	Minimum	Maximum
NTL (no time limit)	16.39 (4.15)	15.98	8.70	23.47
TL (time limit)	13.18 (2.50)	12.07	9.08	17.75

Hypothesis 1 asserts that the completion time is shorter for subjects in the time limit treatment. The results of the one-tail t-test (Table 5) showed that the mean of completion time in the TL group (13.18) was significantly ($p<0.01$) smaller than the mean of completion time in the NTL group (16.39). Therefore, we conclude that hypothesis one was supported.

Table 5. T-test Results for Completion Time

	Completion time (minutes)	
Treatments	Mean	Std. Dev.
NTL (no time limit)	16.39	4.15
TL (time limit)	13.18	2.50

df= 30, t Stat= 2.67, p<0.01

Hypothesis 2 asserts that subjects in the time limit treatment will utilize more information provided by the computerized decision aid compared to those subjects who are not under any time limit. The results of the one tail t-test showed that subjects in the time limit group used significantly ($p= 0.03$) more cues (3.19) than the subjects in no time limit group (2.44), as illustrated in Table 6. Therefore, we conclude that our second hypothesis was also supported.

Table 6. T-Test Results for Information Utilization

	Number of Cues	
Treatments	Mean	Std. Dev.
NTL (no time limit)	2.44	1.05
TL (time limit)	3.19	1.05

df= 30, t Stat= 2.04, p=0.03

Hypothesis 3 asserts that subjects in the time limit treatment will make significantly more accurate judgments. The results of the one tail t-test showed that subjects' mean of achievement in the time limit treatment (0.60) was significantly ($p=0.01$) higher than the mean of achievement in the no time limit treatment (0.47). Based on these results, which are displayed in Table 7, we conclude that our third hypothesis was also supported.

Table 7. T-Test Results for Decision Accuracy

	Accuracy	
Treatments	Mean	Std. Dev.
NTL (no time limit)	0.47	0.19
TL (time limit)	0.60	0.12

df= 30, t Stat= 2.39, p=0.01

Hypothesis 4 asserts that subjects in the time limit treatment will be more coherent than their counterparts. The analysis of heart rate variability, as illustrated in Table 8, indicates that our last hypothesis was also supported. That is, the results of the one tail t-test showed that the mean of coherence for subjects in the TL group (0.03) was significantly ($p=0.01$) higher than the mean of coherence in the NTL group (0.01).

Table 8. T-Test Results for Coherence

	Coherence	
Treatments	Mean	Std. Dev.
NTL (no time pressure)	0.01	0.01
TL (time pressure)	0.03	0.03

df= 30, t Stat= 2.40, p=0.01

VII. DISCUSSION

We defined a *reasonable* completion time as a completion time that can be achieved by a majority of the users. Using the adaptive decision making and information overload theories [Eppler et al. 2004; Payne et al. 1998; Payne et al. 1993; Schroder et al. 1967], we argued that such a time limit would increase (1) the speed by which decisions are made, (2) the utilizations of the provided information, and (3) the accuracy of decisions made using a computerized decision aid. Finally, since an increase in processing speed requires mental focus and clarity, we argued that (4) such a time limit would improve individuals' psychological states (measured via coherence). The analysis of the experimental data supported all of the above assertions. Hence, our results, together, show that a reasonable completion time given as a time limit can lead to more efficient and effective IS usage.

The results of our study have important theoretical and practical implications. From the theoretical perspective, the results of this study provide several avenues of future research and theory development. First, this study defines and tests one possible time limit that can improve effective IS usage. Hence, it provides a rationale and method for examining other time limits that can influence how effectively decision aids are utilized. Second, the results show a significant improvement in information utilization and the accuracy of decisions. While both of these measures have been the primary focus of many studies that examine the effective utilization of a computerized decision aid [e.g., Djamasbi 2007; Todd et al. 1992], the significant improvement in effort is particularly important since a number of studies show that decision makers often use only a small subset of the information available to them [Benbasat et al. 1996; Brehmer et al. 1988; Lim et al. 1996; Slovic et al. 1971; Todd et al. 1992]. Third, this study shows that a *reasonable* completion time, given as a time limit, can enhance a decision maker's coherence, which, according to a number of studies, can improve an individual's cognitive capability [Bradford et al. 2005; McCraty et al. 2006; Nunn et al. 1974; Rice et al. 1989]. That is, those under a reasonable time limit utilized their cognitive capabilities to a higher level.

This study contributes to IS literature by introducing the notion of a reasonable completion time as a time limit and testing its effects on user behavior. In addition to examining users' completion times, effort, and accuracy, this study also investigates users' behaviors by paying attention to their mental states. Moreover, this study captures users' mental states through the objective and continuous measure of HRV as opposed to subjective self report measures, which capture only snap shots of subjects' mental states at specific point of time (typically before and after completing the task). By providing additional explanation for users' behaviors through their mental states as well as a continuous picture of users' mental states, this study provides a more complete picture of decision makers' flexibility in adjusting to their task environments. Consequently, this study not only contributes to the effective IS usage literature, but also to those investigations that examine behavior under varying task environments, such as adaptive decision making, information overload, and time pressure studies. Moreover, this study provides a theoretical direction for including decision makers' mental states when examining behavior under a time limit (e.g., examining decision makers' mental state under low, moderate and extreme time pressure) and also a foundation for using continuous physiological measure, such as HRV, for such examination. In this study, we examined the effect of time limit on IS usage and used coherence to better explain users' cognitive state. Our results show that people who used the IS more effectively (those in the TL group) exhibited a higher level of coherence, suggesting that coherence could be used to better explain behavior. These results provide additional support for including coherence in future IS research.

The results have also important implications for the design of computerized decision aids. For example, this study shows that a *reasonable* completion time given as a time limit has a significant impact on decision makers' efforts. Since literature reports that effort is an important mediator in determining how a decision support tool is used [Arnott et al. 2005; Hess et al. 2006; Todd et al. 1993; Wells et al. 2002], providing information regarding time could potentially lead to building systems that are used more effectively. For example, decision aids may benefit from maintaining a database of task completion times. Based on such recorded completion times, a decision aid could calculate a time limit for the task at hand. Moreover, since our study shows that time limit can encourage individuals to be more efficient (make more accurate decisions in a shorter amount of time), it is likely that awareness about the time spent on the task will help individuals be more effective. Hence, including a timer that displays the amount of time spent on a task may prove to be helpful in using a decision aid more effectively. Future research, however, is needed to examine whether these suggestions are effective.

From a practical point of view, the results of this study suggest that organizations may benefit from providing reasonable deadlines for activities. In order to determine the reasonable deadlines, organizations should keep track of the completion times for each activity when possible. This knowledge base can then be used to estimate reasonable deadlines for future activities. It also has implications in terms of project management and project scheduling. This may be the reason for better performance in projects teams where the scheduling is based on a previous project portfolio. They can make more reasonable estimates, which put the team members under a reasonable time limit, causing them to perform better.

Further, companies may benefit from developing a simulation decision tool for assessing the adaptive behavior of their employees under time limits. For example, using such tools may help managers in forming project group members (e.g., assigning people to projects with a given time limit who demonstrate desirable adaptive responses under those time limits). Companies can also potentially use the same simulation to train employees to adapt to time limits.

VIII. LIMITATIONS AND FUTURE STUDIES

Laboratory experiments provide the necessary control over desired variables and facilitate more precision in manipulating, controlling, and measuring their effects [Staw et al. 1993; Swieringa et al. 1982]. In particular, conducting this study as a laboratory experiment allowed us to examine the effects of time limit on decision makers' psychological state by measuring the objective and continuous physiological measure of heart rhythm coherence. However, as with all laboratory experiments the generalizability of our results is limited by the laboratory setting and the task used. While, we reduced the threats to external validity by designing the experimental setting to capture relevant aspects of real decision tasks and calibrated the task with real world data, future studies using various tasks and environments are needed to increase our confidence in the generalizability of these results. In particular, in this study, we examined the impact of a time limit on the effective usage of a computerized decision aid. Future studies should examine whether the results observed in our study also apply to other types of IS that support other types of tasks.

It may be argued that the generalizability of our results is limited by the use of student subjects. However, there is a resemblance between this sample and new employees forced to adapt their decision making strategies to time limits in their new work environment. Our participants were all students training to enter the job market and were not experienced in the task. Moreover, to improve their decisions, participants were expected to use the information provided by the decision aid, not their experience. In such situations, it is acceptable to use student subjects who have no prior experience with the task [Cooksey 1996b; Swieringa et al. 1982]. Thus, the results of this study are applicable to decision makers learning a new task or adopting a new decision tool. Our theoretical argument was that the reasonable completion time as the imposed time limit will enhance the information processing capability of decision makers, helping them to work more effectively (i.e., process more information and make better decisions). Thus, it is reasonable to speculate that the results of this study may also generalize to the experienced decision makers using a computerized decision aid. Future studies, however, are needed to examine whether experience and/or other relevant variables, such as system, task, and/or user characteristics, can mediate the effects of a time limit on decision aid usage as was observed in this study.

As discussed in the literature review section of this paper, time pressure studies often explain users' behaviors through goal-setting processes [Andrews et al. 1972 ; Peters et al. 1980]. In this study, consistent with the effective IS usage literature [Todd et al. 1993; Todd et al. 1994], we captured the cognitive measures of effort and accuracy to examine IS usage behavior under time limit. Extending this study to include goal setting measures could provide a more refined analysis of user behavior. Moreover, in this study we examined only one possible time limit that improves effective IS usage. Future studies examining various time limits can test whether time and IS usage also form a bell shape relationship and, if so, determine the pick time for this relationship.

IX. CONCLUSION

This study defines a *reasonable* completion time as a time under which a majority of decision makers can complete a task. It then determines and verifies one such time limit for the task used. Finally, it shows that the *reasonable* completion time when used as a time limit not only improves users' task completion times, but also improves their effective utilization of computerized decision aids (via increased use of information cues and accuracy) and enhances their mental states. This study contributes to the IS literature by examining a factor (time limit) that can improve how effectively computers are used. This study also contributes to IS literature by providing a more complete picture of behavior through users' mental states and providing physiological evidence of coherence for their mental states. From a practical viewpoint, the results of this study suggest that organizations can potentially increase effectiveness of IT usage and decrease decision time if they provide reasonable time limit for their projects.

REFERENCES

Andrews, F. M., and G. F. Farris. (1972). "Time Pressure and Performance of Scientists and Engineers: A Five-Year Panel Study," *Organizational Behavior and Human Performance* (5 4), October pp 293-299.

Arnott, D., G. Pervan, and G. Dodson. (2005). "Who Pays for Decision Support Systems Research? Review, Directions, and Issues," *Communications of the AIS* (16:17).

Benbasat, I., and P. Todd (1996). "The Effects of Decision Support and Task Contingencies on Model Formulation: A Cognitive Perspective," *Decision Support Systems* (17:4), August, pp 241-252.

Bettman, J. R., E. J. Johnson, and J. W. Payne. (1990). "A Computational Analysis of Cognitive Effort in Choice," *Organizational Behavior and Human Decision Processes* (45:1), February, pp 111-139.

Blanton, J. E., H. J. Watson, and J. Moody. (1992). "Toward a Better Understanding of Information Technology Organization: A Comparative Case Study," *MIS Quarterly* (16:4), December, pp 531-556.

Bonner, S. (1994). "A Model of the Effects of Audit Task Complexity," *Accounting, Organizations, and Society* (19:3), April, pp 213-234.

Bradford, E. J., K. A. Wesnes, and D. Brett. (2005). "Effects of Peak Performance Training on Cognitive Function," *Journal of Psychopharmacology* (19:5 suppl:S), September, p A44.

Brehmer, A., and B. Brehmer. (1988). "What Have We Learned about Human Judgment From Thirty Years of Policy Capturing?" in: *Human Judgment: the SJT View,* B. Brehmer and C. Joyce (eds.), Elsevier, Amsterdam, pp. 75 -114.

Chewning, E. G., and A. M. Harrel. (1990). "The Effect of Information Load on Decision Makers' Cue Utilization Levels and Decision Quality in a Financial Distress Decision Task," *Accounting, Organizations, and Society* (15:6), August, pp 527-542.

Clark, T. D., M. C. Jones, and C. P. Armstrong. (2007). "The Dynamic Structure of Management Support Systems: Theory Development, Research Focus, and Direction," *MIS Quarterly* (31:3), September, pp 579-615.

Cooksey, R. W. (1996a). *Judgment Analysis: Theory, Methods, and Applications* Academic Press, New York,.

Cooksey, R. W. (1996b). "The Methodology of Social Judgment Theory," *Thinking and Reasoning* (2:3), July 1996b, pp 141-173.

Davis, F. D., and J. E. Kottemann. (1995). "Determinants of Decision Rule Use in a Production Planning Task," *Organizational Behavior & Human Decision Processes* (63:2), August, pp 145-157.

Djamasbi, S. (2003). "Does Affect Influence Judgment When Using a Decision Support System?" Proceedings of the Ninth Americas Conference on Information Systems, Tampa, Florida, pp. 2318-2325.

Djamasbi, S. (2007). "Does Positive Affect Influence the Effective Usage of a Decision Support System?" *Decision Support Systems* (43:4), August, pp 1707-1717.

Djamasbi, S., and E. Loiacono. (2008a). "Do Men and Women Use Feedback Provided by their Decision Support Systems ([DSS)] Differently?" *Decision Support Systems* (44:4), March pp 854-869.

Djamasbi, S., W. Remus, and M. O'Connor. (2004). "Does Mood Influence Judgment Accuracy?" Decision Support in an Uncertain and Complex World, The IFIP TC8/WG8.3 International Conference, Prato, Italy, pp. 213-222.

Djamasbi, S., and D. M. Strong. (2008b). "The Effect of Positive Mood on Intention to Use Computerized Decision Aids," *Information & Management* (45:1), January pp 43-51.

Djamasbi, S., T. Tullis, J. Hsu, E. Mazuera, K. Osberg, and J. Bosch. (2007). "Gender Preferences in Web Design: Usability Testing through Eye Tracking," Proceedings of the 13th Americas Conference on Information Systems, Keystone, Colorado.

Eppler, M., and J. Mengis. (2004). "The Concept of Information Overload: A Review of Literature from Organization Science, Accounting, Marketing, MIS, and Related Disciplines," *Information Society* (20:5), November, pp 325-345.

Fiske, S., and S. Taylor. (1984). *Social Cognition* Addison-Wesley, Reading, MA.

Hess, T. J., M. A. Fuller, and J. Mathew. (2006). "Involvement and Decision-Making Performance with a Decision Aid: The Influence of Social Multimedia, Gender, and Playfulness," *Journal of Management Information Systems* (22:3), Winter, pp 15-54.

Holt, C. C., F. Modigliani, and J. F. Muth. (1956). "Derivation of a Linear Decision Rule for Production and Employment," *Management Science* 2:2, January, pp 159-177.

Hwang, M. I. (1995). "The Effectiveness of Graphic and Tabular Presentation under Time Pressure and Task Complexity," *Information Resources Management Journal* 8:3), Summer, pp 25-31.

Kottemann, J. E., and W. E. Remus. (1989). "A Study of the Relationship between Decision Model Naturalness and Performance," *MIS Quarterly* (13:2), June, pp 171-181.

Lim, J. S., and M. O'Connor. (1996). "Judgmental Forecasting with Time Series and Causal Information," *International Journal of Forecasting* (12:1), March, pp 139-153.

Lim, K. H., M. J. O'Connor, and W. E. Remus. (2005). "The Impact of Presentation Media on Decision Making: Does Multimedia Improve the Effectiveness of Feedback?" *Information & Management* (42:2), January, pp 305-316.

Locke, E. A. (1968). "Toward a Theory of Task Motivation and Incentives," *Organizational Behavior and Human Performance* (3), pp 157-189.

Luce, D. R. (1986). *Response Times,* Oxford University Press, New York.

McCraty, R., M. Atkinson, D. Tomasino, and R. T. Bradley. (2006). *The Coherent Heart: Heart-Brain Interactions, Psychophysiological Coherence, and the Emergence of System-Wide Order,* Institute of HeartMath, Boulder Creek, California, pp. 1-64.

Nissen, M. E., and K. Sengupta. (2006). "Incorporating Software Agents into Supply Chains: Experimental Investigation with a Procurement Task," *MIS Quarterly* (30:1), Mar, pp 145-166.

Nunn, C. M., and J. W. Osselton. (1974). "The Influence of the EEG Alpha Rhythm on the Perception of Visual Stimuli," *Psychophysiology* (11:3) pp 294-303.

Payne, J. W., and J. R. Bettman. (1998). "Adaptive Strategy Selection in Decision Making," *Journal of Experimental Psychology: Learning, Memory, and Cognition* (14:3), August, pp 534-552.

Payne, J. W., J. R. Bettman, and E. J. Johnson. (1993). *The Adaptive Decision Maker,* Cambridge University Press, Cambridge, UK.

Peters, L. H., and E. J. O'Connor. (1980). "Situational Constraints and Work Outcomes: The Influences of a Frequently Overlooked Construct," *The Academy of Management Review* (5:3), July, pp 391-397.

Peters, L. H., E. J. O'Connor, A. Pooyan, and J. C. Quick. (1984). "The Relationship between Time Pressure and Performance: A Field Test of Parkinson's Law," *Journal of Organizational Behavior* (5:4), October, pp 293-299.

Remus, W. (1996). "Will Behavioral Research on Managerial Decision Making Generalize to Managers?" *Managerial & Decision Economics* (17:1), January/February, pp 93-101.

Remus, W. E. (1984). "An Empirical Investigation of the Impact of Graphical and Tabular Data Presentations of Decision Making," *Management Science* (30:5), May, pp 533-542.

Remus, W. E., and J. E. Kottemann. (1987). "Semi-Structured Recurring Decisions: An Experimental Study of Decision Making Models and Some Suggestions for DSS," *MIS Quarterly* (11:2), June, pp 232 - 243.

Rice, D. M., and E. C. Hagstrom. (1989). "Some Evidence in Support of a Relationship between Human Auditory Signal-Detection Performance and the Phase of the Alpha Cycle," *Perceptual and Motor Skills* (69:2), pp 451-457.

Rothstein, H. G. (1986). "The Effects of Time Pressure on Judgment in Multiple Cue Probability Learning," *Organizational Behavior & Human Decision Processes* (37:1), February, pp 83-92.

Schroder, H. M., J. J. Driver, and S. Streufert. (1967). *Human Information Processing* Holt, Rinehart, and Winston Inc., New York, pp. 54-61.

Shugan, S. (1980). "The Cost of Thinking," *Journal of Consumer Research* (7:2), September, pp 99 -111.

Slovic, P., and S. Lichtenstein. (1971). "Comparison of Bayesian and Regression Approaches to the Study of Information Processing in Judgment," *Organizational Behavior and Human Performance* (6:6), November pp 649-744.

Staw, B. M., and S. G. Barsade. (1993). "Affect and Management Performance: A Test of Sadder-but-Wiser vs. Happier-and-Smarter Hypotheses," *Administrative Science Quarterly* (38:2), June, pp 304-331.

Streufert, S., and S. C. Streufert. (1978). *Behavior in the Complex Environment,* John Wiley & Sons, New York,.

Svenson, O., and J. A. Maule.(1993). *Time Pressure and Stress in Human Judgment and Decision Making,* Plenum Press, New York, New York.

Swieringa, R. J., and K. E. Weick. (1982). "An Assessment of Laboratory Experiments in Accounting," *Journal of Accounting Research* (20), September, pp 56-101.

Todd, P., and I. Benbasat. (1991). "An Experimental Investigation of the Impact of Computer Based Decision Aids on Decision Making Strategies," *Information Systems Research* (11:4), June, pp 492-513.

Todd, P., and I. Benbasat.(1992). "The Use of Information in Decision Making: An Experimental Investigation of the Impact of Computer Based Decision Aids," *MIS Quarterly* (16:3), September, pp 373-393.

Todd, P., and I. Benbasat. (1993). "An Experimental Investigation of the Relationship between Decision Makers, Decision Aids, and Decision Making Effort," *Information System Research* (31:2), May, pp 80-100.

Todd, P., and I. Benbasat. (1994). "The Influence of Decision Aids on Choice Strategies: An Experimental Analysis of the Role of Cognitive Effort," *Organizational behavior and human decision processes* (60:1), pp 36-74.

Tuttle, B., and F. G. Burton. (1999). "The Effect of a Modest Incentive on Information Overload in an Investment Analysis Task," *Accounting, Organizations, and Society* (24:8), November, pp 673-687.

Verton, D. (2002). "Insiders Slam Navy Intranet," *Computerworld* (1:16), May.

Violino, B. (1997). "The Intangible Benefits of Technology Are Emerging as the Most Important of All " *InformationWeek*, June.

Wells, J., and T. J. Hess. (2002). "Understanding Decision-Making in Data Warehousing and Related Decision Support Systems: An Explanatory Study of a Customer Relationship Management Application," *Information Resource Management Journal* (15:4), pp 16-32.

Wofford, J. C., and V. L. Goodwin. (1992). "Meta-Analysis of the Antecedents of Personal Goal Level and of the Antecedents and Consequences of Goal Commitment," *Journal of Management Development* (18:3), pp 595-615.

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Communications of the Association for Information Systems

ISSN: 1529-3181