Association for Information Systems
AIS Electronic Library (AISeL)

AMCIS 1999 Proceedings

Americas Conference on Information Systems (AMCIS)

December 1999

The Effects of Information Load on Decision Making In a Decision Support Environment

Russell Ching
California State University, Sacramento

Louis Glorfeld
University of Arkansas

Monica Lam
California State University, Sacramento

The Effects of Information Load on Decision Making In a Decision Support Environment

Russell K.H. Ching, Dept. of MIS, California State University, Sacramento, chingr@csus.edu
Louis W. Glorfeld, Dept. of CISQA, University of Arkansas, 72774.3223@CompuServe.com
Monica S. Lam, Dept. of MIS, California State University, Sacramento, lamsm@csus.edu

Abstract

The conflicting results of previous studies examining DSS effectiveness suggest that other factors may be affecting a user's ability to process information. Several research studies in the marketing, accounting and psychology disciplines have examined the effects information load has on decision quality involving manual decision making tasks. Their results strongly indicate that decision-makers working under increased loads of information beyond an optimal point perform poorly or render poorer decisions. This study examines the relationship between information load and decision quality in a DSS (computer-aided problem solving) environment. The results suggest that in spite of information technology's support, information load can affect a user's decisions.

Introduction

"During the early days of DSS, the challenge was to provide decision makers access to enough information to allow them to make choices. Now, the challenge is not to provide *enough* information for decision makers; rather, it is to access *useful* data without overwhelming or misleading the decision maker" (Sauter, 1997).

A problem faced by decision-makers and has long been recognized in other disciplines is the assimilation and integration of different amounts of information. Wright (1974) referred to the ability of the decision-maker to cognizantly process a given level of information within a measured time period as information load. Past studies suggest that the optimum number of information dimensions (i.e., attributes, alternatives, information groups based on similarities, such as schemata, frames or chunks) most people can cognizantly process while maximizing the quality of their decision is between six and eight (Chewning and Harrell 1990), (San Miguel 1976), (Schroder, Driver and Streufert 1967), (Shields 1983). Prior to and beyond an optimum, decision quality deteriorates as fewer pieces of information are integrated into the decision making process (Chewning and Harrell 1990), (Helgeson and Ursic, 1993), (Jacoby, Speller and Berning 1974), (Keller and Staelin 1987), (Malhotra 1982), (Wright 1974). This suggests that either too much or too little information will have a detrimental effect on the quality of a decision-maker's decision.

The purpose of this study is to examine the effects different levels of information load have on decision quality in a DSS environment. Previous studies of information load and decision quality have concentrated on manual tasks with given sets of information. However, computer-aided problem solving poses a different situation, one that may provide certain cognitive advantages by allowing the decision-maker to selectively assemble information that closely matches his/her strategy, and thereby extending his/her threshold. Hence, it is uncertain if the same results will occur in a computer-aided problem solving task environment. This study investigates the whether higher levels of information load affect decision quality and limit the effectiveness of a DSS.

Background

Several studies have attempted to examine and determine the effectiveness of DSS in decision making. The inconsistencies of their results that suggest another factor may be present and affecting user cognition. Effectiveness has been tested with respect to decision quality and a DSS's impact on the decision making process. Often, the subjects were placed into problem solving scenarios in which a single treatment, such as availability of a DSS, presentation style (i.e., tabular, graphic, color) or user-training, was controlled and measured. The subjects were either observed or questioned in an attempt to distinguish their information and processing gains (e.g., number of responses considered, confidence in their answer) over other control group subjects. Unfortunately, the results of these studies do not overwhelmingly endorse the use of a DSS (Benbasat and Nault 1990). An implied assumption of these studies has been that the level of cognitive processing is constant at all levels of information processing for all DSS users. Yet, a sampling of recent behavioral studies indicates otherwise (Davis and Davis, 1996), (Griffeth et al., 1992), (Handy et al., 1997), (Helgeson and Ursic, 1993), (Horowitz et al., 1996), (Norstrom et al., 1996).

Generally, studies that have examined information load have concluded that the decline in decision quality results from reduced awareness of information and their relationships with other pieces of information (Chewing and Harrell, 1990), (Huber, 1990), (Huber and McCann, 1982), (Jacoby et al., 1974), (Keller and Stelin, 1987), (Malhotra, 1982), (Miller, 1960), Ross and Creyer, 1982), (San Miguel, 1976), (Wright, 1974). However, these studies focused on manual decision making tasks and presented information in predefined sets of printed (hard copy) information.

Information Load and DSS

Although the introduction of information technology (IT) to decision making has led the decision-maker to a greater awareness of information, the effects of information load may still be present, particularly in a DSS environment. In contrast to other IT-based systems, such as transaction processing and management information systems, the success of a DSS depends on its user. A DSS incorporates the knowledge and intuition of the decision-maker into the problem solving process. Intuition introduces subjectivity into the problem solving task by allowing the decision-maker to apply his/her judgment and insight. As a result the solutions derived from a DSS are based on the decision-maker's interpretation and modeling of the problem, and assimilation of information. The ill-defined structure and non-recurring nature of the problem, along with the task's urgency and the organizational context introduce pressures that complicate the process. Hence, the DSS environment provides numerous occasions for cognitive hindrances to arise.

Despite IT's advantages, many decision-makers may still be rendering poor decisions due to high levels of information load. In some cases, IT may be allowing decision-makers to make poor decisions quicker.

Proposed Relationship

Decision quality, in this study the deviation from a correct or favorable response, hinges upon how well the decision-maker assimilates and integrates the information presented to him/her. The adverse effects of both low and high levels of information have been documented in the aforementioned studies. A cognitive processing optimum can be established and based upon the number of information dimensions and cues (Chewning and Harrell 1990), (Helgeson and Ursic, 1993), (Jacoby, Speller and Berning 1974), (Keller and Staelin 1987), (Malhotra 1982), (Wright 1974). Essentially, as information load moves away from the optimum, decision quality decreases. Although decision-makers in a DSS environment can view information in formats conducive to higher recall, retention, comprehension and differentiation, high levels of information load may still negatively affect the their ability to process and manage information. However, IT's positive effects may extend the thresholds of the decision-maker and nullify the effects of high information load. The proposed relationship between decision quality and information load states that higher amounts of information will have the same effects in a DSS environment as they do in a manual environment.

H1: Decision quality decreases as information load increases beyond the optimum.

The results of several studies (Chewning and Harrell 1990), (San Miguel 1976), (Schroder, Driver and Streufert 1967), (Shields 1983) strongly suggest that information processing follows the U-curve posited by Schroder, Driver and Streufert (1967) (Figure 1). The curve's peak or optimum represents the point at which the decision-maker's background (i.e., education, training, experience, etc.) is maximally applied to processing the amount of information present. Beyond that point, information begins to overwhelm the decision-maker's ability to process it, and s/he will employ different strategies to simplify his/her processing (Miller, 1960). In extreme cases, the decision-maker will process no information. The effects of high information load become evident in the decision-maker's decision quality which reflects the amount of information that was accurately processed.

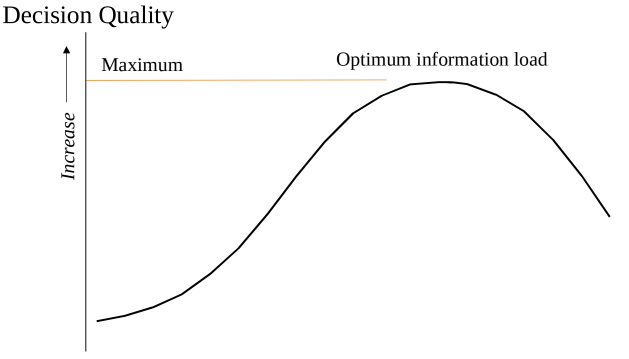

Figure 1. U-curve

Provided that adequate amounts of information necessary to render a decision are presented to the decision-maker, categories can be established to differentiate information load levels. Different formats, greater levels of aggregation, drill-downs and increases to the number of modeling options can be used to helpfully expand information beyond its unidimensionality. However, studies have demonstrated how increasing the number of options and detail can induce higher levels of information load. In many cases, the subjects were unable to integrate and assimilate accurately all pieces of information, or recognize information they would normally have applied. Given a broader range of options (i.e., alternatives) for viewing the same information, a decision-maker in a DSS environment could encounter the same effects noted in previous research using manual tasks. As a result, the decision quality of decision-makers with higher levels of information load is expected to be lesser (i.e., greater error).

Methodology

A general, inter-disciplinary business case problem similar to one found in the graduate management admission test (GMAT) was selected for this study. The problem dealt with a ficticious private university with five campuses that received a multi-million dollar donation from an alumna. The objective was to decide which campus should receive the gift in light of its greatest benefit and service to the university. Within the problem, several key (17) decisions leading to the problem's resolution were required. The subjects manipulated simulated-DSS programs to gather information to support their decisions. These decisions were captured in numerical responses.

An objective of the simulated-DSS software was to induce different levels of information load onto the subjects. Information load is defined as the amount of data an individual can process within a given time period. It can be manipulated *by either increasing the number of decision-relevant pieces of evidence or by increasing the total amount of information in the immediate environment such that the individual becomes distracted* (Wright 1974). In this study, information load was manipulated through the number of dimensions of information presented by the DSS. This included presenting greater summarized information, increasing the number of decision attributes, and increasing the number and combination of reporting levels. Two groups, moderate and high information loads, were formed. The moderate treatment contained an estimated eight dimensions while the high treatment an estimated 14. The dimensions were based upon Waern's (1989) theory of chucking.

Decision quality was determined from a cumulative response score to the questions. Because variations were expected in the responses, the answers could not be simply classified as correct or incorrect. Rather, they had to be recorded in a manner that would capture their deviations from the correct answers. In this study, decision quality was measured as the sum of the absolute standardized errors (i.e, expected minus actual) of the responses.

Results

Forty-five graduate students enrolled in both masters and doctoral programs in a college of business administration volunteered for the study. All possessed either an undergraduate business degree or a working knowledge of the business functions. Because of the two academic levels, subjects were stratified by their levels and then block randomly assigned to the treatment groups. Although the groups were divided near equally, several unusable responses reduced the samples to sixteen and twenty for the moderate and high information load treatment groups, respectively.

The results suggest that subjects who were assigned higher levels of information load made fewer accurate decisions (Table 1). An unbalanced analysis of variance indicates a significant difference in the treatment means ($F = 26.88$, $p < .01$), and supports H1.

Table 1. Group mean scores

Group	*N*	Decision Quality Means
Moderate information load	16	4.91
High information load	20	8.41

Discussion

Advances in storage media, telecommunications technology and desktop processing power throughout the 1990s (Scott Morton, 1995) have opened many new opportunities for accessing, analyzing and modeling enormous amounts of data online and within a relatively short time frame. Users are often motivated into using this technology as the complexity of their problem solving tasks increases. In response to satisfying this growing demand, software and system developers have designed into their software and applications numerous options, some which are redundant, that allow the user to selectively generate reports and graphic models from consolidated or expanded data (i.e., drill-downs and drill-across), rotated across multiple dimensions from a variety of sources. Although their intent is to allow users to better inform themselves, these options may induce higher levels of information load and lead to poorer decisions. Thus, greater consideration for the cognitive limitations of the decision-maker must be made for DSS to be effective.

Conclusion

The amount of information a decision-maker incorporates into his/her decision making process can affect his/her decisions. In the past, many researchers and practitioners viewed computer-aided problem solving as an opportunity to make better decisions while ignoring the effects of presenting too much information. However, evidence suggests that decision-makers in such environments are faced with the same information processing problems confronting others engaged in manual problem solving tasks. Thus, developers of decision support type systems (DSS, EIS.) must be aware of user cognitive limitations to ensure the system's design does not overwhelm the user with information.

References

(*Available Upon Request from First Author*)