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# Examining the Influence of Cognitive Style on the Use of a Decision Support Tool for Structured and Unstructured Tasks

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# EXAMINING THE INFLUENCE OF COGNITIVE STYLE ON THE USE OF A DECISION SUPPORT TOOL FOR STRUCTURED AND UNSTRUCTURED TASKS

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## Abstract

*Decision makers are faced with an ever-growing collection of information, and an ever-growing level of complexity with respect to the types of decisions being made. Appropriately designed computerized decision support tools are needed to support the decision maker in the various tasks that they must undertake in evaluating the information, arriving at a decision, and solving the problem. However, a dilemma arises if the decision maker or problem solver does not have an appropriate tool to support them. This research examines the appropriateness of a common, generic decision support tool, in consideration of the types of tasks, structured and unstructured, decision makers undertake and, in particular, the preferred cognitive style and approach of the individual decision maker. Interesting patterns and significant findings indicate that varying decision or problem solving cognitive styles influence the use made of a decision tool, and subsequently the individual's performance in completing their tasks.*

**Keywords:** Cognitive style, decision style, problem-solving style, decision support tools, structured, unstructured

## Introduction

The concept of using a computer as a decision-aiding tool has been discussed many times and in many venues over the past half century. As the amount of data and information that needs to be analyzed, processed, manipulated, and decided upon grows, the limits of human capability are quickly reached. Using a computer and various electronic decision tools can greatly assist the decision maker in evaluating potential mountains of information. The presumption is that by equipping a decision maker with an electronic decision aid, such as a common spreadsheet, their decision making can be supported and improved. However, a significant component of that presumption is that the decision aid is of a type and format that does, in fact, support the decision maker and the style or method by which he or she prefers to make decisions. A well-intentioned decision aid that is designed contrary to this decision making or problem solving "style" could actually hinder rather than aid the decision maker. Unfortunately, what is often the case today is that a decision aid is designed to support a generic decision maker. Cognitive style research has shown that there is not one generic style of decision maker, but rather several styles and combinations of styles that may or may not be supported by a generic decision aid.

The purpose of this research is to examine the effect that an individual's style of decision making and problem solving has on their use of a decision aid when undertaking both structured and unstructured tasks.

## Background

The question that is driving this research is whether an individual's cognitive style, specifically in the areas of decision making and problem solving, influences a decision maker's performance when using a generic decision support tool. Conversely, is that particular tool designed appropriately when consideration is given toward the individual's preferred style of decision making and

problem solving? A structured tool, while perhaps supporting an individual preferring a structured, logical, analytical approach to decision making and problem solving, may not adequately support an individual preferring a less structured or more conceptual approach. The concept that cognitive style research is directly relevant to designing management information and decision support systems has been suggested since the early days of information systems research (for example, Lucas, 1973; Mason and Mitroff, 1973; Driver and Mock, 1975; Bariff and Lusk, 1977; De Waele, 1978; Sprague,1980; Robey and Taggart, 1985). Robey and Taggart (1985) stated that many of the systems (at that time – and arguably still today) assumed that all users were logical, structured, and sequential, but that perception needs to be reconsidered. Current research, also, continues to address the need to give further consideration to the cognitive differences among decision makers and determine ways in which these differences can be best supported.

### *Decision Making and Problem Solving*

Making decisions and subsequently implementing those decisions through a problem solving process is an integral component of business. There are four commonly accepted phases of the decision process, originally proposed by Simon (1960): Intelligence, Design, Choice, and Implementation. Decision makers/problem solvers are also faced with varying types and degrees of structure in their decisions, ranging from very structured, straightforward problems to very unstructured, highly ambiguous problems. Regardless of the type or nature of a particular decision, the decision making process is often not a simple one, and there are limitations on the human ability to obtain, process, and analyze relevant data. The use of a decision support tool is often appreciated if not absolutely necessary for successful decision making. Furthermore, for such a system to successfully support a manager, it should not only support the decision situation, but also the decision style of the manager, and not force adherence to a specific process (Keen and Wagner, 1979; Sprague, 1980; Robey and Taggart, 1985). Sprague, in discussing decision support tools, comments that the concept of structure within the realm of decision making is very dependent upon the decision maker's cognitive style and approach to problem solving, and states that "a very important characteristic of a DSS is that it provide the decision maker with a set of capabilities to apply in a sequence and form that fits his/her cognitive style" (1980, 13).

### *Cognitive Style*

Cognitive style has been defined as describing the "underlying personality dispositions toward the treatment of information, the selection of alternatives, and the evaluation of consequences" as well as "the subjective process through which individuals organize and change information during the decision making process" (Laudon and Laudon, 1998, 134; Turban, 1988, 60). McKenney and Keen (1974) describe two ends of the cognitive style spectrum that are very relevant to this study: systematic and intuitive decision makers. Systematic individuals tend to structure problems according to a formal method, and gather and evaluate information using this structured approach. Intuitive individuals tend to use multiple methods or approaches, and prefer to avoid using a structured or systematic approach to solving a problem or making a decision (McKenney and Keen, 1974). Specific to this research, two components of cognitive style were examined: Decision Style and Problem Solving Style.

### *Decision Style and Problem Solving Style*

Decision Style captures certain key aspects of a manager's belief system that are applied in decision making, often unconsciously. Individual preferences make up a style that in turn determines the types of experiences and information that are selectively stored and later used in decision making (Nutt, 1993). Rowe's approach to examining decision style developed through his cognitive contingency decision style model and his Decision Style Inventory (DSI), both of which are based on the "four force" model - personal needs, environmental pressures, group demands, and task requirements (Rowe and Mason, 1987). Together, these forces influence the way an individual responds to a situation and makes a decision. Rowe's Model also focuses on two dimensions – cognitive complexity and value orientation. Together these describe an individual's preferred decision style based on high or low tolerance for ambiguity and an orientation towards either thinking or action, and task or people concerns. Four primary decision styles are then identified: directive, analytical, conceptual, and behavioral. Very briefly, an individual possessing a dominant directive style tends to be systematic, efficient, decisive, and structured. Individuals possessing a dominant analytical style would focus on analysis, forecasting, and detailed planning. A dominant conceptual style characterizes individuals who are more complex, creative, adopt a broad outlook, tend to take more risks and who dislike following rules. Lastly, an individual possessing a dominant behavioral style is people-oriented, adopts loose control, and prefers oral to written communication. For a more detailed description, see Rowe and Mason's (1987) work. Essentially, individuals preferring a directive or analytical style are much more structured and logical in their decision making, whereas individuals preferring a conceptual or behavioral style are

much less structured and more broad in their approach to making decisions. These two dichotomies, structured and unstructured, correlate with McKenney and Keen's (1974) "systematic" and "intuitive" classifications.

Problem Solving Style relates closely to the concept of decision style. Varying schools of thought differentiate between the acts of decision making and problem solving. One school considers all four of Simon's (1960) steps to constitute problem solving, and only phase 3 – Choice as decision making. Another perspective is that the first three phases are considered decision making and the fourth phase – Implementation is the actual problem solving (Turban, 1988). Regardless of the semantics, early work in the area of decision support systems (DSS) indicated that such a tool should be designed to support all four phases of this process (Sprague, 1980). Wu, et al., (1996) state that problem solving style describes the *tendency to respond* in a particular way when involved in the problem solving process, but not the performing of the actual steps in the process. Jabri (1991), building on the work of Koestler (1949, 1964), developed the Problem Solving Style Inventory (PSSI) to measure an individual's problem solving style and categorize them as having a propensity towards one of two styles – associative or bisociative. Scott and Bruce (1998) provide a useful description of these two styles. An Associative individual tends to be much more structured and systematic in their approach to problem solving. They are characterized by habitual thought and follow set, mental routines. They use rationality and logic to develop conventional solutions to problems. A Bisociative individual is much less structured. They emphasize imagery and intuition, tend not to be constrained by existing rules and disciplinary boundaries, and are more likely to generate novel and innovative solutions to problems (Scott and Bruce, 1998). Again in reference to McKenney and Keen's (1974) classification, an Associative problem solver correlates to the systematic individual, and a Bisociative problem solver correlates to the intuitive individual.

### *Decision Support Tools and Spreadsheets*

Singh (1998) defines a decision support system as a "computerized aid designed to enhance the outcomes of an individual's decision making activities" (p.145). An electronic spreadsheet certainly adheres to this definition. Chan and Storey (1996) identify electronic spreadsheets as probably the most commonly used decision support software tool, and a recent study indicated that 94% of the survey respondents reported Microsoft Excel was their primary spreadsheet (Pemberton and Robson, 2000). Vazsoni (1993) argues that while electronic computers revolutionized the cognitive style of scientists and engineers, the cognitive style of managers did not change until the advent of the microcomputer and the creation of the electronic spreadsheet. He states that managers are becoming more "numerate" and are using the computer to improve problem formulation, problem solving, and decision making (Vazsoni, 1993). However, the argument remains that these tools are designed primarily to assist structured, systematic decision makers in the completion of structured, systematic tasks.

### *Structured and Unstructured Tasks*

Simon (1960) and Gorry and Scott-Morton (1971) describe varying types of decision situations, ranging from the programmed, or structured, to the non-programmed, or unstructured. Structured decisions are repetitive and routine and involve using a standard rule or procedure with which to arrive at a solution. Unstructured decisions are those in which the decision maker has to inject judgment and insight and are often novel and non-routine, lacking a standard approach for making the ultimate decision. Part of the focus of this research is to determine the effect of using a generic decision support tool to aid in making decisions for tasks of both greater and lesser degrees of structure, particularly in consideration of an individual's decision style and problem solving style – which identify that individual as being more or less structured in their approach to making decisions and solving problems. Tasks with varying degrees of structure have been studied in several contexts (for example, Daniel and Esser, 1980; Abdolmohammadi and Wright, 1987; Bystrom and Jarvelin, 1995).

## Research Model and Hypotheses

Lucas (1973) presents a framework that addresses the impact of a variety of variables on the use of a system and ultimately on the performance achieved through the use of that system. User attitudes, the quality of the system, situational and personal factors, as well as an individual's decision style were each posited to impact the use made of an information system (Lucas, 1973). In Vessey and Galletta's (1991) discussion of cognitive fit, the authors present a problem-solving model which indicates that problem-solving skills influence an individual's mental representation of a problem, and subsequently their problem solution. Their concept of problem-solving skills is described as existing only within the context of a specific task, rather than an individual difference characteristic. However, the construct of problem-solving skill was assessed partially using Witkin's Group Embedded Figures Test which does measure one aspect of cognitive style (Leonard, et. al, 1999). Thus, this model also suggests a

relationship between cognitive style and mental representation, and indirectly, the problem solution. Goodhue and Thompson (1995) argue that technologies (e.g., a computer system) must be utilized and fit the task that they are designed to support. Further, the notion of task-technology fit describes "the correspondence between task requirements, individual abilities, and the functionality of the technology" (Goodhue and Thompson, 1995, 218). Characteristics of the individual include training, computer experience, and motivation, but also must consider the individual's personal approach or style in solving problems, making decisions, and accomplishing the task. Singh (1998) presents a conceptual model which includes the characteristics of the decision environment, the decision maker, and the decision strategy in a study to determine the effectiveness of using computerized cognitive aids to support decision makers. Drawing from these works, Figure 1 presents the research model tested in this study.

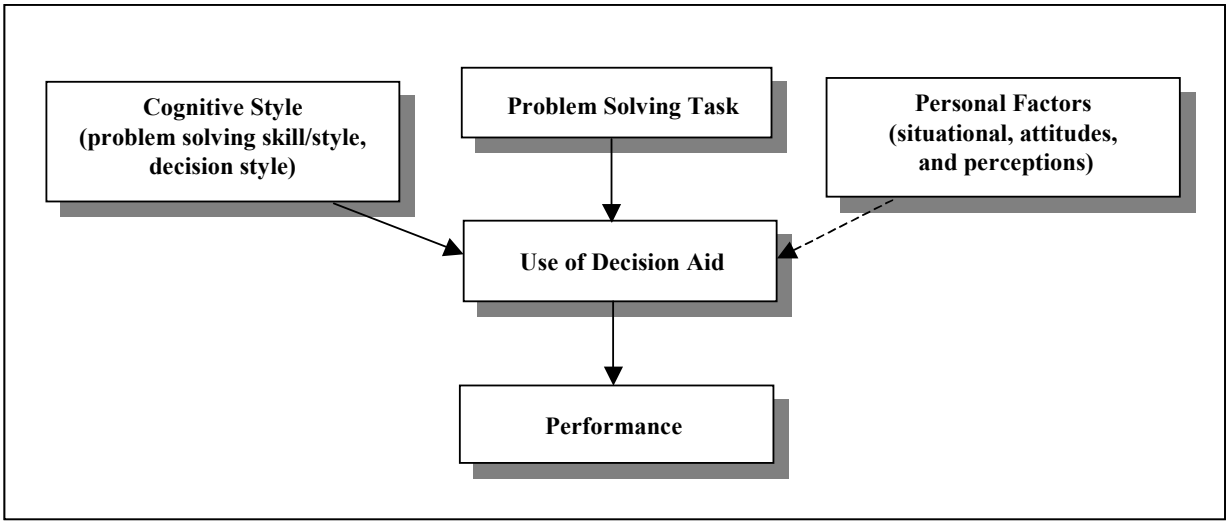


**Figure 1. Research Model**

Consistent with previous work (Vessey and Galletta, 1991; Goodhue and Thompson, 1995), this model proposes that performance on a task will be influenced through the use of a computerized decision tool which in turn is influenced by the nature of the task and personal characteristics of the individual, namely their cognitive style. The tasks in this study are delineated as either structured or unstructured. Decision Style and Problem Solving Style were the variables used for the cognitive style construct. Various personal and situational factors may also influence the use made of the tool. Specific to this study, these factors include the amount of training received on the tool and the use made of the tool, as well as effort put forth in the completion of the task and the perceived quality of the solution.

The primary null hypotheses tested in this study were as follows:

$H1_0$: Cognitive style has no influence on performance when completing a structured task using a generic decision support tool.

$H2_0$: Cognitive style has no influence on performance when completing an unstructured task using a generic decision support tool.

## Research Methodology

This intent of this study was to specifically focus on the responses of "novices" to the decision aid. These individuals would have limited and relatively homogeneous experience with the tool, and thus the influence of their cognitive style should be greater. It is possible that after gaining experience using a decision tool, the effect of cognitive influence is lessened. The author is currently studying this proposal. However, it is necessary to establish a baseline of the cognitive effect on inexperienced users. Thus, it was appropriate for this study to make use of student subjects who were enrolled in an Introduction to Microcomputers course in which they were given instruction on the use of Microsoft Excel™.

The subjects were first given an overview of the instructions, and were then asked to complete cognitive style instruments that assessed their propensity towards a particular decision style (using the Decision Style Inventory (DSI)) and problem solving style (using the Problem Solving Style Inventory (PSSI)). After the subjects completed these instruments, they then proceeded to work on two tasks requiring the use of Microsoft Excel.

The first task was very structured and straightforward. The subjects were given very specific instructions on how to assemble a spreadsheet for assistance in a payroll calculation and subsequent consideration of the effect of a potential pay raise for an employee. For this task, the subjects were asked to calculate the result of two scenarios and answer two questions pertaining to the results. The time required to complete the task, in seconds, as well as the correctness of the task were measured. Correctness was measured by looking at thirty-two possible items such as correct placement of a label on the spreadsheet, correct use of a formula, correct formatting, and providing correct answers to the two questions.

The second task was much less structured and involved using the spreadsheet to assist in making a decision regarding a choice of which graduate school to attend. For this task the subjects were given three possible choices of schools and had to consider the amount of money they would have to borrow to attend the school, three different interest rates and terms for which to pay the loan back, and the potential starting salary of a graduate of that school. No specific directions were provided as to how elaborate or simple the spreadsheet needed to be, nor how it needed to be formatted. Performance for this task was measured as the amount of time, in seconds, needed to complete the task, a determination of the adequacy of use made of the spreadsheet while solving this task, and a determination of the extent to which the subject's final decision was based on the spreadsheet. These last two measures were based on a scale of 1 to 7, with 7 being the greatest adequacy of use or extent of use. Two independent evaluators examined and scored the results of this task following the completion of all administrations of the experiment. Where there was a variance in the ratings, the evaluators reexamined the results and came to a consensus.

Lastly, the subjects were asked several demographic questions, including age and gender, how much training they had received and how much use they made of an electronic spreadsheet on a weekly basis. They were also asked to indicate their perceived level of effort put forth and perceived quality of their work on each task.

All subjects completed the entire experiment in less than 75 minutes.

## Data Analysis

A total of 79 voluntary subjects, all undergraduate business majors at a medium-sized university, participated in the experiment. The subjects, 54% male, ranged in age from 17 to 25 with a mean of 19.4. They reported having received an average of 20.7 hours of training on Microsoft Excel, and used the tool approximately 3.3 hours each week. On average the subjects were first introduced to the tool 20.6 months prior to the experiment.

### *Performance*

To test the primary null hypothesis, that there is no difference between individuals preferring a structured approach to decision making and problem solving and individuals preferring an unstructured approach to decision making and problem solving, ANOVA was performed comparing individuals both by their decision style and problem solving style with performance measures from each task. As described above, individuals preferring a directive or analytical decision style are more structured in their approach to decision making, whereas individuals preferring a conceptual or behavioral decision style are much less structured. As the primary focus of this research was examining the differences between structured and unstructured decision makers, and in keeping with McKenney and Keen's (1974) dichotomy, the directive- and analytical-oriented individuals were combined into one "structured" (systematic) group, and the conceptual- and behavioral-oriented individuals were combined into a second "unstructured" (intuitive) group. Again, the Problem Solving Style Instrument identifies individuals as either Associative (structured/systematic) or Bisociative (unstructured/intuitive). The results from the first (structured) task are shown in Table 1.

As Table 1 indicates, there is a significant difference in the performance of individuals with respect to their preferred style of making decisions and solving problems, and thus the null hypothesis, H1, is rejected completely with respect to decision style and partially with respect to problem solving style. Individuals preferring a more structured decision making approach tend to spend more time using the tool and achieve a higher level of correctness than individuals preferring a less structured approach. With respect to problem solving style, significant performance differences are also evident, but only with respect to the amount of time spent using the tool. There was not a significant difference found for the correctness of the solution between structured and unstructured problem solving styles.

**Table 1. Task 1 Results**

| Time | n | mean (sd) | F | p |
|---|---|---|---|---|
| Structured Decision Style (Directive and Analytical) | 21 | 877.67 (416.8) | 3.376 | .070 |
| Unstructured Decision Style (Conceptual and Behavioral) | 50 | 732.18 (244.2) | | |
| Structured Problem Solving Style (Associative) | 37 | 855.41 (323.3) | 5.356 | .024 |
| Unstructured Problem Solving Style (Bisociative) | 36 | 694.75 (266.8) | | |
| **Correctness** | **n** | **mean (sd)** | **F** | **p** |
| Structured Decision Style (Directive and Analytical) | 22 | 33.36 (4.2) | 4.843 | .031 |
| Unstructured Decision Style (Conceptual and Behavioral) | 51 | 29.65 (7.4) | | |
| Structured Problem Solving Style (Associative) | 39 | 31.13 (6.4) | .371 | .544 |
| Unstructured Problem Solving Style (Bisociative) | 36 | 30.17 (7.3) | | |

**Table 2. Task 2 Results**

| Time | n | mean (sd) | F | p |
|---|---|---|---|---|
| Structured Decision Style (Directive and Analytical) | 19 | 1112.26 (291.0) | 2.942 | .091 |
| Unstructured Decision Style (Conceptual and Behavioral) | 51 | 1305.51 (456.6) | | |
| Structured Problem Solving Style (Associative) | 37 | 1339.11 (443.8) | 3.953 | .051 |
| Unstructured Problem Solving Style (Bisociative) | 36 | 1140.63 (400.7) | | |
| **Adequacy of Using the Tool** | **n** | **mean (sd)** | **F** | **p** |
| Structured Decision Style (Directive and Analytical) | 20 | 3.65 (1.4) | .156 | .694 |
| Unstructured Decision Style (Conceptual and Behavioral) | 51 | 3.49 (1.6) | | |
| Structured Problem Solving Style (Associative) | 37 | 3.57 (1.7) | .278 | .600 |
| Unstructured Problem Solving Style (Bisociative) | 35 | 3.38 (1.4) | | |
| **Solution Based on Use of Tool** | **n** | **mean (sd)** | **F** | **p** |
| Structured Decision Style (Directive and Analytical) | 20 | 3.23 (1.9) | 1.142 | .289 |
| Unstructured Decision Style (Conceptual and Behavioral) | 51 | 2.68 (2.0) | | |
| Structured Problem Solving Style (Associative) | 37 | 3.00 (2.1) | .659 | .420 |
| Unstructured Problem Solving Style (Bisociative) | 35 | 2.63 (1.7) | | |

Table 2 provides the results from the second (unstructured) task. As indicated in Table 2, when faced with a much less structured task, the results are less clear. The element of time again produced significant differences, and thus the null hypothesis, H2, is rejected for this measure. However, with respect to decision style, the task generated results that were *opposite* of what was seen with the structured task. Structured individuals spent significantly *less* time using the tool and arriving at their conclusion on this unstructured task than those individuals preferring an unstructured approach to decision making. With respect to problem solving style, the results were consistent between both the structured and unstructured tasks. Again, structured problem solvers took significantly more time than problem solvers who prefer an unstructured approach. This one and only pattern difference between decision style and problem solving style presents an interesting dilemma that implores further study.

As this was designed to be a much less structured task, requiring an element of subjectivity and not having one, definitive solution, a measure of correctness, per se, was not assessed. However, what is important is the extent to which the subjects used the tool, and subsequently the extent to which their solution relied on this tool. These measures, in essence, act as a surrogate of the extent to which the subjects felt the tool was appropriate for their decision making and problem solving. When consideration was given to these variables, no significant differences were found, and thus the null hypothesis, H2, failed to be rejected for these measures. A consistent pattern did arise, however, in that individuals preferring a structured approach to decision making and problem solving made more adequate use of the tool, and their decisions were based more on the results generate by the tool than individuals preferring an unstructured approach.

### *Effort and Quality*

It is also important to assess the subjects' perceived level of effort applied to completing the tasks, and the perceived level of quality in their solution. Table 3 provides a summary of the results of these measures. As this table indicates, there is a consistent pattern with respect to both decision style and problem solving style. Individuals preferring either a structured decision style or problem solving style tend to be more critical and consistently rate themselves lower on both the amount of effort expended to complete the task, and the perceived quality of their solution than did individuals preferring an unstructured decision style or problem solving style. Significant differences were seen, however, only with respect to perceived quality for the first task through the influence of both decision style and problem solving style.

### *Correlation*

A Pearson Correlation was run to evaluate the relationship between these personal assessments of effort and quality, as well as various personal and situational variables, and actual performance. For the first (structured) task, perceived level of effort was not correlated with either the amount of time required, or the correctness of the solution. Perceived quality was significantly *negatively* correlated with time (-.343, p=.004) but was not correlated to correctness. Perceived level of effort and perceived quality of the solution were significantly and positively correlated (.385, p=.001) For the second (unstructured) task, perceived level of effort was positively and significantly correlated with the time required to complete the task (.342, p=.004), the adequacy of use of the tool (.440, p=.000), and the extent to which the solution relied on the spreadsheet (.241, p=.046). Perceived quality of the solution on this task was also significantly and positively related to the adequacy of the use of the tool (.403, p=.001), but was not related to the extent to which the solution relied on the spreadsheet. Consistent with the first task, perceived level of effort and perceived quality of the solution were significantly and positively related (.578, p = .000). The amount of training received, number of hours per week the tool was used, age, and gender had no relation to any performance measures.

**Table 3. Perceived Effort and Quality**

| Task 1 | | | | |
|---|---|---|---|---|
| **Perceived Effort** | **n** | **mean (sd)** | **F** | **p** |
| Structured Decision Style (Directive and Analytical) | 22 | 4.00 (1.2) | .249 | .619 |
| Unstructured Decision Style (Conceptual and Behavioral) | 50 | 4.14 (1.1) | | |
| Structured Problem Solving Style (Associative) | 40 | 4.05 (1.0) | .145 | .705 |
| Unstructured Problem Solving Style (Bisociative) | 34 | 4.15 (1.2) | | |
| **Perceived Quality** | **n** | **mean (sd)** | **F** | **p** |
| Structured Decision Style (Directive and Analytical) | 22 | 3.82 (1.1) | 6.985 | .010 |
| Unstructured Decision Style (Conceptual and Behavioral) | 50 | 4.42 (0.8) | | |
| Structured Problem Solving Style (Associative) | 40 | 4.05 (0.9) | 3.359 | .071 |
| Unstructured Problem Solving Style (Bisociative) | 34 | 4.44 (0.9) | | |
| **Task 2** | | | | |
| **Perceived Effort** | **n** | **mean (sd)** | **F** | **p** |
| Structured Decision Style (Directive and Analytical) | 22 | 3.82 (1.1) | 1.609 | .209 |
| Unstructured Decision Style (Conceptual and Behavioral) | 50 | 4.12 (0.9) | | |
| Structured Problem Solving Style (Associative) | 40 | 3.93 (0.9) | .335 | .564 |
| Unstructured Problem Solving Style (Bisociative) | 34 | 4.06 (1.0) | | |
| **Perceived Quality** | **n** | **mean (sd)** | **F** | **p** |
| Structured Decision Style (Directive and Analytical) | 22 | 3.59 (1.0) | .184 | .669 |
| Unstructured Decision Style (Conceptual and Behavioral) | 50 | 3.71 (1.1) | | |
| Structured Problem Solving Style (Associative) | 40 | 3.45 (1.1) | 2.667 | .107 |
| Unstructured Problem Solving Style (Bisociative) | 34 | 3.87 (1.1) | | |

## Discussion

It is evident from these results that cognitive style does influence the use made of a computerized decision aid. For unstructured tasks, when comparing individuals based on their preferred style of making decisions and solving problems, there is a significant difference in the amount of time spent on these tasks. Those individuals who tend to prefer a more structured approach spend more time completing structured tasks. This is not necessarily a desirable trait, however, with consideration given to decision style, these individuals do outperform (i.e., more correct solution) individuals preferring a less structured approach. When faced with a much less structured task, there remains a significant difference in the amount of time spent complete the task. The results of this study indicated that when considering an individual's decision style, structured individuals spend significantly less time working on the unstructured task than do individuals preferring an unstructured approach to decision making. However, when

considering problem solving style, the results were just the opposite – individuals preferring a structured approach to problem solving spent significantly *more* time completing the task. This finding bears further consideration and study, and may rest in differences between the cognitive processes of problem solving and those of decision making, more evident when attempting to develop a solution to less structured problems.

Although not statistically significant in this study, very definitive patterns developed with respect to how adequately the subjects used the decision tool in arriving at a solution, and the extent to which their solution relied on the information provided by the tool. More structured individuals, both with respect to decision style and problem solving style, consistently made more extensive use of the tool and relied more on the tool for their solution. Further studies with larger numbers of subjects could verify these results for statistical significance.

It is also interesting to note that a consistent pattern resulted in the perceived levels of effort and quality of the subjects' solutions. More structured individuals consistently rated their effort as lower than their less structured counterparts. With respect to perceived quality, again the more structured individuals perceived their solution as being of lower quality than the less structured individuals. The results, however, indicated that although the more structured subjects judged their effort and quality lower, their performance (correctness) was higher on the first task, and for the second task they made more adequate and extensive use of the decision tool, and relied more heavily on the tool when arriving at their solution. These findings imply that individuals preferring an unstructured approach to decision making and problem solving are not adequately supported by common, generic tools for structured tasks, and seem to discount the tool's support for less structured problems, as well. For structured individuals completing structured tasks, this generic decision support tool seems reasonably appropriate. However, when facing less structured problems, although they do make more adequate use of the tool and rely more heavily on the tool for their solution, these structured decision makers and problem solvers are more critical of their efforts and solutions than the less structured subjects.

## Limitations

As is evident in every experimental setting, generalizability of the results is limited. However, care was taken to broaden the applicability of the results by using an appropriate "novice" group of subjects and employing the most common, most powerful, general-purpose decision support tool available – Microsoft Excel.

The tasks the subjects were asked to perform were relatively common spreadsheet tasks, incorporating a variety of actions such as cell positioning, data entry, formula creation, and function use. It could be argued that the specific nature of the tasks was too simplistic, and the author encourages additional studies incorporating other, more involved and complex tasks to confirm or challenge these results.

Finally, when considering the assessment of cognitive style, the validity of the instruments used to determine an individual's preferred style is often called into question. The Decision Style Inventory has been used in thousands of administrations, its validity has been reported in Rowe and Mason (1987), and the instrument continues to be used in several published studies (Rowe and Mason, 1988; Bowman, 1992, Leonard, et al., 1999; Fox and Spence, 1999). The Problem Solving Style Instrument has not seen nearly the level of validity testing that the DSI has seen, but has been described and validated in Jabri (1991) and used in published research (Scott and Bruce, 1998).

## Conclusion and Suggestions for Future Research

It is evident that there exist significant differences with respect to cognitive style, specifically decision style and problem solving style, when individuals are required to complete tasks using a computerized decision support tool. Perhaps most disturbing is the level of correctness of the completed task – structured decision makers achieving a significantly higher performance level than unstructured decision makers. There is also a significant difference with respect to time – structured decision makers and problem solvers spend more time using the tool than do unstructured individuals. These results are most manifest when the individual is required to complete a structured task. When using a spreadsheet to complete a less structured task, individuals continue to display a significant difference with respect to the amount of time spent developing a solution with the tool, but not with regard to the adequacy of use made of the tool and the extent to which their solution is based on the tool. A definite pattern does present itself, however, and future studies should utilize a larger number subjects to determine if this pattern proves significant.

Future research should examine the extent to which these differences continue to be manifest as the decision maker gains experience with the decision support tool, or whether they are lessened if decision makers force themselves to adapt to a generic tool. In the predicted event that significant differences continue to exist at an "experienced" and "expert" level, it is imperative that further research consider the various types and nature of tools that might be more appropriate for the varying styles of decision makers. For example, interfaces employing audio input and output, or perhaps tactile (i.e., touch screens) interfaces are more appropriate and supportive for the conceptual, behavioral, intuitive decision maker. Individuals think differently, make decisions differently, solve problems differently, and need different tools that can support them in the manner and style which they prefer.

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