Improving Dynamic Decision Making Through Debriefing: An Empirical Study

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Abstract

Empirical evidence suggests that people perform poorly in dynamic tasks. The thesis of this article is that dynamic decision performance can be improved by helping people to develop more accurate mental models of the task stems through training with debriefing supported computer simulation-based interactive learning environments (CSBILEs). I report a laboratory experiment in which subjects managed a dynamic task by playing the role of fishing fleet managers. One group of participants used a CSBILE with debriefing, whereas another group used the same CSBILE but without debriefing. A comprehensive model consisting of four evaluation criteria is developed and used: task performance, structural knowledge, heuristics, and cognitive effort. It is found that debriefing was effective on all four criteria; debriefing improves task performance, helps the user learn more about the decision domain, develop heuristics, and expend less cognitive effort in dynamic decision making.

Key Words: Computer simulation, Interactive learning environments; Dynamic decision making; Debriefing; Feedback; Renewable resource management

INTRODUCTION

Overexploitation and mismanagement of renewable resources abounds. Examples, where such resources have been more or less mismanaged, include fish and whales, forests, soil, ground water reservoirs, as some reindeer pastures (Moxnes 2000). There are two main theoretical themes for why overexploitation of renewable resources happens. One prominent theory is known as the "tragedy of commons" (Hardin 1968). On this reading, open access to a resource whereby users of the resource compete to maximize their individual benefit (the commons problem) causes overexploitation of common renewable resources. The other explanation of why renewable resources are poorly mismanaged, drawing on the emerging literature on dynamic decision-making, is the misperception of feedback (MOF) hypothesis (Sterman 1989a) or misperception of the bioeconomics of renewable resources (Moxnes 1998, 2000). From this perspective, people's poor performance in renewable resource management tasks can be attributed to a general tendency for people systematically to misperceive the dynamics of bioeconomic systems. Even when the commons problem is eliminated, overexploitation occurs. On this reading, interpretation of the MOF hypothesis is that people mismanage the renewable resources because their knowledge of renewable resource system structure is less than perfect. Appropriate management could perhaps be achieved through training by helping people to develop more accurate mental models of renewable resource systems.

Computer technology together with the advent of new simulation tools and methods provides a potential solution to the need for the training tool for complex dynamic systems such as renewable resource systems. For instance, computer simulation-based interactive learning environments (CSBILEs) are often used as decision support systems to improve decision making in dynamic tasks. CSBILEs allow the compression of time and space and provide an opportunity for managerial decision making in a non-threatening way. Despite an increasing interest in CSBILEs, recent research on their efficacy is inconclusive. The increasing urge to improve the efficacy of CSBILEs in promoting decision making in dynamic tasks has led the researchers to suggest improvements. One such way to improve the efficacy of a CSBILE is to incorporate debriefing. Debriefing is the processing of simulation-based learning experience from which the decision-makers are to draw the lessons to be learned (Ledrman 1992; Stienwachs 1992). With the help of the facilitator, debriefing activity allows the decision makers to reflect on their experiences and overcome the misconceptions they had with the dynamic task. Thus, debriefing influences decision makers' learning in such a way that it may enhance their task performance and learning in dynamic tasks.

Although the literature on dynamic decision-making (DDM) and learning in CSBILEs (e.g., Davidsen and Spector 1997; Issacs and Senge 1994) has embraced the concept of debriefing its effectiveness has rarely been evaluated empirically. Does debriefing improve performance in dynamic tasks? Does debriefing influence subjects' structural knowledge? Does debriefing help users to improve their heuristics knowledge? How does debriefing affect decision makers' cognitive effort? This study attempts to find answers to these questions. The findings should be valuable to CSBILE designers, users, and researchers. If supported, CSBILE designers will be able to enhance the efficacy of CSBILEs by explicitly building in debriefing. CSBILEs users will get more effective support in understanding the dynamic tasks such as renewable resource management. CSBILEs researchers will be able to use this research as a base to examine other important issues, such as the influence of debriefing on group decision making, the value proposition of debriefing, and the impact of debriefing on time-critical tasks.

DEBRIEFING IN CSBILEs AND DYNAMIC DECISION MAKING

How well people perform in dynamic tasks? The empirical evidence on DDM suggests it is "very poorly" (Brehmer 1990; Diehl and Sterman 1995; Moxnes 1998; Sterman 1989b). In dynamic tasks, where a number of decisions are required rather than a single decision, decisions are interdependent, and the environment changes (Edwards 1962), most often the poor performance is attributed to subjects' misperceptions of feedback. That is, people perform poorly because they ignore time delays and are insensitive to the feedback structure of the task system (Diehl and Sterman 1995). Debriefing may help reduce the misperception of feedback.

In dynamic tasks, outcome feedback alone is not effective (Paich and Sterman 1993). Decision makers have to be able not only to examine the results of their decisions but also the causes of these results. Debriefing provides an opportunity to reflect on their experiences with task the (Cox 1992; Davidsen and Spector 1997; Spector 2000). Such discussions, necessarily held after accomplishing the task, purport to foster learning by making the decision makers aware of their entrenched beliefs and provide them with information which facilitates their eventual re-interpretation (Issacs and Senge 1994).

There are many experiences that the decision-makers can have with a decision-making environment. They initially have no way of knowing which are important and useful in the real world (Elsom-Cook 1993). Debriefing may provide this knowledge and hence aid learning.

The behavior of dynamic systems is most often counter-intuitive (Forrester 1961). Decision makers have their own views about what types of decision strategies are needed to achieve desirable behavior in the system as a whole. But, when they play out their assumptions and strategies, often the outcome is not what they perceive, even though they thought they understood the interactions in the task system (Sterman 1994). Debriefing may effectively fix the inadequacies of their mental models – preconceived conceptions about the task system. The decision-makers can discover gaps between their expectations of system behavior based on their understanding of system interactions and the behavior that actually arises (Issacs and Senge 1994). This discovery may help the decision makers to have an “adequate model” of the system and hence improve learning.

These previous studies provide an insight into the effectiveness of debriefing. However, several gaps in the understanding of the effects of debriefing still remain:

- We still do not know the incremental effects of debriefing. Only one study, (Davidsen and Spector 1997), analyzed the combined effects of CSBILE and of debriefing rather than the effects of debriefing alone.

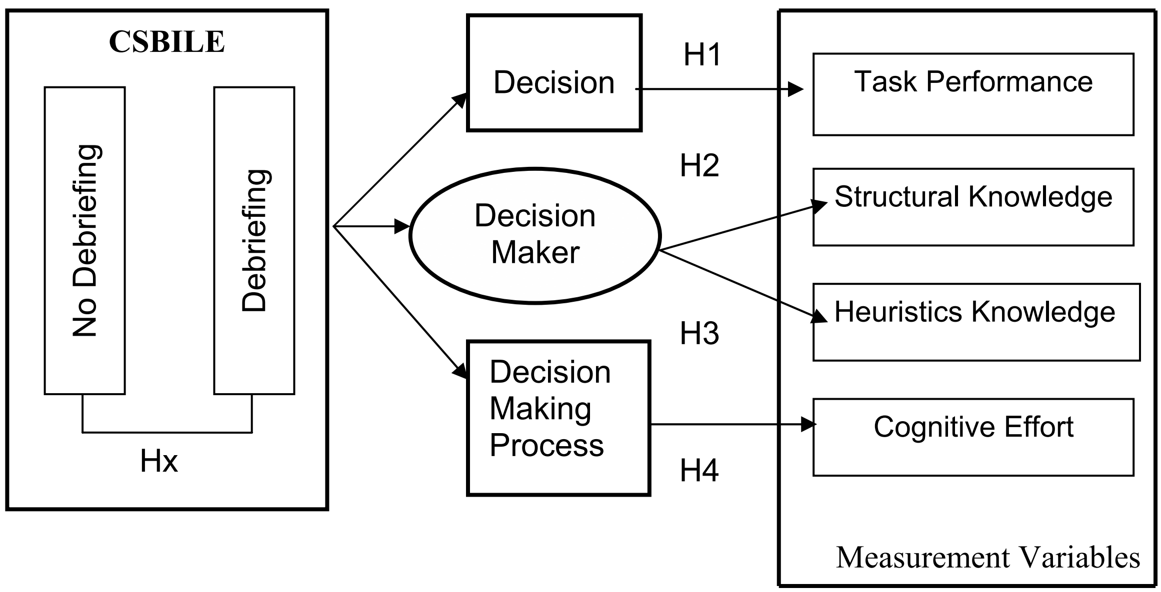
- In the context of CSBILE, the definitions and measures of effectiveness of debriefing lack a comprehensive framework.

This study bridges some of these gaps and advances of previous research by proposing and using a comprehensive research model, discussed in the next section, to evaluate the effectiveness of the collaborative discussion type of debriefing in CSBILEs on multidimensional performance outcomes.

RESSEARCH MODEL AND HYPOTHESES

We use “CSBILE” as a term sufficiently general to include microworlds, management flight simulators, learning laboratories and any other computer simulation-based environment – the domain of these terms is all forms of action whose general goal is the facilitation of decision making and learning. Based on this conception of CSBILE, we propose a comprehensive evaluation model (Figure 1) that evaluates the influence of debriefing on the decision, the decision maker, and the decision-making process.

Figure 1: The Model: The Effects of Debriefing on Decision Making



In our model, we view learning as a progression towards expertise (Davidsen and Spector 1997; Issacs and Senge 1994; Sternberg 1995). To better capture the range of expertise development, we propose that CSBILEs effectiveness should be evaluated on four criteria: (1) task performance, (2) structural knowledge, (3), heuristics knowledge, and (4) cognitive effort.

Task Performance

Research on DDM and learning in CSBILEs has focused on improving managerial performance (Bakken 1993; Dörner 1980; Langley and Morecroft 1995; Sengupta and Abdel-Hamid 1993). CSBILEs provide a practice-field for managerial decision making. After having experiences with the simulation environment, debriefing may help the decision makers in at least two ways: (i) expanding the limits of their bounded rationality, and (ii) reducing their misconceptions about the task system. When CSBILEs are used as tools to expand the cognitive capacity, a decision maker is able to accomplish the task more thoroughly by processing more information and evaluating more alternatives. As a result, the decision maker makes a better decision.

In addition to the expansion of cognitive capacity, debriefing activity allows the decision makers to discover the gaps between their expectations of system behavior and the actual behavior. This clarity about the misconceptions about the task system leads to better understanding of task system. Improved understanding helps the decision makers to analyze similar task problems in future. Therefore, users of debriefing should perform better in dynamic tasks.

H1: Users of CSBILE with debriefing show relative improvements in task performance more than users of CSBILE without debriefing.

Structural Knowledge

Structural knowledge pertains to knowledge about principles, concepts, and facts about the underlying model of the decision task. Subjects improved both their structural knowledge and their task performance when the task was changed to one with relatively more salient relations among the task system variables (Berry 1991). Provision of structural information about the underlying task system results in improved task knowledge and task performance (Gröbler, Maier, and Milling 2000).

Debriefing provides an opportunity to the facilitator to elaborate on the relations between key variables of the task system. As a result, decision makers may develop better understanding about the facts and principles (e.g., which variables are related to goal-attaining behavior of the task system) about the underlying task system. Consequently, the users of debriefing should acquire better structural knowledge.

H2: Users of CSBILE with debriefing show relative improvement in structural knowledge more than users of CSBILE without debriefing.

Heuristics Knowledge

Heuristics knowledge concerns how decision makers actually control or manage the task. Dynamic decision makers may well know the strategies to achieve better task performance (heuristics knowledge) even though they can not show improvement on declarative knowledge (Hsiao 2000). In a debriefing session instructing subjects with task properties, strategies and decision rules and their lagged effects may enhance their capability for dynamic decision-making. Thus, the users of CSBILEs with debriefing should acquire better heuristics knowledge.

H3: Users of CSBILEs with debriefing show relative improvement in heuristics knowledge more than users of CSBILE without debriefing.

Cognitive Effort

CSBILEs, like any support tool, affect the decision-making process by making it more (or less) efficient and therefore, enable decision makers to make decisions faster (or slower). Using decision time as a surrogate provides an estimate of the cognitive effort employed by a decision maker in performing a task (cf. Jarvenpaa 1989). Provision of cognitive feedback actually lengthens the decision-making process (Sengupat and Abdel-Hamid 1993). Debriefing can reduce the decision-making time by helping users make judgmental inputs and avoid spending extra time for searching for which variables of the task systems give rise to specific system behavior. In the absence of debriefing users have to turn solely to their cognitive resources to infer the relationships between key task variables, leading to more time to digest the information and hence to make a decision. Therefore, users of CSBILEs with debriefing should make decisions faster.

H4: Users of CSBILEs with debriefing make decisions relatively faster than users of CSBILE without debriefing.

METHODOLOGY

Research Design

To test the hypotheses we designed a single-factor, completely randomized design involving one control group and one experimental group. Each participant in the control group used a CSBILE without debriefing and each participant in the experimental group used a CSBILE with debriefing.

Experimental Task

The research questions were explored in the context of a CSBILE, FishBankILE (Qudrat-Ullah et al., 1997) in which subjects played the role of fishing fleet managers making fleet capacity acquisition and utilization decisions over the life of fishing area contract: 30 years. The task simulation is based on system dynamics model of Dennis Meadow's board game built around the "tragedy of the commons" phenomenon.

This task embodies the essential characteristics of a dynamic task – a series of multiple, interrelated decisions made over a period of time and in a dynamic environment (Edwards 1962). Each year, as fishing fleet managers, subjects were required to order new ships and decide on the percentage utilization of the fleet. Figure 2 exhibits the "Decision Panel" of FishBankILE. In the task, there are delays between 'action' and their 'consequences', e.g., it takes three years for new ship to be built and added to the fleet. Uncertainty surrounds the 'carrying capacity of the fishery area' and the 'fish re-generation threshold'. Subjects had to 'infer' the nature of relationships between task variables, e.g., between 'fish harvested' and 'fish re-generation threshold'. Performance was measured by cumulative profits made by each firm over a period of 30 years plus the remaining resource (fish) value in the final year.

Participants

The experiment was conducted with senior undergraduate students, 47% males and 53% females, at the National University of Singapore. They were on average 23 years old. There were eighty-seven student subjects who signed up for the FishBankILE task experiment. Seventy-eight of them showed up, signed the consent form, and completed the whole experiment. Participation in the experiment was entirely voluntary. US $25, 15, 10 respectively was paid to the top performers in each group.

Procedure

Two separate electronic classrooms in the faculty of business administration at the National University of Singapore, where forty IBM PC compatibles have been set up, were reserved for the experiment, one for the control group and other the for experimental group. The task program, FishBankILE, was installed and pilot tested one academic term prior to the main study. In addition to the task program, all subjects were supplied with a folder containing the consent form, instructions to lead them through a session, training materials (which were also available on the computer screen), as well as notepads and pens (as they were encouraged to take notes along the experiment). The task training materials were also emailed to all the subjects two days prior to their experiment session and they were asked to go through it thoroughly. The experiment started with each participant returning the signed consent form and taking a pre-test on FishBankILE task knowledge. Both the groups received the same general instruction.

Two goals were made clear to the participants: to obtain a good result when controlling the simulation task (i.e., maximize the total profit) and to learn as much as possible about system structure and behavior.

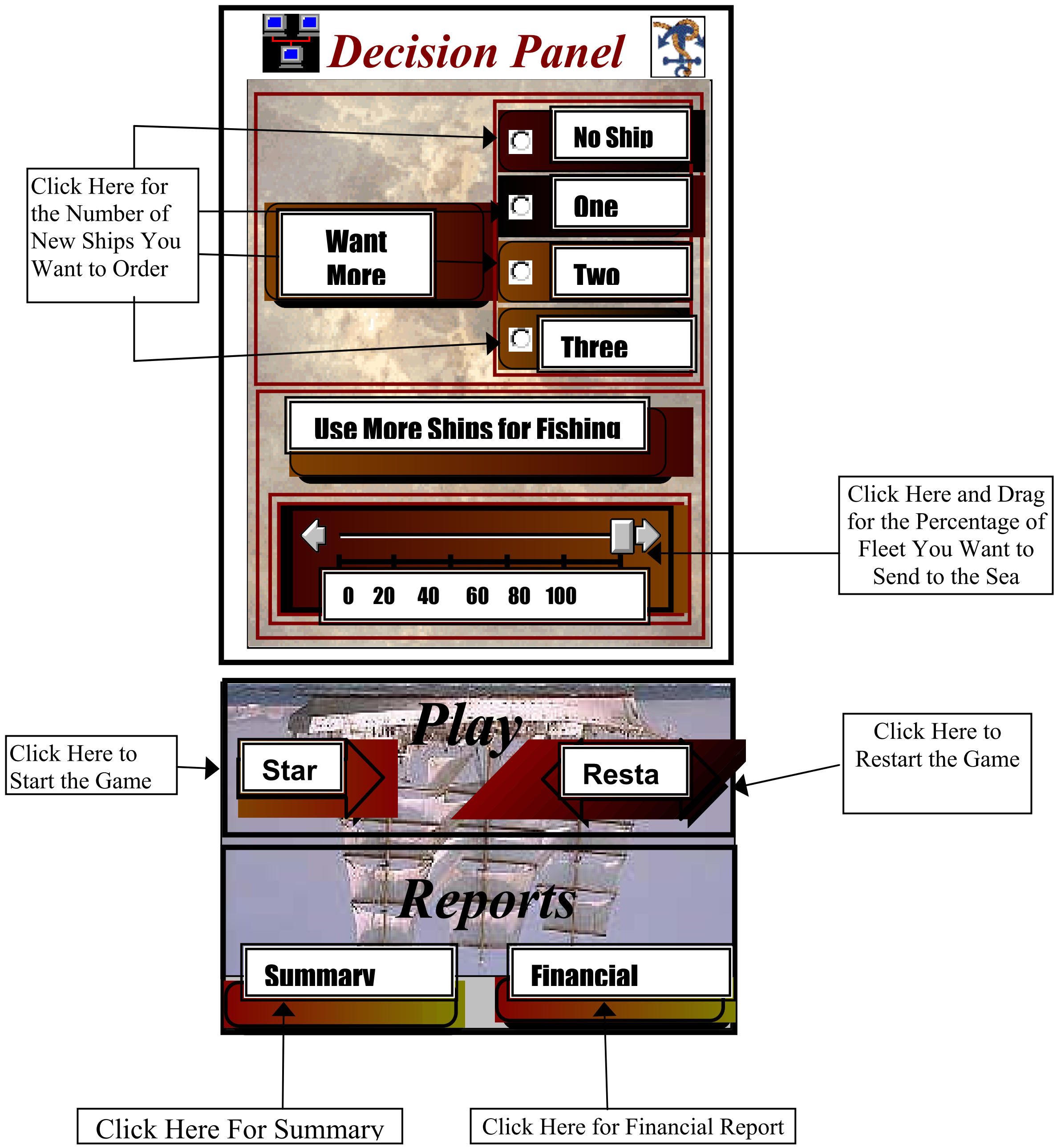


Figure 2: The Decision Panel of FishBankILE

All the subjects completed a training trial by going through the computer screens of FishBankILE, making decisions in each period, accessing and observing the feedback of their decisions via graphs and tables. Then, all the subjects completed two formal trials interceded by either a small break of about 10 minutes for the control group (the experimenter prepared the computers for the next trial and the subjects were told to relax without any communication with the fellow subject(s)) or a debriefing activity of about 40 minutes for the experimental group.

In the debriefing activity, not only 'what happened' but also 'what did not happen' was discussed. Subjects' performance charts were shown and discussed to relate the structure of the system to its behavior. Structure-behavior graphs (Davidsen 1996) of all the main feedback loops of FishBankILE system were explicitly elaborated on. Subjects were free to ask questions and were answered accordingly.

Each participant took a post-test, which was identical to the pre-test, following the completion of the 2nd formal trial. It was conducted to measure any possible structural and heuristics knowledge gain or loss during the experiment. The experiment took about 80 minutes for the experimental group and about 60 minutes for the control group.

Measurement

Dependent Variables: For H1, user task performance is the dependent variable. The task performance metric for each subject was chosen so as to assess how well each subject did relative to a benchmark rule. The task performance measure for subject s, TP_s has the following formulation:

$$TP_S = \frac{\sum_{t=1}^{n_y} \sum_{t=1}^{n_T} \left| y_{it} - b_{it} \right|}{n_y * n_T}$$

where n_y is the number of task performance variables, n_T is the number of trials the task has to be managed, b_{it} is the benchmark† value of task performance variable i at time t, and y_{it} is the empirical value of task performance variable i at time t. Every decision period, the benchmark's performance variables' values are subtracted from those of the subjects. The subject's final performance, TP, is the accumulation over 30 periods of this difference averaged over the number of task performance variables and number of trials.

For H2, user structural knowledge about the task system is the dependent variable. A post-test measured structural knowledge reflected by fourteen closed-ended questions on the relationships between pairs of the task variables and six questions on the algebraic relationships of the variables. The answer to each question was evaluated as right (one point) or wrong (zero points). The difference between pre-test and post-test scores was used in the analysis.

For H3, user heuristics knowledge about the task system is the dependent variable. On the post-test, two open-ended questions asked the subjects about their strategy for ordering new ships and ships utilization. Two independent domain experts scored the answers. The average score measured heuristic knowledge in this study.

† Details about the benchmark rule are available to interested readers from author upon request.

For H4, cognitive effort in decision-making is the dependent variable. Using decision time as a surrogate provides an estimate of the cognitive effort employed by a subject in performing a task (Sengupta and Abdel-Hamid 1993). Decision time was measured as the time spent by a subject making decisions in each of the decision periods. The CSBILE we used in the experiment was designed to record the decision time for all thirty periods period in a complete trial of the decision task.

Independent Variable: For all hypotheses (H1, H2, H3, and H4), the independent variable is the availability of debriefing in a CSBILE. Two self-reported scales (Usefulness of debriefing in arousing Interest in the Task (UIT) and Usefulness of debriefing in Understanding the Task (UTT)) were used to assess the subject's reaction to the debriefing.

RESULTS

Table 1 summarizes demographic characteristics of the participants. The results of various ANOVA and chi-square test suggest that the group distributions were statistically identical for age, gender, academic background, structural knowledge, and heuristics knowledge. Therefore, it is safe to assume that even if these demographic factors were to have any effect on the subject performance, the effect was same for both the groups and did not materially affect the results of this study.

Table 1: Participant Demographics

	Control Group (without Debriefing)	Experimental Group (with Debriefing)	Test statistic	Critical value	p-value
Participants	39	39			
Age	23.1	23.4	F=.26	3.97	0.611
Gender					
Male	19	18	χ^2 = .97	28.87	1
Female	20	21	χ^2 = 3.66	31.41	1
Academic Background[a]					
FAE	2.2	2.2	F=.03	3.97	0.864
CMS	.6	.5	F=.07	3.97	0.798
BL	.6	.6	F=.05	3.97	0.818
Structural Knowledge[b]	10.15	10.05	F=.11	3.97	0.739
Heuristics Knowledge[b]	3.92	4.13	F=.93	3.97	.338

[a]: FAE: Finance, Accounting, & Economics group (score is 1 if course is taken & 0 if no course is taken in the area; max is 3 and min is 0); CMS: Computer Science, Mathematical Modeling, and System Dynamics group (max is 3 and min is 0); BL: Business Strategy and Logistics group (max is 2 and min is 0).
[b]: average score on pre-test with a max score of 20 and min score of 0.

Table 2 summarizes the results of four ANOVA tests for task performance for H1, structural knowledge for H2, heuristics knowledge for H3, and cognitive effort for H4. Since the calculated F-values are higher than the critical F-values, all four hypotheses are supported. Subjects who received debriefing outperformed those without it.

For H2, there is overwhelming support. Subjects in the debriefing group scored significantly higher on post-test on structural knowledge. H3 is also supported very strongly. Subjects in the debriefing group developed better heuristics knowledge than subjects without debriefing aid. Finally, H4 is immensely supported. Subjects with debriefing support made decisions very efficiently. They spent less than half the time subjects without debriefing spent.

Table 2: Effects of Debriefing

Hypotheses	Group	Performance	F-Value	Critical F-Value	p-value
H1	Without Debriefing With Debriefing	TP[a] = -.63 TP = -.45	353.09	$F_{.95, 1, 76} =$ 3.97	0.000
H2	Without Debriefing With Debriefing	SK[b] = 12 SK = 16.32	141.53	$F_{.95, 1, 76} =$ 3.97	0.000
H3	Without Debriefing With Debriefing	HK[c] = 3.85 HK = 13.08	726.37	$F_{.95, 1, 76} =$ 3.97	0.000
H4	Without Debriefing With Debriefing	DT[d] = 64 DT = 28.03	852.81	$F_{.95, 1, 76} =$ 3.97	0.000

[a]: TP: Task Performance is the average performance (relative to the benchmark) in Trial 2. A score of 0 means that subjects performance is at par with the benchmark rule. A score of > 0 would mean better performance and a score of < 0 means subject performed poorly as compared with the performance of the benchmark rule.
[b]: SK: Structural Knowledge is score on post-test, a max score of 20 and min score of 0.
[c]: HK: Heuristics Knowledge is also a score on post-test, a max score of 20 and min of 0.
[d]: DT: Decision Time is the average time in seconds, per decision period, in Trail 2.

One could argue that improvement in performance in Trial 2 might have come as a result of practice of Trial 1. We analyzed the effects of practice separately utilizing the data obtained from control group. Table 3 summarizes the results of the analyses. We find significant effects of practice on structural knowledge and decision time of the subjects in the control group, but not so much as to represent a real threat to the support of the hypotheses.

Based on separate ANOVAs, significant effects for debriefing manipulation were found for UIT (Usefulness of debriefing in arousing Interest in the Task) (F=18.66, p=0.000) and UUT (Usefulness of debriefing in Understanding the Task) (F=22.91, p=0.000).

Table 3: Effects of Practice

Performance [a]	F-Value	Critical F-Value	p-value
TP1 = -.64 vs. TP2 = -.63	1.01	$F_{.95, 1, 76} = 3.97$	0.319
SK1 = 10.15 vs. SK2 = 12	27.29	$F_{.95, 1, 76} = 3.97$	0.000
HK1 = 3.92 vs.HK2 = 3.85	.17	$F_{.95, 1, 76} = 3.97$	0.682
DT1 = 59 vs. DT2 = 64	11.85	$F_{.95, 1, 76} = 3.97$	0.001

[a]: TP1 refers to Task Performance of Control Group (CG) in Trial 1; TP2 refers to Task Performance of CG in Trial 2; SK1 refers to Structural Knowledge of CG on pre-test and SK2 refers to Structural Knowledge of CG on post-test; HK1 refers to Heuristics Knowledge of CG on pre-test and HK2 refers to Heuristics Knowledge of CG on post-test; DT1 refers to average decision time spent (in seconds) by subjects in CG in Trial 1 and DT2 refers to average decision time spent (in seconds) by subjects in CG in Trial 2.

DISCUSSION/ CONCLUSION

Limitations

The main limitations of this study center on the simulation-based experimental approach and the participants. First, the experimental setting was computer simulation-based laboratory experimentation. Despite the general concern of external validity associated with the experimental approach, computer simulation-based laboratory experimentation is advantageous in the study of complex dynamic decision-making environments such as renewable resource management. In such environments, much of the complexity in the tasks is the result of the interaction among the flow of information, actions, and consequences during the performance of the task (Sterman 1989a). In CSBILEs, experimental simulations can capture some of the dynamic intertemporal aspects of tasks which are characteristics of natural settings but absent from the preprogrammed stimuli in a controlled laboratory experiment (Abdel-Hamid and Sengupta 1999). Moreover, laboratory experimentation is an established method of scientific inquiry within psychology/organizational behavior literature. A review of this literature has found remarkable similarities between research findings obtained in laboratory and filed settings (Lock 1986). A priori, there is no reason to believe that use of experimental approach should be less successful to study dynamic decision making than to study judgment and choice in traditional cognitive psychology discipline (Moxnes 2000).

The use of students as participants raises the question of the generalizability of results. However, student subjects have been used in many decision making studies including software project environments (Abdel-Hamid and Sengupta 1999), production scheduling task (Brehmer 1992), market strategy task (Paich and Sterman 1993), and fisheries management task (Moxnes 1998) based on the general conclusion that the formal properties of task are much more important determinants of decision making than subject profiles (Ashton and Kramer 1980). Although the task of managing fishing fleet is somewhat different from all of these tasks, it is similar enough to assume that student subjects are acceptable surrogates in this experimental investigation.

Key Findings

This study demonstrates that debriefing is an effective decisional aid for dealing with complex, dynamic tasks. In CSBILEs, debriefing is useful because it improves subjects' task performance, helps user learn more about the decision domain, develop heuristics, and expend less cognitive effort in decision making. Subjects with debriefing aid performed better because of their access to what Schön (1938) called "reflective conversation with the situation" gave them greater adaptability in recognizing system changes and updating their mental models about the task system. Debriefing helped decision makers to understand better the task system and employ an effective capacity acquisition and utilization heuristic in managing the fishing fleet as well as the fishery stock (Puts-Osterloh, Bott, and Koster 1990; Moxnes 1998**).** Also, subjects with debriefing aid took significantly (F=852.81, p=0.000) less time, and therefore expended less cognitive effort in making their decisions than those subjects who were without any debriefing aid. As indicated by self reports, subjects provided with debriefing aid were more motivated and understood the task better than those without debriefing. These results provide evidence that improved performance of the subjects was due to debriefing. This reduces the likelihood of a potential alternative explanation that it was simply the provision of more information, as opposed to debriefing, that caused the improvement.

Implications for the Understanding of Renewable Resource Management

These findings are important for renewable resource management because they suggest that misperceptions of bioeconomics can be reduced through training with debriefing supported CSBILEs. Debriefing activity allowed the decision makers to reflect on their performance and examine their conceptions about the task system in a constructive way. Improved and 'corrected' understanding about the dynamic task system helped the decision makers to employ effective heuristics to manage the fishing fleet. More specifically, if debriefing support can improve human performance in a CSBILE, then the same debriefing support could perhaps also be used to redesign pedagogical instruments including CSBILEs being used for training of the public policy makers in the domain of renewable resource management. CSBILE users will get more effective support in understanding the dynamic tasks such as renewable resource management task.

The challenge for further studies is to re-assess the earlier studies pertaining to dynamic decision making, especially those supporting Sterman's misperception of feedback hypotheses and Moxnes's misperceptions of bioeconomic dynamics. Performed rigorously, these future experimental studies may help generalize the efficacy of debriefing-supported CSBILEs in renewable resource management.

Implications for DDM Research

One of the findings of this study that debriefing helped the subjects to acquire more heuristics knowledge, a score of 13.08 for subjects with debriefing and 3.85 for subjects without debriefing, is of immense importance to DDM researchers. Specifically, heuristics knowledge is believed to support transfer learning-how well the decision makers learn from the previous task by making them attempt another task either in the same domain (Huber 1995) or in a different domain (Hayes and Broadbent 1988). Only a future study, where debriefing is interceded by two different dynamic tasks, can better evaluate the effects of debriefing on transfer learning.

This study proposes and uses a comprehensive model to evaluate debriefing effectiveness. The model comprises four evaluation criteria-task performance, structural knowledge, heuristics knowledge, and cognitive effort. This research model is an all-inclusive instrument that can be used by other researchers in future studies. For instance, researchers will be able to use this research as a base to examine other important issues, such as the influence of debriefing on group decision making, the value proposition of debriefing, and the impact of debriefing on time-critical tasks.

Finally, task complexity affects the decision behavior of a decision maker, as a result, CSBILEs effectiveness (Brehmer 1990). This study focused on only one decision task. There is need to extend this research to dynamic task with varied degrees of complexity.

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