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Data Mining, Group Memory, Group Decision Making: A Theoretical Framework

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Abstract

One facet of group decision making that has escaped close scrutinization is the effect of individual biases and group biases on group work. In this paper we present a theoretical framework for using data mining based group memory to overcome the biases in group decision making situations. By studying the patterns extracted from the group memory data, the group members can develop a better understanding about the decision situation and identify the criteria that are most appropriate for them, thereby reducing bias and improving group decision making performance.

Keywords: Group decision making, group memory, data mining, bias, decision performance

Introduction

There has been considerable research in the area of group memory and groupware supported group decision making. However, one facet of group decision making that has escaped close scrutinization is the effect of individual biases and group biases on group work. This paper proposes research in this important area.

Individuals usually have biases when making judgments under conditions of uncertainty (Tversky and Kahneman 1974). In addition, groups are subjected to shared information bias when members do not share all information cues that are necessary in decision making. Group members usually have the tendency to discuss shared information more than unshared information (Wittenbaum and Park 2001).

In groupware supported group tasks, group memory can capture and store information generated during group interaction. Although the information stored in group memory can be shared by all members, it may be of little use unless the information is analyzed carefully. In this paper, we suggest that data mining can be used to analyze the group memory information and discover knowledge which may reduce the effects of individual and group bias for the members using the memory. We also expect that the mined data can improve the decision making process by speeding consensus and reducing the effort required to reach a final decision.

The following section describes the group decision making process and group bias. The next section explores the role of group memory in group decision making. Then a brief explanation of the potential relationship between data mining and group memory is provided. Next, our proposed research model and propositions are outlined. Finally, the paper ends with a short conclusion.

Group Decision Making, GDSS and Group Bias

Individuals and groups often work on unstructured or semi-structured decisions and employ judgment heuristics which may result in unintended biases (Tversky and Kahneman 1974). A heuristic can best be described as an exploratory problem-solving skill.

In this work, we focus on the three heuristics, availability, representativeness and anchoring (Tversky and Kahneman 1974), which provide individuals with means to efficiently make decisions when faced with unstructured decision situations.

In organizations, groups are formed usually with a specific problem to solve because groups are expected to ensure comprehensive information sharing and to evaluate information from various sources (Gigone and Hastie 1993). It is the organization's intention to broaden the perspective of the group by including various individuals with different areas of expertise who can contribute different pools of knowledge.

Groups more often discuss shared information than unshared information (Weiser and Morrison 1998). When information is not exchanged, group judgment is based on incomplete information (Gigone and Hastie 1993). This tendency biases the final group judgment in the direction of the initial information distribution. Inequitable information distribution can bias the outcome of a group judgment.

Group support systems (GSS) aid group decision makers through the use of various technologies (DeSanctis and Gallupe 1993). Because of distributed organizational setups and significant advancement of group decision-making aids, organizations are increasingly using GSS. Even though GSS technology can potentially improve the group decision-making process, information sharing still may not be completely balanced.

Group Memory and Group Decision Making

Memory helps to retain and recall things pertaining to the current situation from the past. Although the primary focus of memory-related research is on individuals, researchers (Walsh and Ungson 1991) proposed the concept of organization memory which is historical organizational information that can be used in current decision situations. Group memory is a form of organizational memory and can be used in various types of group work such as meetings and projects (Jessup and Valacich 1993). Technology-enabled group memory can record inputs, decisions, discussions, voting results and other related information in one shared repository to facilitate access for future use (Stein and Zwass 1995).

Because group memory records and presents previous information that may affect present decisions, new group members can consult group memory, form an understanding about a task and minimize the difference in task-related knowledge between themselves and longer-term group members. Additionally, all members can consult group memory to refresh their recollection about past events and this recall can substantially aid in the decision-making process.

Because of the availability of large pools of information in the group memory, users may fail to duly process information or become easily overwhelmed with information, thereby experiencing information overload. Group members may fail to appropriately pool the important information or they may acquire incomplete information, which can result in poorer decision quality.

The advancement of information systems technology, object-oriented data modeling and data warehousing provide a technological basis for the group memory to be developed and used as an information base for group decision making.

With the availability of such vast stores of prior group members' interaction- and discussion-related data, a logical next step is to extract meaningful patterns or knowledge from it. The discovery of relevant patterns in group memory, using data mining, can help members to focus on relevant information, thereby avoiding the information overload problem.

Data Mining and Group Memory

The specific purpose of data mining is to identify new and useful information and patterns in existing data (Chung and Gray 1999). Data mining has many applications and includes techniques such as association, clustering, classification, sequencing, prediction, link analysis and summarization which are used to discover relationships within available information.

Mining the group memory data on prior decisions may reveal interesting patterns, such as the association among different decision attributes that lead to a particular type of decision; the cluster of decision outcomes based on characteristics of the group members; the sequence in which group members explore different information cues in the initial phase of decision making. By studying the patterns hidden in the group memory data, group members can develop a better understanding about the decision situation and identify the criteria that are most appropriate for them. Data mining based group memory can provide decision makers with

a frame of reference, which is particularly useful for new or novice members who can develop an insight into the decision task by studying mined data patterns.

By utilizing data mining with the group-memory, information could be provided to groups that would aid in debiasing decision makers and in providing the same background knowledge. These aids should enable the groups to focus on relevant patterns and avoid information overload.

Research Model

We propose that by applying data mining techniques to group memory, useful information will be provided to group members that will aid in reducing individual and group biases and hence improve the decision making performance of groups. For example, when considering a new product for development, an individual or group might recall from memory a similar product that failed in recent times and therefore predict the failure of the current product. However, data mining may reveal that similar products have historically been successful. The reduction in bias will lead to better quality decisions. Additionally, the use of data mining to extract relevant patterns from group memory will help group members develop a common understanding about the decision situation, thereby reducing the amount of time required to reach a group decision. Figure 1 displays the model depicting the relationships among data mining enabled group memory, individual and group biases, and group decision making performance. In this paper, we focus only on decision quality, decision time, and the effort required to reach the final decision. The specific effects and rationale for the research model (Figure 1) are outlined in the propositions that follow.

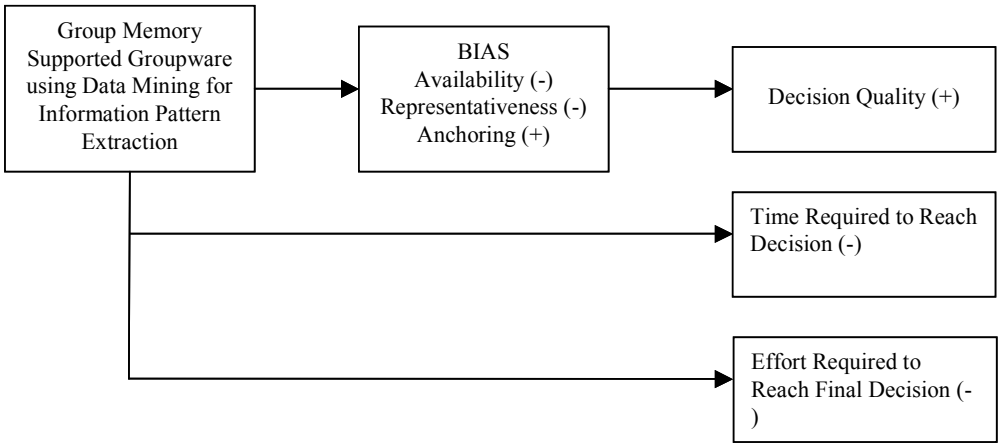

Figure 1. Research Model

Propositions

Availability refers to making predictions based on how easily instances related to the prediction can be recalled. Both individuals and groups may be susceptive to this bias. Recency of memory also impacts judgments made utilizing the availability bias. Recent events and instances are more easily recalled than those further back in time. For example, product failures in the last year will be more easily recalled than those of ten years ago.

By mining group memory, each group member could be provided with a larger, timely, common pool of organizational experience and information to draw from. Rather than relying on each individual's potential bias, all group members would begin with the same larger pool of information. Organizational knowledge would only be time delimited by the age of the information in the repository. Hence:

P1: In group memory based decision making, the use of data mining will result in a lower level of availability bias in groups.

The next specific bias considered is representativeness which is employed when an individual makes a prediction about a problem or situation based on how closely it resembles another problem or situation. When probabilities are evaluated by representativeness, serious errors can result because no regard is given to prior probabilities, or the base rate. This particular problem is referred to as the base-rate fallacy (Tversky and Kahneman 1974).

In a group decision-making situations, this type of bias could be avoided by providing the group with shared base rate information. By making the information more salient and available to all group members, it is more likely that an individual would make use of the base rate information. Such base-rate data could be mined from existing group memory and presented to the decision makers with a high degree of saliency. Hence:

P2: In group memory based group decision making, the use of data mining will result in a lower level of representativeness bias in groups.

The third bias considered is anchoring which is employed when making a numeric estimate. When the anchoring heuristic is used, individuals make numeric estimates which are insufficiently adjusted from an initial value. Because the adjustments from the initial value may be insufficient, underestimation may occur.

In this type of situation the use of mined data could further induce bias. Data mining can provide statistical data on the identified data patterns; however if individuals rely on the data as a basis for future decisions, unintended anchoring bias may result. Hence:

P3: In group memory based group decision making, the use of data mining will result in a higher level of anchoring bias in groups.

The combined effect of reduced availability bias, reduced representativeness bias and increased anchoring bias should result in increased decision quality. Hence:

P4: In group memory based group decision making, the use of data mining will result in improved decision quality in groups.

Cost-benefit framework advocates that the decision-maker aims to maximize accuracy or decision quality and minimize effort (Todd and Benbasat 1992). The advantage of data mining based group memory is that all members can be provided the same knowledge about the task. It is expected that a shared interpretation of the group memory information will be developed and the group will reach its final decision with minimized effort. Hence:

P5: In group memory based group decision making, the use of data mining will result in requiring less effort to reach the final decision.

Since all members would have similar information, the decision process should be expedited. The group does not have to spend time to explain or reiterate key issues discussed earlier. All group members would know facts based on the past, so they would be able to decide their course of action quicker based on past experience and available knowledge.

Furthermore, decision making requires the development of shared understanding of criteria and alternatives to determine the best alternative in order to reach a consensus (Dennis et. al. 2001). Data mining can aid in developing shared understanding.

Group members would not have the information overload problem since data mining presents extracted patterns rather than raw data. Moreover, everyone would be presented with the same knowledge mined from the group memory. Hence, there would not be the probability of picking up different knowledge by different members. There would only be one set of knowledge representation. This would resolve differentiated understanding problems. Therefore, all members would meet with similar predispositions (Gigone and Hastie 1993), which would result in coming to quicker consensus because each would judge the situation from a similar framework. Hence:

P6: In group memory based group decision making, the use of data mining will result in quicker decision making in groups.

Conclusion

The paper presents a conceptual framework for the use of data mining based group memory to reduce individual and group biases in group decision making. We propose that by providing group members with timely, salient, and objective information, common biases in judgment may be reduced.

In addition, we believe that other factors of decision making will also be impacted by the use of such memory. Decision quality will improve because group members will consider a greater number of alternatives through shared information. We also propose that the effort required to obtain shared information will be reduced and that groups can reach decisions quicker.

Actual empirical investigation is needed to validate these propositions. We intend to implement data mining enabled group memory and conduct an experiment in a groupware supported decision making environment to test our propositions. We plan to use approximately 50 groups of student subjects involved in a relevant decision making task. Half of the groups will perform the task utilizing a group memory enabled GSS with data mining support and the other half will not utilize data mining support. The results of the experiment will be analyzed to find support for our propositions.

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