December 2001

Debiasing Group Judgments through Computerized Delphi Systems

Hee-Kyung Cho
New Jersey Institute of Technology

Murray Turoff
New Jersey Institute of Technology

DEBIASING **G**ROUP **J**UDGMENTS THROUGH **C**OMPUTERIZED **D**ELPHI **S**YSTEMS

Hee-Kyung Cho
Department of Computer and Information Science
New Jersey Institute of Technology
hkc7959@njit.edu

Murray Turoff
Department of Computer and Information Science
New Jersey Institute of Technology
turoff@adm.njit.edu

Abstract

Cognitive biases in judging subjective probabilities may interfere with the accuracy of individual human judgment under uncertainty. Because of the systematic nature of cognitive biases, the resulting level of inaccuracy of group judgments can be amplified. Previous research addresses the importance of improving the current GSS by the use of group structuring method and reevaluation through group feedback in order to achieve a "collective intelligence." It is our hypothesis that computerized Delphi systems which are based on asynchronous GSS incorporating a group process structuring method and a group feedback method can eliminate cognitive biases.

Introduction

In organizations, most important decisions are made under conditions of uncertainty, where decision-makers do not know with certainty the effect of the decision problem. Those decisions are usually based on the decision-maker's judgment regarding the likelihood of occurrence of uncertain events, such as "what is the probability of success in launching a new product in the market next year?" In continuously changing decision-making environments, the utility of a mathematical model is limited because the model is too rigid to cope with such high level of uncertainty. On the other hand, faced with uncertain decision environments, human beings are capable of processing information by using heuristics which can be produced by intuition, past experience, and analogy between similar situations. Blattberg and Hoch (1990) reported that in a business-forecasting situation a combination of database model and managers' intuition always outperforms either of these decision inputs in isolation. However, due to the limited capacity of the human short-term memory, information processing by heuristics can easily be contaminated by cognitive biases. Cognitive biases are defined as "either conscious or subconscious adjustments in the decision-maker's responses that are systematically introduced by the way he/she intellectually processes his/her perceptions (Spetzler and Stael Von Holstein 1975, p. 345)." In group judgment research, the main question investigated is "Are *N* heads better than *ONE* head?" However, if there exists any *systematic* bias in individual judgments, the resulting level of inaccuracy of group judgments can be amplified. Therefore, in order to make a "better" quality decision, cognitive biases should be removed or at least reduced.

Findings of Previous Group Judgment Research

Previous research (Harmon and Rohrbaugh 1990; Rohrbaugh 1979) findings suggest that groups make better judgments than their average members do but fail to make as accurate a judgment as those of their most capable members ("collective intelligence"). Rohrbaugh (1979) found that the ***group process structuring*** methods such as the Delphi Method were useful for groups to increase judgment quality by reducing problems associated with interaction process. The findings of several studies (Harmon and Rohrbaugh 1990; Reagan-Cirincione 1994; Rohrbaugh 1979) emphasize the importance of providing ***group feedback*** to improve group judgments. These group feedbacks should provide diverse viewpoints of group members for increasing mutual understanding and reducing disagreements. Hiltz et al. (1991) found that statistical feedback providing only the average opinion of the group could rather harm the quality of group judgments. Reagan-Cirincione (1994) found that a newly proposed intervention procedure that incorporates both a group process structuring method and a group feedback mechanism using information technology helped groups make more accurate judgments than any of their members. The findings of the above studies emphasize the importance of the use of appropriate *group process structuring* methods and *group feedback* methods for facilitating mutual understanding of different viewpoints and re-estimating procedures with which group members update their initial judgments based on the group responses.

Fjermestad and Hiltz (1998) found from their assessment of Group Support Systems (GSS) experimental research that groups using GSS (mostly in *synchronous* conditions) generally did not achieve better outcomes in terms of both decision quality and consensus compared to their face-to-face counterparts. These findings suggest that the current GSS technologies do not provide a sufficient level of support to enable groups to achieve better judgments and a true agreement among group members.

Based on the above findings it is our hypothesis that improving GSS to eliminate cognitive biases requires forms of group process structuring and group feedback.

Computerized Delphi Processes

Delphi is a method for structuring a group communication process to aid a group solving a complex problem in an effective manner. Usually Delphi undergoes four distinct phases (Linstone and Turoff 1975): (1) Facilitating individual contribution to the exploration of the subject under discussion, (2) Understanding of how the group views the issues, (3) Bringing out the underlying reasons for the different viewpoints and evaluating them, (4) Analyzing the final results.

Delphi has distinct characteristics that distinguishes it from other decision-making tools (Linstone and Turoff 1975; Turoff and Hiltz 1995):

(1) Delphi uses a questionnaire in order to gather diverse opinions from knowledgeable experts possibly geographically dispersed.
(2) Delphi allows the individual group members to express their opinions and judgments anonymously in order to avoid undesirable social pressures.
(3) Voting is used to explore disagreement among group members, rather than reaching a premature consensus.
(4) In addition to a statistical summary of group response, arguments for underlying reasons used by group members to support their views are fed back to the group.
(5) Individuals are given opportunity to update their views based on the group judgments and underlying reasons behind those judgments.

Currently, most Delphi procedures are performed by mailing questionnaires to the respondents, gathering responses and sending out the feedback to the respondents. These multiple steps are iterated until there is a reasonable amount of agreement reached among the respondents. This questionnaire-based Delphi method is very inefficient because of high non-response rates and long time lags between response and feedback.

In order to overcome these flaws in the current Delphi procedures, a concept of computerized Delphi systems was proposed (Turoff and Hiltz 1995). Rooted in different philosophies of inquiry systems, computerized Delphi systems are based on ***asynchronous GSS*** in which any member of a group can add items to be discussed and also other members of the group can evaluate the validity of those items using voting tools. Asynchronous GSS differs from synchronous GSS in a sense that different members can contribute in the decision process at different times.

Computerized Delphi systems combine the advantages of the current questionnaire-based Delphi process (group process structuring and group feedback), the potential features of asynchronous GSS, and hypertext links. In these systems, decision problems can be *structured* by various types of *nodes* representing actions, goals, criteria, requirements, solutions, decisions, etc., and *links* representing relationships between two nodes. A group of nodes representing each decision item corresponds to a list in the computerized Delphi system—similar to a thread of discussion in a conferencing system. A member can enter a proposition or alternative (forming a node) and any other member can enter either a pro or con argument (forming a pro or con link) associated with one or more of the proposition nodes. Anyone can vote for the various scales of proposition or argument nodes contributed by other members (e.g., how valid the proposition / argument is?). The voting results are analyzed and fed back to the group members. Each member could use this group feedback to explore hidden disagreement in a group for a given items and thus improve their understanding of the decision problem being investigated. After getting group feedback, each member can update his/her position in the vote as he/she finds new evidences from other members' viewpoints to support his/her new position. This *vote-feedback-revote* process is important to improve judgments by achieving *consistency* of judgments in both *individual* level and *group* level. A decision-maker might not be always consistent in his/her intuitive judgments because of his/her limitation in cognitive processing capability. Those inconsistencies could cause cognitive biases in human judgments. Furthermore in case of group decision-making, there might exist many inconsistencies among judgments by different members because each member might view the same problem from totally different viewpoints. The group is asked to discuss and adjust those inconsistencies using pro and con argument structures. By using asynchronous GSS, the round-based traditional Delphi system can evolve into an ongoing decision process in any physical or virtual organization.

Cognitive Biases and Impacts of Computerized Delphi Processes

A large number of studies in cognitive psychology indicate that people do not follow the rules of probability theory in judging subjective probabilities of uncertain events. Different types of cognitive biases in judging subjective probabilities emerged from previous cognitive psychology literatures.

Representativeness biases (Kahneman and Tversky 1972; Tversky and Kahneman 1974) are caused from a tendency to have more confidence in a small number of representative information (i.e., individuating information, such as "whether the person's characteristics suggests such person is engaged in a specific occupation") rather than a large body of more general information (i.e., base-rate or distributional information such as "the frequency of an occupation in the population"). People also tend to judge the probability of events by ***availability***, i.e., by the difficulty of retrieval and construction of relevant instances in their minds. When judging the likelihood of an event that is so unique that there is no past history relevant to the evaluation of its likelihood, people tend to judge based on only a small number of salient scenarios. The generation of only available scenarios might inhibit the emergence of other possible scenarios and therefore lead to a sub-optimal judgment (Tversky and Kahneman 1973; Tversky and Kahneman 1974). Benbasat and Lim (2000) found that GSS helped reduce availability biases and but they did not explain which aspects of GSS caused such reduction.

In computerized Delphi process, the participants are asked to make a quantitative judgment about the future trend and to explicitly specify the underlying *assumptions* behind their judgments or any additional *uncertainties*, which would change their estimates. Those assumptions and uncertainties are structured as separate nodes in the system (Turoff et al. 1999). Eliciting underlying assumptions could help to bring out true base-rate or probability distribution and thus result in reducing representativeness biases. Bringing out any uncertainty, which would change a decision-maker's estimate, is also helpful in expanding the scope of events or scenarios beyond a small number of available ones. Furthermore, the group votes on *assumptions* or *uncertainty* nodes that group members contributed in the scale of *validity*. Therefore, using group evaluation on individual contributions, the group may have better chance to eliminate any irrelevant and individuating information from further consideration. Further structuring of the problem also can reduce representativeness biases (Spetzler and Stael Von Holstein 1975). Semantic hypertext links incorporated in computerized Delphi systems would be helpful in identifying all the relevant elements, decomposing the complex problem into manageable elements, making separate judgments for each element and exploring the relationship among them. This knowledge structure may help the group understand the true nature of uncertainty in their decision problems and to reduce their potential reliance on any salient or representative features of uncertain elements.

When confronted with a large amount of data, people make estimates by starting from an initial value (i.e., an ***anchor***) and then ***adjust*** that value in order to incorporate the rest of the data.(Sage 1981) Different starting points yield different estimates and afterward adjustments are typically insufficient (Whyte and Sebenius 1997). There are different hypotheses of anchoring effects in the group level and one hypothesis suggests that group discussions have debiasing effects by providing competing anchors generated by different group members (Whyte and Sebenius 1997). If we accept this competing anchor hypothesis, computerized Delphi systems could reduce anchoring biases in a great extent. A computerized Delphi system which is based on conferences that represent topics or issues to be discussed provides a virtual place for a group which is geographically dispersed and of which members have diverse expertise. In this place, any member can bring up any idea on any aspect of the problem and he/she can contribute at his/her most convenient time and place. A group member may have enough time for probing contribution from other members, sharpen his/her viewpoint by learning from others and build up a better idea or thought on the basis of information provided by others. In these ways, the diverse viewpoints generated by the group can play a role as "competing anchors" which potentially reduce anchoring biases. The vote-feedback-revote process incorporated in computerized Delphi systems would help the group can evaluate the validity or reliability of each anchoring information and adjust that starting estimate based on more reliable evidences that emerged during the group discussion.

People tend to underestimate the impact of new evidences and fail to revise estimates as much as they should based on receipt of new significant information (Sage 1981). This ***conservatism*** may be caused by the tendency that people have greater confidence in their premature conclusions on the basis of small amounts of information gathered in earlier information acquisition stages and thereby stop acquisition of further evidences (Benbasat and Taylor 1982; Sage 1981). Even though the Bayesian rule provides a normative model of revising opinion on the basis of additional evidences, the actual revisions are not sufficient compared to the full level of revisions guided by the Bayesian rule (Benbasat and Taylor 1982). The voting process which separately evaluates every piece of evidence would be helpful to overcome this conservatism. While the group members evaluate evidences, they may realize the importance of these evidences for making better judgments. Re-voting after seeing feedback may provide a good opportunity for the group members to update their views based on the receipt of new significant evidences.

Conclusion

In this paper, we hypothesized that computerized Delphi systems which are based on ***asynchronous GSS*** incorporating a ***group process structuring*** method and a ***group feedback*** method can eliminate cognitive biases. Using computerized Delphi systems, groups can update their beliefs on the problem being investigated based upon emerging evidences during group discussion. We expect computerized Delphi systems will contribute in building group models for complex problems by eliciting group members' unbiased judgment about the future. In future research, more specific hypotheses will be developed and empirical tests will be conducted to investigate the impacts of computerized Delphi systems in eliminating these biases.

References

Benbasat, I. and Taylor, R. "Behavioral Aspects of Information Processing for the Design of Management Information Systems", *IEEE Transactions on Systems, Man and Cybernetics* (SMC-12:4), 1982, pp. 439-450.

Benbasat, I. and Lim, J. "Information Technology Support for Debiasing Group Judgments: An Empirical Evaluation", *Organizational Behavior and Human Decision Processes* (83:1), 2000, pp. 167-183.

Blattenberg, R. and Hoch, S. "Database Models And Managerial Intuition: 50% Model + 50% Manager", *Management Science* (36:8), 1990, pp. 887-899.

Fjermestad, J. and Hiltz, R. "An Assessment of Group Support Systems Experimental Research: Methodology and Results", *Journal of Management Information Systems* (15:3), 1998-99, pp. 7-149.

Harmon, J., and Rohrbaugh, J. "Social Judgment Analysis and Small Group Decision Making: Cognitive Feedback Effects on Individual and Collective Performance", *Organizational Behavior and Human Decision Processes* (46), 1990, pp. 34-54.

Hiltz, S. R., Johnson, K. J., and Turoff, M. "Group Decision Support: Designated Human Leaders and Statistical Feedback", *Journal of Management Information Systems* (8:2), 1991, pp. 81-108.

Kahneman, D. and Tversky, A. "Subjective Probability: A Judgment of Representativeness", *Cognitive Psychology* (3), 1972, pp. 430-454.

Linstone, H. and Turoff, M (editors) *The Delphi Method: Techniques and Applications,* Addison Wesley Advanced Book Program, 1975.

Reagan-Cirincione, P. "Improving the Accuracy of Group Judgment: A Process Intervention Combining Group Facilitation, Social Judgment Analysis, and Information Technology", *Organizational Behavior and Human Decision Processes* (58), 1994, pp. 246-270.

Rohrbaugh, J. "Improving the Quality of Group Judgment: Social Judgment Analysis and the Delphi Technique", *Organizational Behavior and Human Decision Processes* (24), 1979, pp. 73-92.

Sage, A. "Behavioral and Organizational Considerations in the Design of information Systems and Processes for Planning and Decision Support", *IEEE Transactions on Systems, Man and Cybernetics* (SMC-11:9), 1981, pp. 640-678.

Spetzler, C. and Stael Von Holstein, C. "Probability Encoding in Decision Analysis", *Management Science* (22:3), 1975, pp. 340-357.

Turoff, M. and Hiltz, S. R. "Computer Based Delphi Processes", in *Gazing Into the Oracle: The Delphi Method and Its Application to Social Policy and Public Health*, Adler, M. and Ziglio, E. (editors), 1995, London, Kingsley Publishers, pp. 56-88.

Turoff, M., Hiltz, R., Bieber, M., Rana, A., and Fjermestad, J. "Collaborative Discourse Structures in Computer Mediated Group Communications", *Proceedings of the Thirty-Second Annual Hawaii International Conference on System Sciences,* 1999.

Tversky, A. and Kahneman, D. "Availability: a Heuristic for Judging Frequency and Probability", *Cognitive Psychology* (5), 1973, pp. 207- 232.

Tversky, A. and Kahneman, D. "Judgment under Uncertainty: Heuristics and Biases", *Science* (185), 1974, pp. 1124-1131.

Whyte, G. and Sebenius, J. "The Effect of Multiple Anchors on Anchoring in Individual and Group Judgment", *Organizational Behavior and Human Decision Processes* (69:1), 1997, pp. 75-85.