THE NEED TO CONSIDER MODES OF COGNITION IN DESIGNING SYSTEMS THAT REQUIRE
DISTRIBUTED DECISION MAKING

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Abstract. Designers of distributed decision making systems should consider the impact the systems may have on the functions necessary for successful group decision making. In particular, the constraints on group interaction, communication, and individual environment, that are imposed by a distributed decision making system, may affect individuals' mode of cognition -- analysis, intuition, pattern matching, or functional thinking. This in turn may affect decision quality. Methods for compensating are suggested.

Computer networks make it possible for groups of people who are at different locations to share information and use it in making decisions, but the group members may face unanticipated difficulties. In order for distributed decision making systems to allow decisions to be made well, they must preserve the necessary functions of group decision making, including information exchange, construction and evaluation of options, task allocation, and motivation and commitment of group members[1]. Construction and evaluation of options may require individuals to use a number of modes of cognition[2]. While the use of these modes in individual and face-to-face group decision making is not fully understood, the impact of the move to distributed decision making needs to be anticipated. In particular, when group members are distributed, the channels of communication they use for exchanging information, coordinating the group process, and managing each other's modes of cognition are limited.

The notion that people use different modes of cognition helps organize diverse observations and explain performance differences and task effects. Distinctions among cognitive modes include analysis versus intuition[2] and pattern seeking versus functional relation seeking[3]. Task conditions such as the presence of graphical information, time constraints, and the requirement for a numerical response influence the mode of cognition people adopt. The degree of congruence between cognitive mode and task condition is thought to determine performance accuracy[2]. Since mode of cognition varies during performance of a task[3] in response to

self-defined subtask organization,[4] management of cognitive mode may depend as much on the possibilities that the distributed decision making system makes available, the person's expertise, and the group process, as on the leader's direct control.

Group decision making involves production and evaluation of possible courses of action[5]. The intermediate objects of thought need to be shared and judged. When individuals perform these functions in different locations, communicating via computer (using delayed or immediate messages, with or without voice), their immediate task environments are different from what they encounter in face-to-face groups, in ways that may directly affect the ease with which different modes of cognition are carried out. It may be essential, for the production or evaluation of courses of action, that group members engage in several specific modes of cognition. For example, the recall of candidate actions may depend on pattern matching; evaluation of actions may require both analysis and functional relation seeking; determining whether the analysis is complete may require an intuitive judgment. The immediate task environment that the system provides for the individuals should support their use of the appropriate mode of cognition at the appropriate time.

A detailed analysis of what the system must provide for the group members should start with the cognitive modes required for the best performance of each of the functions of group decision making. For each cognitive mode, the analysis would go back to the conditions that best support that mode, and ask how the computer system can be designed to provide these conditions. The dynamic nature of individuals' cognition suggests that these conditions should be flexibly available,[6] rather than being provided in a tightly controlled manner.

In face-to-face decision making, there are many opportunities for group members to control each others' mode of cognition through setting examples, demanding products or responses, directing each other's attention to ideas at a given pace, etc. Many of these techniques are informal, nonverbal, and unconscious. The distributed decision making environment entails more formal and less immediate communication. The formality will induce more analytical cognition. The delay and separation

will allow one's mode of cognition to be relatively independent of influence from the group leader and other group members. To compensate for this lost control, it may be necessary to develop techniques for constructing messages that induce group members to use particular modes of cognition. For example, conveying information graphically versus verbally may influence the degree of intuition or of pattern seeking. Methods for suggesting or demanding a response pace may be required, as well as explicit vocabulary for negotiating evaluations of options and judgments of relative importance, on shared scales.

- [1]S. P. Weisband, J. M. Linville, M. J. Liebhaver, R. W. Obermayer, and J. J. Fallesen, "Computer-mediated Group Processes in Distributed Command and Control Systems," Technical Report 795, Army Research Institute, Alexandria, VA, 1988.
- [2]K. R. Hammond, R. M. Hamm, J. Grassia, and T. Pearson, "Direct Comparison of the Efficacy of Intuitive and Analytical Cognition in Expert Judgment", 1987. IEEE Transactions on Systems, Man, and Cybernetics, SMC-17, 753-770. See also R. M. Hamm, 1988. Clinical Intuition and Clinical Clinical Analysis: Expertise and the Cognitive Continuum. In J. Dowie and A. Elstein (Eds.), Professional Judgment: A Reader in Clinical Decision Making. Cambridge: Cambridge University Press, pp. 78-105.
- [3]K. R. Hammond, "Judgment and Decision Making in Dynamic Tasks". Information and Decision Technologies, 14, pp. 3-14, 1988.
- [4]R. M. Hamm, "Moment by Moment Variation in Experts' Analytical and Intuitive Cognitive Activity". IEEE Transactions on Systems, Man, and Cybernetics, SMC-18, pp. 757-776, 1988.
- [5]B. Fischhoff, and S. Johnson, "The Possibility of Distributed Decision Making". In J. March and R. Weissinger-Baylon (Eds.), Political-Military Decision Making. New York: JAI Press.
- [6]See W. W. Noah, and S. M. Halpin, "Adaptive User Interfaces for Planning and Decision Aids in C3I Systems. IEEE Transactions on Systems, Man, and Cybernetics, SMC-16 pp. 909-918, 1986.