# THE DYNAMICS OF SMALL GROUP DECISION MAKING OVER THE E-MAIL CHANNEL

*Danielle Fafchamps†, Dave Reynolds††, Allan Kuchinsky†*

†Hewlett-Packard Laboratories
1501, Page Mill Road
Palo Alto, CA 94304

††Hewlett-Packard Laboratories
Filton Road
Stroke Gifford
G.B. Bristol, BS 12bQZ

*ABSTRACT*

The coding scheme of Benne & Sheats (1948) was used to explore the dynamics of electronic mail discussions in a team five co-located system designers who used the technology as a support to decision making. The results show that the discussions display (1) similar group task activities but few of the group-centered strategies documented in face-to-face meetings; (2) verbal devices that may serve a different function when used in electronic mail discussions. The study identifies a profile of the discussion leader that is consistent with findings of research on computer conferencing. Implications for research in remote collaboration are considered.

## 1. INTRODUCTION

Electronic mail (e-mail) is a versatile tool, and users' ingenuity in integrating it into their work has already triggered an abundance of research. For example, studies have examined how access to e-mail technology empowers individual users, both in terms of access to information (Sproull & Kiesler [1]) and task management (Mackay [2]); other studies have looked at professionals who were geographically dispersed and described the effect of e-mail on the emergence of new types of groups in organizations (Finholt & Sproull [3]) and on the patterns of interaction and group structures (Eveland & Bikson [4]); still others have compared experimentally face-to-face and computer-mediated communication of group decision making (Siegel et *al.* [5]).

The impetus for the present study came from discussions with co-located design teams who had attempted to use e-mail to support their decision making process during the requirements phase of system design. They told us that their efforts had been shortlived, but team members could not explain why they had discarded e-mail as a channel for decision preparation. They simply had reverted to their old ways of using e-mail and of conducting meetings. We filed our observations away until we heard about a success story[1].

[1]Experimental studies typically use subjects who are brought together only for the duration of the experiment. We felt that the phenomena we wanted to capture required that we analyzed the spontaneous interactions of a team engaged in a real decision making process whose outcomes would have an impact on the future work of the team members.

A team of five co-located software designers had used e-mail to support their decision making in preparation of a meeting on a controversial design issue. In many ways, this team was quite similar to the many teams who had discarded e-mail as a channel for decision preparation (i.e., organizational culture and structure, group size, type of work, design stage). Why was this team of software engineers capable of conducting a systematic discussion over e-mail when others had stopped in mid-course? To explore this question we examined the group processes of the team's e-mail interactions. We used the coding scheme that Benne & Sheats [6] developed in their work on the functional roles of group members engaged in face-to-face problem solving situations.

## 2. METHOD

### 2.1 Context and data

A newly constituted group of five male co-located software engineers used electronic mail as a part of their decision making process to resolve a controversial design issue. The task was to select a programming language to be used as the end-user programming language in a system for the construction and optimization of knowledge-based programs targetted to use in embedded systems. The selected language had to be amenable to program transformation and able to support the knowledge-based programming style. Early discussions while the group was forming narrowed the set of candidate languages down to three--Prolog, Scheme, and SML, each of which represented the best choice (for the group's purposes) from a different class of languages. The manager (A), and team member B were the first members of the team that was constituted around the month of October 1987. Team member C in joined late November from a University. Team members D and E joined the team in January. Team member D had worked with the manager in a previous company.

The e-mail discussion began in February 1988 shortly after the last two members joined the team. The reason for using e-mail was that the large number of interrelated issues involved meant that the preliminary discussion would take considerable time and would need to be carefuly recorded so that it could all be brought together in the final decision meeting. The team members were all computer literate and very familiar with e-mail and bulletin boards for communication and technical discussions. E-mail was in regular use within the project for administrative use and general information dissemination. At the time of the e-mail discussion, the team had regularly scheduled meetings, but none specifically on the topic of the programming language. All e-mail messages related to the language selection were automatically posted to an electronic bulletin board where postings on a given topic are linked together. The coupling of the bulletin board to e-mail provided the team with a structured archive for the group discussion. It also provided a non-intrusive means to make the group discussions public in order to invite comments and contributions from other members of the research center.

The data for this study were retrieved from the team's archive. The 51 e-mail messages in the archive were posted over a period of three months. At the end of the first month (November 87), the manager posted the first message to announce the creation of a bulletin board. He sent two messages in December. There was no e-mail activity in January. The discussion resumed on February 2, 1988, until February 26, when team member E posted a message to announce the decision the team had reached on that day (see Appendix I).

## 2.2 Coding Scheme

In research on small group decision making, there is no standardized unit of analysis to quantify the participation of the members in a discussion (Fisher [7]). Some researchers have used a criteria of a time interval (3 to 5 seconds) to define the unit of

Table 1: Coding scheme [1]

| Types | Definitions | Examples |
|---|---|---|
| **1. Group tasks activities** Facilitate the group effort in the selection, definition, and solution of the group problem | | |
| Initiating | Propose new ideas, novel ways | *It would be worth dissecting the dirtyness in terms of categories like these.* |
| Information seeking | Request factual or authoritative information | *I want more proof.* |
| Information giving | Provide factual or authoritative information | *This has been true for other languages such as Lisp.* |
| Opinion seeking | Request opinion | *Do you feel this is an inherent problem, if so, why?* |
| Opinion giving | Provide opinion | *I don't think that SML is especialty clean.* |
| Elaborating | Examplify, give rationale for previous suggestions | *I especially worry about the relative paucity of efficient data types--especially ID array(vectors) and hash table--whose performance is directly related to the ability to update them without copying (even when shared).* |
| Coordinating | Note relationships among ideas and suggestions | *This work is relevant to our representation stack and all that.* |
| Orienting | Compare past work to the goal of the group | *Our current language options have already been biased towards pragmatism.* |
| Evaluating | Assess suggestions against specific standards | *It (OOP style] is an extreme test of the suitability of polymorphic static typing.* |
| Energizing | Encourage higher quality of activity | *Watch out for times when you have to bend your mental description too much when trying to fit into the language.* |
| **2. Group-centered strategies** Alter or maintain the group way of working | | |
| Encouraging | Express understanding and acceptance of others' perspective and ideas | *This is an excellent question for which there is no single answer.* |
| Gate-keeping | Call for others' participation | *What do *you* think.* |
| Following | Provide an audience, accept others' ideas | *(uhuh)* |
| **3. Individual attitudes** Fulfill personal needs, e.g., aggressing, dominating, etc. | | |

[1]We modified Benne & Sheats' terminology: group task activities in lieu of group task roles, group-centered strategies in lieu of group building and maintenance roles, and individual attitudes in lieu of individual roles.

participation (Bales [8]), while others defined a speaker's uninterrupted talk as a single unit of participation (Fisher [7], Waltz [9]). The notions of time intervals and interruptions are irrelevant to the study of e-mail exchanges. In e-mail interactions, the members themselves structure their messages through punctuation, spacing, indentation, etc. We built on this structure and identified the sentence as the basic unit of participation, unless: (1) the next sentence begins with a conjunctive, or a joining sign (e.g., hyphen) in which case the second sentence is lumped with the first one, and both sentences count as only one unit of participation; (2) a phrase introduces a series of indented phrases (paragraphs), and then the phrase counts as a unit of participation. Each unit of participation was classified according to the coding scheme of Benne & Sheats [6] presented in table 1 together with examples from our data.

## 3. RESULTS

Two levels of analysis were performed, one on the messages structures, the other on the functions of message content.

### 3.1 The topography of the e-mail discussion

The visual representation of the data showed three basic structures: islands, dialogues, and webs (see Appendix II). *Islands* are messages that do not receive a reply. *Dialogues* are sets of two or more messages that share a common header, and where two participants take turns as in face-to-face conversations. In a *Web*, a message may receive more than one reply, and may respond to one or many messages. Messages in a web may not share a common header. The data showed that team members sometimes changed the header of their replies to more accurately reflect the content[1]. The three webs in the data had a unique message at the apex. All three webs occurred during the week prior to the decision making meeting. Table 2 computes the frequency of messages initiated and of replies for each member.

Table 2: Frequency of messages initiated and of replies

| Messages | Team members | | | | | Others | Total |
|---|---|---|---|---|---|---|---|
| | A(Mgr) | B | C | D | E | | |
| Initiated | 16 | 2 | - | 1 | 2 | 1 | 22 |
| Replies | 9 | 1 | 6 | 1 | 7 | 5 | 29 |
| Total | 25 | 3 | 6 | 2 | 9 | 6 | 51 |

The manager contributed half of all messages, and three quarters of his messages were initiated messages.

[1]The automated archiving system identifies a message as a reply only if it has the same header as the message to which it replies. Here, replies are (1) messages that have the same header as a previous message, and/or (2) messages that quote or explicitely refer to a previous message.

In the subsequent analyses, messages from non-team members (n=6) and the replies (n=3) they received--all from team members--were not included. Non-team members contributed only five short messages. Except for one message, they were not directly related to the discussion topic (e.g., comments on the bulletin board system), or were very brief. The message that announced the results of the meeting was also excluded because, in the present study, the focus was on decision preparation. Thus, the analyses were performed on 41 messages.

The topography of the e-mail discussion showed three message structures: islands, dialogues and webs. Islands and webs can be conceived of as the opposite extremes on a scale from low to high level of e-mail interaction. Within our framework, one approach to the description of the message structures was to determine if a parallelism existed between the message structures and the distribution of group task activities in the messages. A comparative analysis between the 11 islands and the 3 messages at the apex of the webs showed no such parallelism. However, a difference between islands and the message at the apex of a web, could be captured in terms of topics. Islands dealt with a single topic. For example, the manager's messages reported on discussions with customer or colleagues engaged in related research, summarized and commented on journal articles. A message at the apex of a web presented a collection of topics. In our data, islands had also to be understood in the context of the team members' interactions that took place outside the e-mail channel. For example, after the manager sent message 9A (see Appendix II), he had a short conversation with two team members about the content of the message. Later, he posted two messages (10A and 11A) where he elaborated on the two topics of the discussion he had with the team members. This phenomenon, called channel switching, has been well-documented (Murray [10], Reder & Schwab [11]).

Still at the level of content, messages at the apex of the webs seemed to have an evaluative function, in the sense that they make previous statements explicit and recast them in the specific context of the emerging options of the decision making. For example, during the early stage of the discussion, an island that reported on the manager's discussion with the customer included criteria such as code size and data structures. The message at the apex of web #1 also reported on the manager's discussion with the same customer, but the discussion was organized into the options (SML, Prolog, Mixed Languages) that were meaningful at that moment. From a content perspective, the concept of "webness" seemed less elusive than from the disstribution of the group tasks activities, but the data were too limited to pursue this line of inquiry.

## 3.2 The functions of message content

This section examines the frequency distribution in the e-mail messages of group task activities, group-centered strategies, and individual attitudes.

### 3.2.1 Group task activities

Group task activities facilitate the problem-solving activities of a group during a face-to-face meeting. This section explores the following questions: How are activities distributed among the messages of the different team members? Do these distributions change over time?

The 41 messages contained a total of 918 units of participation, with 620 units coded as group task activities. Table 3 presents the frequency distribution of the group task activities per member.

Table 3: Frequency distribution of group task activities

| Team / Activities | Mgr | B | C | D | E | Total B, C, D, E |
|---|---|---|---|---|---|---|
| Initiating | 22 | - | - | 3 | 1 | 4 |
| Information seeking | 2 | - | 7 | 3 | 6 | 16 |
| Information giving | 142 | - | 2 | 17 | 56 | 75 |
| Opinion seeking | 21 | - | 1 | - | - | 1 |
| Opinion giving | 69 | - | 14 | 15 | 41 | 70 |
| Elaborating | 52 | 2 | 4 | 16 | 22 | 44 |
| Coordinating | 8 | - | - | 1 | 5 | 6 |
| Orienting | 22 | - | 2 | 4 | - | 6 |
| Evaluating | 33 | - | - | 1 | 14 | 15 |
| Energizing | 12 | - | - | - | - | - |
| Total for each member | 383 | 2 | 30 | 60 | 145 | |

Table 3 shows that more than half of all units of participation were from the manager. Half of the team's units of participation were classified as information and opinion giving activities. All team members contributed a substantial amount of information giving, but the manager emerged as the primary source of information with 142 units of participation compared to 75 for all other members. Besides information giving, the most frequent activity for all members was that of opinion giving. The manager alone contributed as many units of participation coded as opinion giving as did all other team members taken together. Units of participation from the manager's messages span the whole range of the group task activities, and the frequency for all these activities exceeded the frequency of others team members both individually and as a group--except for the information and opinion giving activities. The manager's messages contained the highest frequency of initiating activities and they were the only one with units of participation classified as energizing activity.

The actual team e-mail discussion took place over a period of about three weeks. Did group task activities change over time as the date for the decision making meeting came closer? Figure 1 contrasts changes in three activities--information giving, opinion giving, and elaborating, for the manager and for other team members during the month of February. The relevant units of participation are plotted over four periods (T1, T2, T3, T4) of successive working days--excluding week-ends and days when there were no e-mail activity. Figure 1 captures the increasing participation of team members as the date of the meeting approached. At T1, the manager was the sole participant in the discussion, and the source of information, opinion, and evaluation. At times T2 and T3, his contribution diminished while those of team members increased.

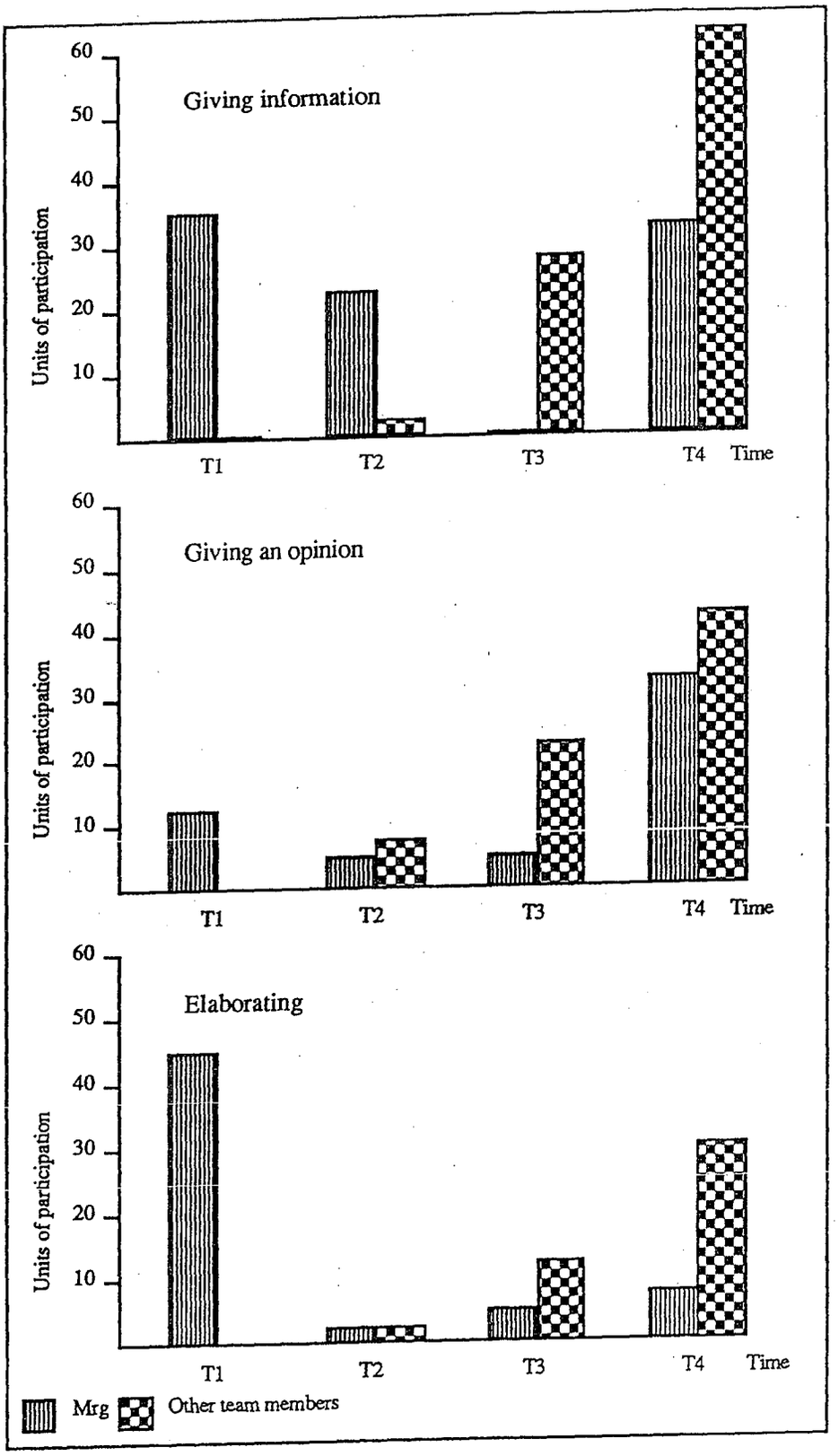


Figure 1: Frequency distribution of units of participation for three activities

At T4, which covers the period closest to the decision making meeting, the contributions of the manager increased again, especially in information and opinion giving activities, and the contributions of the other team members continued the increase observed at T2 and T3.

### 3.2.2 Group-centered strategies

Strategies that contribute to group building and maintenance are important in face-to-face meetings. What is the situation when a group interacts over e-mail? Do people who use e-mail employ the same strategies or different strategies? Benne & Sheats' coding scheme includes a "following" strategy for units of participation that fulfill a back-channeling function. In face-to-face interactions, this strategy can be non-verbal, e.g., facing the speaker ostentatiously, nodding, or verbal such as 'uhuh', 'yeah', 'agreed', 'that's right'). The data did not show instances of units of participation that could be coded as instances of a following strategy. For example, no one sent a message to *just* say 'yes', or 'that's right.' A possible explanation for this, is that Unix communities strongly discourage users from sending "me too" messages that take up valuable disk space. It would be interesting to see what happens in business communities. Only two of the seven strategies described in Benne & Sheats were identified: gatekeeping and encouraging[1]. Two instances of the encouraging strategies were recorded:

> *This is an excellent question for which there is no single answer.*
>
> *Thank you for your missive.*

The manager's messages contained all six instances of the gatekeeping strategy, either at the end of the message 'Comments?', 'What do *you* think?', or early in one message prior to a rather long discussion (72 units of participation): 'Here are my sketchy thoughts on the subject. Comments?'

### 3.2.3 Individual attitudes

Individual attitudes reflect individual needs that are irrelevant to the task, or to the functioning of the group. No unit of participation was coded as individual attitudes. Yet, the data showed recurrent forms of talk "disclaimers" and "off record" strategies. In face-to-face interactions, disclaimers [Hewitt & Strokes [12], Strokes & Hewitt [13]) are verbal devices that speakers use when they believe their action could be misunderstood by others, 'People use disclaimers in order to secure the success of substantive claims, but without the possible negative implications for their identities.' (Hewitt & Strokes [12]). Examples of disclaimers in our data included hedging and credentialing expressions, and cognitive disclaimers. These terms are described below and illustrated with examples from our data.

Hedging expressions preface the act and indicate the willingness to receive discrepant information and to change opinion.

> *Again, I am not too familiar with SCHEME (though this will change after Stalag-SICP in a couple of week :-).* [...]
>
> *Here are my sketchy thoughts on the subject.*[...]

Speakers use credentialing statements to assert their qualifications.

> *The work I did on software design led me to the conclusion that the imperative style was often a superior vehicle for design than the much admired mathematical style. Behind all the reluctance to accept the mathematical 'look and feel' is a valid concern about software design.* [...]

[1]Besides gate-keeping, encouraging, and following, the other strategies are: harmonizing, compromising, setting standards, and keeping records.

Cognitive disclaimers express speakers' anticipation that others may doubt their capacity to aptly identify the facts in a given situation.

> *I haven't used Quintus Prolog & though I have heard mixed reports it's supposed to be OK.* [...]

The e-mail messages exhibit also off record strategies (Brown & Levinson [14], Linde [15]) that serve the same function as disclaimers. Unlike disclaimers which preface the action, off record strategies are embedded within or end the utterance. Examples of off record strategies include mitigations, understatement, overstatement, and jokes.

> [...]. *A definite non-starter in my bitter, twisted, and prejudiced view at least as a development front-end language.*
>
> [...]. *There you are, apologies for the length and I hope the information and contention densities are high enough.*
>
> [...]. *But it has a typed face, so [sounds of trumpets, stage right, swelling organ, Heavenly choir..] It must be possible, I *believe*.* [...]
>
> [...] *Good grief, I am beginning to sound like a believer--I think I 'd better go and lie down for a while.*

## 4. DISCUSSION AND IMPLICATIONS

The study began with the question: Why was a team of software engineers capable of conducting a systematic discussion over e-mail when others had stopped in mid-course? To explore this question, we conducted a case study and characterized the structures (islands, dialogues, webs) and the group processes (group task activities, group-centered strategies, individual attitudes) of the team's e-mail conversations.

This study has various limitations. First, the findings of a case study cannot be generalized. The data came from a single pre-meeting discussion that a team of five software engineers conducted over e-mail during the early stage of the design process. The communication patterns we described may not be observed in other successful computer-based conversations. Second, individual characteristics may account for our findings. The small number of e-mail messages (41) and of team members (5) does not permit the separation of the findings from the individual characteristics of this team. Finally, the analysis focussed essentially on group processes. Other methods such as content analysis, could uncover yet other critical aspects of the team's electronic interactions. In spite of the limitations, we believe that the study was productive. First, from our interest in emergent communication practices, we were intrigued that co-located professionals used an asynchronous means of communication to support their decision making process. Second, the team of software engineers had succeeded where many others had failed, and we believed we could learn something from their experience. Last and most important, this study offers insight into aspects of collaborative work where theoretical guidance is, as yet, inexistent.

Probably the least debatable finding of this study is that the participation of the manager was crucial to the maintenance of the e-mail discussion, in terms of volume of messages he produced, the range of group task activities he assumed, and the timing of his contributions. His messages provided a platform from which most other messages sprang. It is difficult to compare the frequency of these activities with previous research on face-to-face meetings (Hirokawa [16]), mainly because of differences in the definition of the unit of participation. The findings are, however, consistent with experimental and empirical research on computer conferencing (Hiltz et

*al.* [17], Fanning & Raphael [18]) which show that that the single most important factor for a successful computer conference is the activity level of the organizer of the conference.

> The relationship between active Organizer hours (on the system) and total hours spent by all conference participants was so direct that it seemed that the definition of an Organizer could be 'the person who keeps a conference alive.' [18]

The team of software engineers used e-mail to nurture the incubation phase of a crucial decision. This was accomplished through various means. The manager used e-mail to build a common group perspective by posting all information (e.g., discussions with the customer; summaries and comments on articles) relevant to the decision making. He used e-mail to ensure a shared background of knowledge among all team members by posting messages on topics that had cropped up during his discussions with individual team members. The manager and other team members did not, however, use e-mail as an information dump. Even though they shared the same workspace, they took the time and effort to clarify their positions and to give feedback to one another. They contributed messages that had an evaluative function (webs). Following these messages, the level of interaction in the discussion appeared to increase. Finally, the fact that the e-mail discussion was hosted in an "environment" reserved for that purpose may have been a contributing factor to the successful progression of the discussion. This special environment gave the discussion its own "identity" distinct from the private files of the individual team members.

The study reported on a team that had been recently constituted and this may explain why the manager was the most active participants in the discussion. Future research should examine the interaction of teams where members have a history of working together. Further research should also investigate the emergence of participation and leadership in remote collaboration, as well as in teams where members belong to different occupational groups and where expertise is distributed across different disciplines.

The findings showed few instances of group-centered strategies. Team members were co-located, and they had many opportunities for interacting outside the e-mail channel. The coding scheme may have been inadequate to capture instances of group-centered strategies that are specific to the e-mail channel. For example, the e-mail messages of the team showed that all team members made an abundant use of first person pronouns (I) and group pronouns (we, us, our project) which could be construed as group-centered strategies. Another way of looking at the emergence of group-centered strategies over the e-mail channel is in terms of what disclaimers and off record strategies actually accomplish in the e-mail context. In face-to-face interactions, these strategies are individual-centered, in the sense that they help maintain (or protect) the identity and credibility of the individual vis-à-vis the group. In e-mail, however, they could be construed as group-centered strategies. E-mail is text-based, and a statement sent over e-mail has more "force" and is more emotionally charged than a verbal statement (Kiesler et *al.* [19]). Disclaimers and off record strategies lessen the force of the written statement, and thus the possibility of triggering strong responses from other team members. These findings suggest further research questions: what group-centered activities are socially acceptable (desirable, undesirable) in remote collaboration? What cues would members use to determine when it is acceptable to bypass the group channel and establish a private connection with a remote colleague? What factors foster or hinder group affiliation in remote collaboration?

Finally, individual differences are to be expected in the ease and willingness to use e-mail. For example, team member D "observed" the on-going discussion and, a few days before the meeting, he sent a long message where he responded 'to many of the e-mail messages that have been circulating until now, having just changed evaluation

strategy from lazy to eager.' The behavior of team member D suggests that the level of interaction in e-mail (as in face-to-face interactions) should not be assessed solely in terms of number of messags contributed.

The communication patterns we described are still speculative. Further research should validate their occurrence and explore how various technologies subtly alter our communication practices.

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Appendix I

Team member E sent a message after the meeting

/9:17PM Feb 26, 1988/

Re: [name of the team] Language decision

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Avid followers of the debate about the "front-end" language for [name of team] will be interested to note that we have jointly decided that Standard ML is our prime candidate. This does not mean that we have set aside all thoughts on other areas but that our plans will be revolving around ML rather than Scheme or Prolog. The key factors which made us take Standard ML seriously were its type discipline, which supports ADTs, its basic cleanliness, and associations with academic work that support [name of the group]. We also believe that providing the next level of representation for Knowledge-Based programming can be done inside its static type system and can achieve a suitable level of efficiency.

The other candidates, namely Scheme and Prolog, were faulted on the grounds of needing remedial work (addition of ADTs) before we can start. It is almost needless to say that the prospect of remedial work is not encouraging.

So, there you have it. We are now especially keen on tracking work in the ML and functional program translation worlds. If you get hold of any hot news, let us know!

[Team member E]

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Appendix II

The topography of the e-mail discussion