Training to improve virtual team communication

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Abstract. *Organizations are utilizing virtual teams, comprising workgroup members who communicate and collaborate with technology, to accomplish tasks. These teams are geographically distributed and communicate via computer-mediated communication systems (CMCS), and may never or rarely meet face-to-face. Relational links among team members have been found to be a significant contributor to the effectiveness of information exchange in the use of CMCS. In most cases, team members receive little or no training to improve the effectiveness of this form of communication. When training is used, it often focuses on software utilization skills, not on interpersonal communication dynamics. This paper discusses the effect of virtual team communication training on group interactions, especially for enhancing these relational links and thereby improving communication and information exchange in virtual teams. It was found that teams that were given appropriate training exhibited improved perceptions of the interaction process over time, specifically with regard to trust, commitment and frank expression between members. Discussion of the role of training on virtual team processes and outcomes is discussed and future research implications are presented.*

Keywords: Computer-mediated communications systems (CMCS), media richness, relational links, social presence theory, teamwork training, virtual teamwork

INTRODUCTION

The rapid growth of the Internet and telecommuting coupled with increased globalization of organizations have contributed to the growing number of people who work in virtual teams within and between organizations. *Virtual teams* are groups of people engaged in a common task or goal communicating through electronic means, which may be electronic mail (email), Web-based communications, video and/or audio, but in general having considerable interaction online. Miles & Snow (1986) defined a virtual team as an evolutionary form of a network organization; virtual team processes are enabled by communication and information technology (Davidow & Malone, 1992; Jarvenpaa & Ives, 1994). Computer-mediated communication

systems (CMCS) are sociotechnical systems that support and enhance the communication- and co-ordination-related activities of team members engaged in computer-supported co-operative work. These computer-based communication technologies are utilized to overcome space and time constraints that burden face-to-face meetings, to increase the range and depth of information access and to improve group task performance effectiveness, especially by overcoming 'process losses' (McGrath & Hollingshead, 1993, 1994). Further, CMCS increase the range, capacity and speed of managerial communications (Culnan & Markus, 1987). They can also 'reduce or eliminate the expense and inconvenience associated with distributed work' (Galegher & Kraut, 1994). One objective of using these technologies is to create similar levels of communications' speed and effectiveness as those achieved at traditional meetings. Virtual teams allow managers to assemble groups of employees to meet transient, unanticipated needs (Hammer & Champy, 1993). Virtual teams that can fulfil constantly changing task requirements can offer organizations the flexibility to remain competitive (Mowshowitz, 1997).

Virtual teamwork may be synchronous ('same time/different place') or asynchronous ('different time/different place'). Synchronous meetings are spontaneous, in which ideas are exchanged with little structure. Participants communicate with each other in such a way that it is sometimes difficult to attribute an idea to one participant or establish the reason behind a particular decision. In contrast, asynchronous meetings are more structured than synchronous meetings. These meetings rely more on documents exchanged among participants. Compared with synchronous meetings, asynchronous meeting participants have longer to compose their messages and therefore it is easy to attribute an idea to its originator and establish the reason behind a particular decision (Warkentin *et al.*, 1997). However, asynchronous meetings require more time than synchronous meetings because information exchange takes longer. Asynchronous meetings are frequently used by groups in which at least one participant is in a remote location (Kinney & Panko, 1996).

CMCS technologies that support synchronous communication include AOL 'chat rooms' and the Internet Relay Chat (IRC). CMCS technologies that facilitate asynchronous meetings include email, electronic document management systems and computer conference systems. Computer conferencing systems, which are a 'structured form of electronic mail in which messages are organized by topic and dialogues are often mediated' (see Hiltz & Turoff, 1978; Baecker, 1993) include Internet Usenet newsgroups and bulletin board systems (BBS) or threaded discussion databases. The technology utilized in this paper ('MeetingWeb^{TM}') is an asynchronous BBS computer conference technology and is explained in detail below.

RELATIONAL LINKS

Developing *relational links* involves performing activities related to the member support and group well-being function (Warkentin *et al.*, 1997) by establishing position or group status of members, defining task roles of group members and establishing norms for group interaction. According to social information processing theory, the exchange of social information will help teams develop relational links. This activity is a natural process between persons meeting face-

to-face in which communication includes the content of the spoken word as well as cues that are visually communicated. People rely on multiple modes of communication in face-to-face conversation, such as paraverbal (tone of voice, inflection, voice volume) and non-verbal (eye movement, facial expression, hand gestures and other body language) cues. These cues help regulate the flow of conversation, facilitate turn taking, provide feedback and convey subtle meanings. As a result, face-to-face conversation is a remarkably orderly process. In normal face-to-face conversation, there are few interruptions or long pauses and the distribution of participation is consistent, although skewed toward higher status members (McGrath, 1990). In the electronic communications arena, the use of 'emoticons' or 'smilies' (Pastmaster & Decair, 1997) when sending electronic messages, typing in ALL-CAPS or bracketing words in *asterisks* to denote emphasis, or the use of exclamation points!! to 'shout' are instances of such socioemotional exchanges (Chidambaram, 1996; Walther, 1996).

The development of relational links among team members has been found to be a significant contributor to the effectiveness of information exchange (Warkentin *et al*., 1997). Past research on relational links has indicated that computer-supported groups, given adequate time, will exchange enough social information to develop strong relational links (Burke & Chidambaram, 1995; Chidambaram, 1996). Methods of improving the interactive experience among virtual team members have been investigated and devised (Warkentin *et al*., 1997). Recent research has suggested that teams given virtual team communication training will develop stronger relational links faster than teams without such training.

THE VIRTUAL TEAM PROCESS AND VTC TRAINING

This paper evaluates the effects of virtual team communication (VTC) training on group interactions over time. Most studies concerning the use of CMCS and group communication have focused on single-session uses and have not focused on the *repeated use* of CMCS, in which group attitudes and outcomes can evolve over time. (In this study, each group worked together on three sequential tasks over the course of 8 weeks.) It has been suggested that organizations can accelerate the acceptance and utilization of CMCS technologies by training users in relationship development. This paper explores the role of VTC training in enhancing these relational links and thereby improving communication and information exchange effectiveness.

Some of the guidelines (see Table 1) for organizing and conducting CMCS meetings from

Table 1. Guidelines for successful virtual teams

Define the team's objectives	Foster social presence (interaction, inclusion, and participation)
Assess agenda items	Incorporate channels to share socioemotional cues
Identify appropriate members	Establish the position of group members
Establish a team leader	Define task roles Establish norms for group interaction

Adapted from Jay (1976); Niederman *et al*. (1996); McGrath (1991); Warkentin *et al*. (1997)

previous research (Jay, 1976; Niederman *et al*., 1996) include a definition of the objective of the meeting, assessment of agenda items, identification of appropriate members and the establishment of a team leader. Other work has identified the necessity of fostering interaction, inclusion and participation (McGrath, 1991), as well as incorporating channels for sharing socioemotional cues between participants to increase the media richness of participants' communications (Warkentin *et al*., 1997). Performing activities such as establishing the position of group members, defining task roles and establishing norms for group interaction all can help support the establishment of relational links (Warkentin *et al*., 1997). Drawing on these sources and guidelines, a programme of VTC training was developed and implemented in this study and the effects of this training are presented.

Several bodies of research address the impact of computer support on teams. In particular, media richness theory and social presence theory state that computer-mediated group interactions are lacking in their ability to share socioemotional information and cues needed to develop trust, warmth and other interpersonal affections (Daft *et al*., 1987; Short *et al*., 1976). This approach has been termed the 'cues-filtered-out' view (Culnan & Markus, 1987). Central to this approach is the premise that the written channel precludes the ability to exchange non-verbal and paraverbal cues necessary for socioemotional exchange. Media richness theory (Daft & Lengel, 1986; Daft *et al*., 1987) suggests that media vary in the levels of richness according to the number of cues they are able to convey, the timeliness of the feedback and the capacity of natural expression. Rich media, such as face-to-face communication, are better suited to highly equivocal tasks, and leaner media, such as written or textual, are better suited to less equivocal tasks (Daft & Lengel, 1986); the appropriate match of medium and task is related to enhanced managerial effectiveness (Zack, 1993). Social presence theory (Short *et al*., 1976) suggests that the fewer channels available within a medium the less attention is paid by the users to the presence of other social participants' interactions, and social presence declines as messages become more impersonal (Hiltz *et al*., 1986). After reviewing the literature, Rice & Love (1987) concluded that 'CMC, because of its lack of audio and video cues, will be perceived as impersonal and lacking in normative reinforcement, so there will be less socioemotional content exchanged.' Training teams to adaptively utilize technology for communicating such types of information may help computer-supported teams develop relational links faster and more efficiently.

However, other CMCS studies have found that computer-mediated teams do share relational information (Adler, 1995; Chidambaram, 1996; Walther, 1996; Warkentin *et al*., 1997). Social information processing theory (Walther, 1996) suggests that relational intimacy may take longer to develop in computer-supported groups and was used as the basis for testing a temporally bounded model of group behaviour. The basic argument underlying this model is that computer-supported groups, given adequate time, will exchange enough social information to develop strong relational links. Thus, whereas computer support was expected to limit group interaction initially, the model predicted that over a period of time such constraints would dissipate. The results show evidence of such shifts among computer-supported groups. Walther (1996) suggests computer-mediated communication does not differ from face-to-face communication in terms of the substance but in terms of a slower rate of transfer, and suggests the use of 'emoticons' and ALL-CAPS to exchange socioemotional information.

Group cohesiveness has been linked to a number of positive outcomes, such as enhanced motivation, better decisions and more open communication (Mabry & Barnes, 1980; Keller & McGrath, 1988; Budman *et al*., 1993). Groups that are more cohesive also tend to communicate more openly, exert more influences on members to conform to group norms and display higher task satisfaction (Seashore, 1954; Keller & McGrath, 1988; Miranda, 1991; Burke & Chidambaram, 1995).

The team performance model (Drexler *et al*., 1988) represents a macroview of the meeting process and can be used from the moment teams are formed. This model (see Figure 1) summarizes the basic dynamics of teams and involves seven stages. Each stage provides an important step in the team-building process. The model contributes to the task outcome of the meeting as well as to the relationship outcome. A critical part of any meeting is the development of a relationship among the participants to provide a foundation for trust and commitment (Chidambaram, 1996). Each of these stages of the model can be consciously approached during a meeting. In the 'creating' stages of the meeting model, members get to know one another, generally by introductions and developing an understanding of other group members. This helps foster interaction as well (McGrath, 1991). In this creating stage, members also define the task (Niederman *et al*., 1996) and determine how to break the task up into steps if needed, defining task roles and establishing norms (Warkentin *et al*., 1997). It is at this point that members may want to identify a team leader, as suggested in Niederman *et al*. (1996).

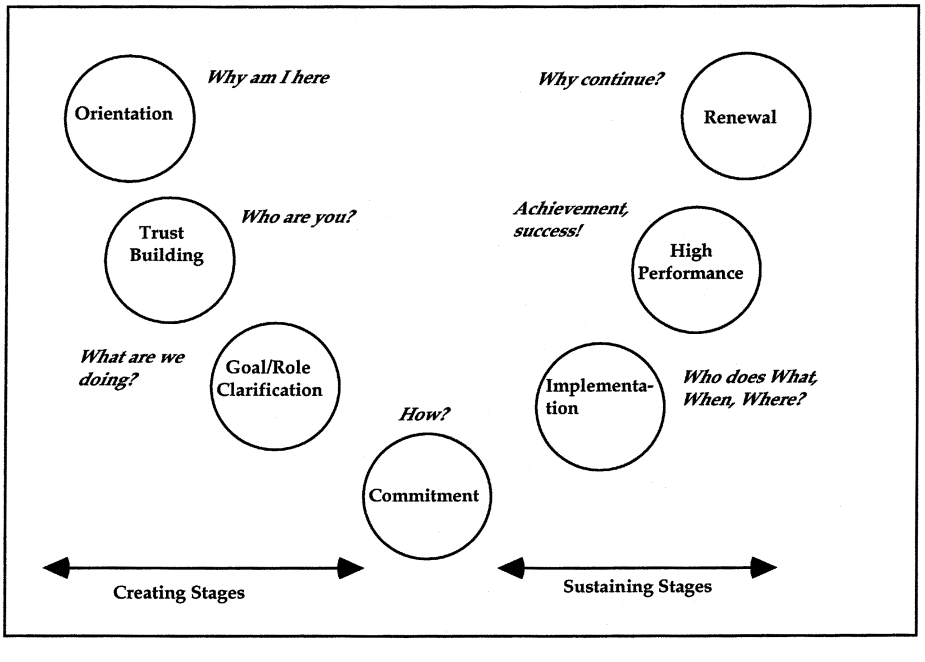

Figure 1. Team performance model. Adapted from Drexler *et al*. (1988).

Electronic communication has benefits and drawbacks that have often been referred to as 'process gains and losses' (Nunamaker *et al*., 1991). Overcoming the drawbacks involves first understanding what they are and then having mechanisms for approaching them. Drawbacks include information overload, free-riding, flaming and fewer information cues. Structuring the electronic conversation is necessary to help to overcome information overload. The system used in this study helps structure the meeting by providing for new topics as well as hierarchical responses to topics. In addition, comments were identified by group member names, which may not prevent free-riding but will identify those actively participating. Group members were urged to send messages to non-participating members (if any) in an effort to draw them into the group and foster inclusion and participation (McGrath, 1991).

Although it has been found that electronic communication channels initially lower relational intimacy, the members of such teams will develop ways of exchanging socioemotional communication and, over a period of time, groups using computers will gradually develop close relational ties (Burke & Chidambaram, 1995; Chidambaram, 1996). The research also showed that members of a group will eventually reveal group feelings and attitudes. In addition, it was argued that members were able to build a representation of the group, even in anonymous conditions (Chidambaram, 1996). Further support for the importance of relational links was found by Warkentin *et al*. (1997), who showed them to be a significant contributor to the effectiveness of information exchange and went on to present steps that could be taken to improve the interaction experience of virtual teams.

McGrath (1990) offers the TIP theory (time, interaction, performance), which purports that the development of relational links in groups involves performing activities related to the member support and group well-being functions. According to this theory, groups make contributions to group discussions at three different levels: (1) production function, (2) member-support function, and (3) group well-being function. In addition, all three functions are achieved by means of one of four modes — (1) inception, (2) solution, (3) resolution of conflict, and (4) execution of the performance. The development of relational links involves performing activities relating to either the member-support function or the group well-being function. A team with no past history that is working on a challenging problem with much technological and environmental uncertainty will have to engage in all three functions and in all four modes to avoid detrimental effects on performance. This is another area in which appropriate training may facilitate improved outcomes.

Because the exchange of socioemotional information will help teams develop relational links and because stronger relational links in groups have been associated with higher task performance, anything that improves the level of exchange of socioemotional information can improve the outcomes of virtual team processes. Further, because it has also been shown that higher total levels of information exchange within groups is associated with improved outcomes and that information exchange is strongly affected by the group's internal dynamics or relational links, efforts to build stronger relational links within virtual teams should also result in improved task performance. Therefore, it is proposed that teams that have received VTC training will have developed stronger relational links faster than the teams without VTC training, and that such higher levels of relational links should lead to improved virtual team performance levels.

THE STUDY

An exploratory study (see Figure 2) was devised to evaluate the effects of VTC training on virtual team members' perceptions of group interaction. Subjects were from two sections of a graduate computer architecture class. Six teams of three or four students were established in each section giving a total of 12 teams. Six teams (teams 1–6) in one section were formally presented with VTC training; they served as the treatment group. But teams 7–12 in the other section were given no such training; they served as the control group. All teams used asynchronous communications via the MeetingWeb^{TM} software, described below.

The participants (subjects)

The participants in this study were upper-level graduate students enrolled in a course on computer architecture, which was required for their degree course 'Computer Information Systems.' They were administratively placed into 12 groups in such a way that no two members who met face-to-face in other course projects would be virtual partners. The subjects were provided with sufficient grade incentives to ensure that they were motivated to contribute to the team's success. Furthermore, because this was an evening course (typically populated by older, experienced full-time employees rather than younger, full-time students), the typical student was mature and comfortable with group-related work. As evening students, they also had little chance of knowing their virtual partners, who also only came on campus to take classes. Fourteen participants were women and 24 were men.

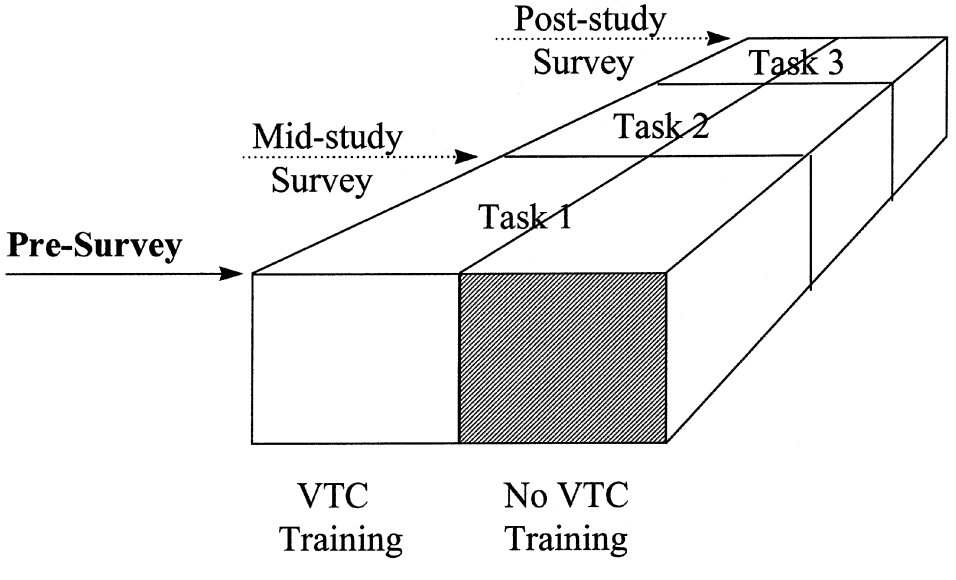

Figure 2. Research design.

The tasks

Three tasks were used; all teams were given the same tasks in the same order. The subject matter of each of the tasks paralleled material covered in the class. All three tasks were dealing with computer architecture material and required groups to collaboratively solve a problem. All three tasks were adopted from Englander's (1996) Instructor's Resource Guide and Test Bank. Students were told that they were part of a team that needed to solve the task, but were not told who their team members were. To communicate with their team-mates, they were required to log in to the on-line meeting created just for their team within MeetingWeb™. They could enter comments and replies that could only be read by other members of their team and by the faculty involved. All members were told they were not to discuss the case with their team members outside MeetingWeb™. Tasks 1 and 2 each had three parts to be answered and task 3 had two parts. (The task description of each task was approximately one-half page long.) The answers for all parts were *objective*, such that there was one correct answer for each part. Additional information and hints on solving the task were also supplied; however, only portions of these hints and descriptions were given to each member, requiring the exchange of this information to solve the task. Three versions of each task were developed with each version containing portions of the hints and descriptions. Within each team, each member received one of these versions. This organization required information sharing on the part of the team members in order to solve the problem correctly. Only by fully sharing their 'unique information' and making it 'common information' could the team actually solve the problem and perform well on the task.

The three virtual team tasks were part of the required work for the course. In addition to the three virtual tasks, individual assignments were allotted during the university term. The virtual tasks were designed to reflect current material in the course and virtual teams were given 2 weeks to complete each virtual task. Tasks were distributed at the beginning of a class, followed by a basic discussion of the task to ensure that all students understood the nature of the task. The class with the treatment group (teams 1–6) were also presented with guidelines on virtual team communication, which is discussed below.

Procedure for VTC training

Virtual team communication training was developed and administered in an effort to evaluate the ability of such training to positively impact perceptions of group interaction. This training consisted of three parts. First, teamwork, meetings and CMCS were discussed in the context of the Drexler *et al*. (1988) model (see Figure 1), in which team dynamics and the stages of the meeting process were introduced. For instance, participants were told that in the early stages of the meeting process introductions could be made and team members might want to spend time getting to know one another. Defining task roles could also take place at the beginning of each task. Second, participants were informed of possible drawbacks to electronic communication (Nunamaker *et al*., 1991), such as information overload and 'free-riders', along with possible mechanisms for addressing these problems. The treatment group was presented with various methods of overcoming such problems, e.g. by sending email messages to non-participating members.

Finally, participants were introduced to the 'rules of netiquette' and were given examples of common 'ebbreviations' (Table 2) to assist in communication and for sharing socioemotional cues. Participants were educated about the common misunderstandings and misinterpretations that can occur between virtual team-mates because of the lack of non-verbal and paraverbal cues. They were presented with some basic tools to expand the media richness (or 'emotional bandwidth') of their communications channel. They were instructed in the use of emoticons to denote sarcasm or jokes, and in the use of ALL-CAPS and various punctuation (discussed earlier) to denote emphasis. They were also instructed not to 'flame' their partners by typing comments which could be misinterpreted as inflammatory without the normal visual clues of face-to-face communication. These lessons from the initial VTC training session were reiterated in a shorter session before the second task.

The system

The asynchronous CMCS used in this study was MeetingWeb™, a secure moderated bulletin board system accessible from the World Wide Web. MeetingWeb™ was developed by and licensed from CitySource Inc., and has been further customized for use by the College of Business Administration (CBA) with custom extensions. (More information about MeetingWeb™ can be found at http://www.cba.neu.edu/MeetingWeb™.) It is a custom proprietary collaboration software system residing on a university web server and accessible to anyone with a connection to the Internet (such as an ISP), any web client (browser) software (such as Netscape), a valid username and a valid password. It is a computer conferencing system which provides structured textual and graphical communication capabilities to its users.

MeetingWeb™ was designed to have a familiar look and feel to users of the World Wide Web, a new standard platform for computer communications (see Figure 3 for a representative screen). The MeetingWeb™ system is easy to use; pilot tests confirmed that the participants could learn to use the system with only a brief introduction. The system permits group members to communicate by 'posting' messages in a hierarchical manner, termed a 'threaded discussion', which appears as a familiar outline format. A 'comment' (message) can be posted as a new 'topic' (leftmost in the hierarchy), as a reply to a topic (indented under that topic), or as a reply to a reply. This intuitive structure makes the organization of the messages clear and

Table 2. Common 'ebbreviations' for enhancing virtual communications

BTW	By the way
FEIW	For what it's worth
GG	Got to go
IMHO	In my humble opinion
J/K	Just kidding
PAW	Parents are watching
TTFN	Ta-ta for now

Excerpted from US News and World Report, 1999.

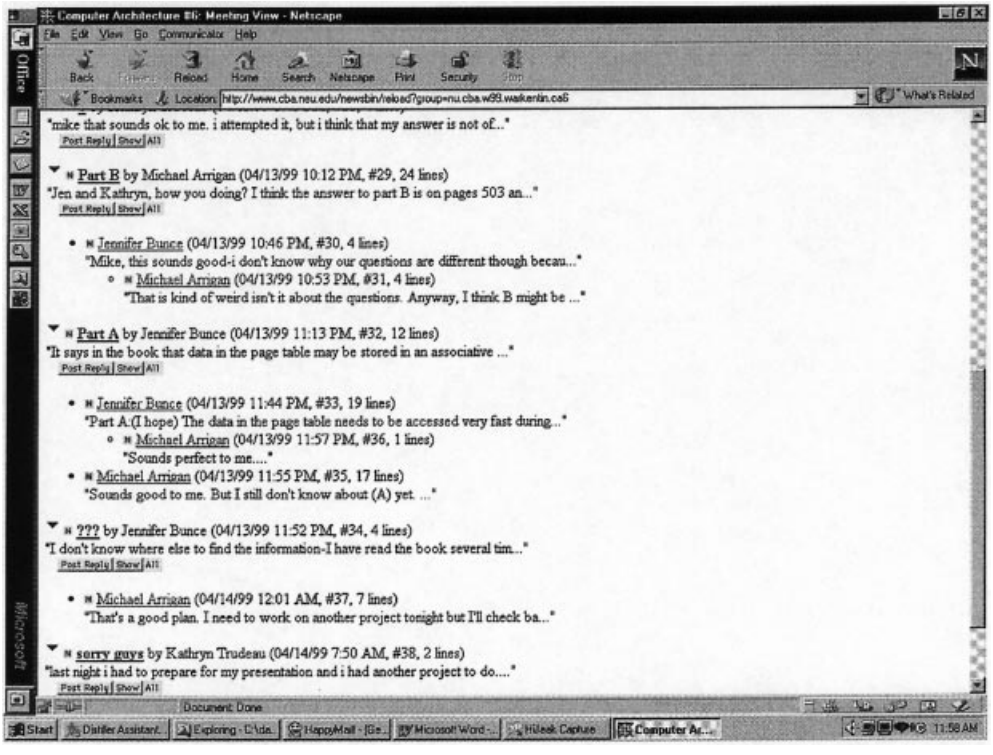

Figure 3. MeetingWeb™ sample screen.

unambiguous. Furthermore, the source of each message is clearly identified; the system provides an eponym.

The near ubiquity of the World Wide Web today makes MeetingWeb™ (and other web-based CMCSs) extremely accessible to a broad audience. Further, the protocol of the web (hypertext transfer protocol; HTTP) is hardware independent, so it provides an essentially universal platform for communication support among virtual team members.

The instrument

Surveys were administered at the beginning of the course before students collaborated using MeetingWeb™, mid-study after performing the first task, and after performing the last task (see Appendix A). The surveys tracked relational and group performance variables. Several research variables related to the perceptions of the group cohesiveness were measured with a previously validated instrument. Three are specifically addressed here: (1) member commitment to team goals, (2) trust, and (3) openness of expression. The initial survey established the participants' baseline expectations from previous team activities (along with some demographic information), whereas the other two surveys captured their perception of the

team process and relationship *during* and *after* the longitudinal series of tasks (see Figure 2 for clarification).

FINDINGS AND FUTURE RESEARCH DIRECTIONS

Analysis of the data indicates that the teams not receiving the VTC training started out with fairly high evaluations in terms of the three relational variables, but these measurements steadily decreased throughout the project. Individuals that received VTC training started with lower evaluations in terms of the three relational variables, but these measures steadily increased throughout the project until they were much higher than those in the control group (Figures 4–6). This indicates that VTC training led to increasing perceptions of cohesiveness and satisfaction with process over time.

The individual responses to the qualitative open-ended questions on the research instrument proved to be informative. Question 7 asked, 'What are the *negative* aspects of working on a task in virtual team mode, or ways in which the process could be improved?', and question 8 asked, 'What are the *positive* aspects of working on a task in virtual team mode?' The raw responses to these questions can be found in Tables 3 and 4, whereas Table 5 shows answers organized by two main categories. Note that members of both the treatment and the control groups had significant objections to engaging in groups without the benefit of traditional face-to-face interaction dynamics. However, they also found that there were significant advantages to this form of interaction. For example, many respondents indicated that the lags and delays of asynchronous communications constrained their communications, making it inefficient and impeding the formation of group consensus and conclusions. Yet many study participants also noted that the asynchronous environment enabled them to take time to think through answers,

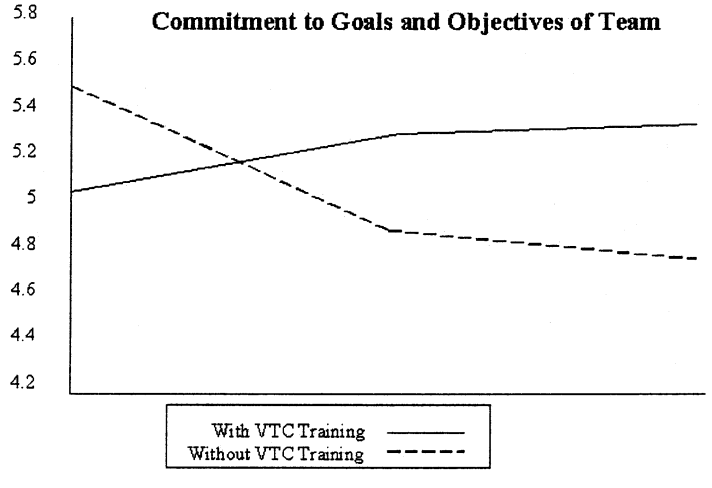

Figure 4. Change in research variable no. 1 — goals (before the study, mid-study and after the study).

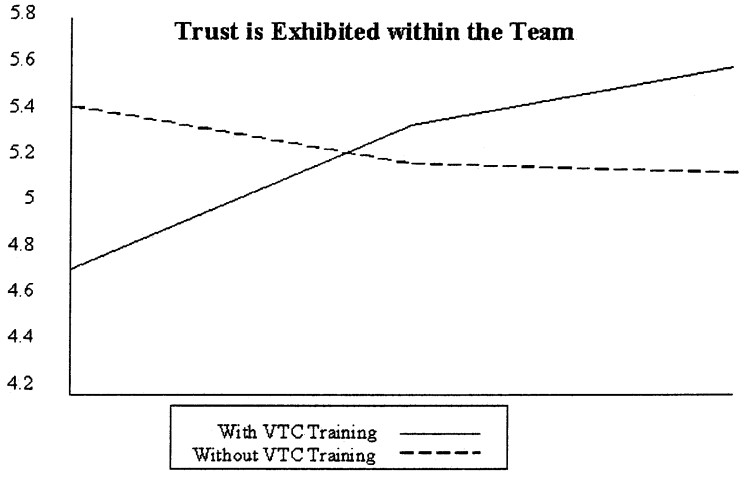

Figure 5. Change in research variable no. 2 — trust (before the study, mid-study and after the study).

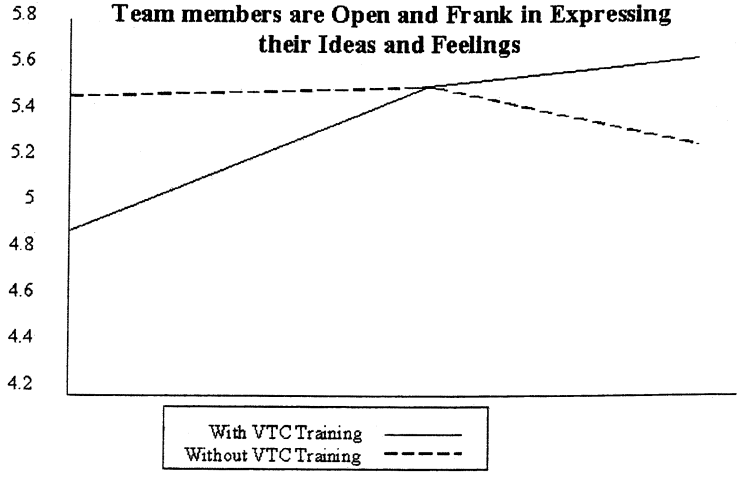

Figure 6. Change in research variable no. 3 — openness (before the study, mid-study and after the study).

thus improving the quality of their work and leading to faster conclusions! Similarly, although they suggested that the lack of face-to-face involvement constrained brainstorming and group problem-solving processes, they also indicated that this mode reduced bias and facilitated greater involvement by all members with greater equality and freedom of expression. So, the participants recognized both positive and negative aspects of the same features of virtual teamwork. There was no temporal trend — participants were able to identify these characteristics by the mid-study survey and these perceptions were not significantly different at the end of the study.

Table 3. Responses to open-ended questions (no. 7 and no. 8) — control group

Response	No. of responses
Negative comments (mid-study — survey no. 2)	
Lack of participation (free-riders)	7
Communication was stop and start	
You never know when someone would post	5
Not everyone was accessible at the same time	3
No brainstorming	
Need to be proactive and respond sooner (set times)	4
Need some face-to-face, no personal interaction	2
More difficult to settle differences, understand what someone meant	3
Not able to contact free-riders	
Web access	
Positive comments (mid-study — survey no. 2)	
Can meet at any time (any place/no travel)	14
Come to conclusions earlier	
More interaction	
More time to think through answers	2
Better answers (more time)	2
No personal feelings come into play	
Reduces bias	
More ideas	
Have time to think about other ideas	2
Thoughts are clearly structured	
Ideas documented	
Negative comments (post-study — survey no. 3)	
Free-riders	5
Had to wait for replies	
Need to formalize time synchronization	
Posting answers at the last minute	
More difficult to get ‘back up to speed’ every time you look at answers on web	
Difficult to get consensus and conclusion	4
Positive comments (post-study — survey no. 3)	
Could meet at any time	12
Saves time commuting (no meetings)	
Speedier	2
Sharing of ideas/different perspectives	3
Feedback from other members	
Learned from other members	
More thought put into answers	
Useful to understand how to work remotely with teams	

Table 4. Responses to open-ended questions (no. 7 and no. 8) — treatment group

Response	No. of responses
Negative comments (mid-study — survey no. 2)	
Waiting for responses	3
Slow feedback (no real-time discussion)	
Communication does not flow smoothly	
Had to wait for clarification of comments	
Not everyone got involved daily	
Needed to document everything	
Lack of expression	
Hard to come to a conclusion	4
No group dynamics	
Hard to access the server sometimes	
Need fewer screens	
Very controlled	
Positive comments (mid-study — survey no. 2)	
People with different schedules can still 'meet'	5
Don't have to set a group meeting time	2
'Real-time' interaction not needed	
Less domination	
Can give answer when ready	2
Time to think	
Everything is documented	4
Can look back at all responses	
Easy to summarize	
Could get good perspectives	
All members can express themselves	2
More focus from members	
Negative comments (post-study — survey no. 3)	
Responses not all given at same time (some sooner, some later)	
Need daily participation and brainstorming	
By the time you responded, answers were already there	
Was difficult to break into parts	
Time to log on	
Free-riders had to wait for responses	4
Need to set times to respond	
Not as efficient as face-to-face	
No real-time discussion to set up approach to solving problem	
Poor writing skills	
Time to document everything	
Positive comments (post-study — survey no. 3)	
Can work at any time	
Fastest way to communicate	
No meetings	
Can work from home	
Good practical groupware exercise	

Table 4. Continued

Response	No. of responses
Can freely express individual ideas Everyone gets equal voice Everything is documented So we can follow the logic Was easy to tell who was not participating	2

Table 5. Qualitative survey responses organized by category

Negative comments related to asynchronous communications (timing factor)
Waiting for responses and clarification, communication does not flow smoothly, slow feedback
Responses not all given at same time (some sooner, some later)
Not everyone got involved daily, need daily participation and brainstorming
By the time you responded, answers were already there
Posting answers at the last minute
Communication was stop and start
You never know when someone would post
Not everyone was accessible at the same time
No group dynamics, no brainstorming
Need to be proactive and respond sooner (set times)
Need to set times to respond, need to formalize time synchronization
Not as efficient as face-to-face
More difficult to get 'back up to speed' every time you look at answers on web
Positive comments related to asynchronous communications (timing factor)
People with different schedules can still 'meet'
Don't have to set a group meeting time
Can meet at any time (any place/no travel), saves time commuting
Can give answer when ready, time to think
More time to think through answers, have time to think about other ideas
Better answers (more time), more thought put into answers
Can work at any time, fastest way to communicate, speedier, earlier conclusions
Everything is documented, can look back at all responses, easy to summarize
Negative comments related to lack of face-to-face communications dynamics
No group dynamics, no brainstorming
Need some face-to-face, no personal interaction
More difficult to settle differences, understand what someone meant, lack of expression
Difficult to get consensus and conclusion
No real-time discussion to set up approach to solving problem
Hard to come to a conclusion
Positive comments related to lack of face-to-face communications dynamics
Reduces bias, could get good perspectives, more ideas
All members can express themselves, less domination, everyone gets equal voice
Can freely express individual ideas, no personal feelings come into play
More interaction, more focus from members
Documented logic, was easy to tell who was not participating

Although the group sizes for each section (18 with VTC training and 20 for non-VTC training) are too small to offer rigorous statistical analysis, it is worth noting that after conducting a repeated measures ANOVA, using the presurvey values and the post-survey values on each of the variables, three of the process variables (common goals, trust and openness) were significant at the 0.05 level. This indicates that the teams that received VTC training felt that team members were committed to the goals and objectives of the team, that their team exhibited trust and that team members were open and frank in expressing their ideas and feelings.

Finally, although not statistically significant, teams with VTC training out-performed the control teams on the assigned tasks, and anecdotally reported higher levels of satisfaction with the dynamics of group interaction. The results of this study support the growing body of research that suggests that computer-mediated teams can develop effective collaborative partnerships if given sufficient opportunity to develop strong relational links. For some organizations, this means initiating their virtual team experiences with face-to-face communications before moving to the virtual communications modality. In other circumstances, where this may not be possible, VTC training may play a critical role.

This initial exploratory study suggests several areas for future research. First, few business teams meet only in the virtual space; they combine face-to-face communication with email, telephone and other forms of communication. It would be informative to evaluate teams that communicate face-to-face initially and then proceed to work virtually. It is presumed that these teams develop greater relational links (and trust) than teams whose members have never met in person.

Second, Chidambaram & Bostrom (1996) developed a framework that classifies all models of group development into two broad categories: sequential and non-sequential. Sequential models posit that groups move through unitary sequences of development and the main focus of these models is to describe the actual sequence of behaviours exhibited by groups over time. Non-sequential models do not propose a predetermined sequence of events but focus on explaining the underlying factors that cause shifts in group development, and attempt to explain the relationships among the various causal factors underlying group development. These shifts in group development can be studied using longitudinal teams. More research with virtual teams that collaborate in sequential tasks over time will shed more light on the development of effective communication patterns.

Third, the findings from the analysis of the trust, common goals and openness variables above suggest that it may be worthwhile to investigate further these relationships. In particular, the effects of trust development on task focus, task completion and management of uncertainty are worthy of investigation. Trust is a basic feature of social situations that require cooperation and interdependence. It also plays a critical role in problem solving (Zand, 1972), organizational performance (Hart *et al*., 1986), organizational communication (Roberts & O'Reilly, 1974), and acceptance of feedback (Earley, 1986).

Fourth, it may be helpful to evaluate the role of leadership in building strong relational links between virtual team members and in building effective teams that perform tasks well. Finally, extensive research has identified significant differences between the communication patterns used by men and women in Western culture. Specifically, Tannen (1990, 1994) and others

found that there are measurable conversational differences in the patterns and uses of interaction primitives such as verbosity, interruption/turn-taking, tag questions and directives. These differences lead to generalized perceptions of male communicators as assertors and female communicators as facilitators (Warkentin *et al*., 2000). Such distinctions may play a role in the evolution of relational links between virtual team members. Whether these patterns are exhibited in the on-line realm in the same way that they appear in face-to-face communication has yet to be determined, but ongoing research with MeetingWeb™ is designed to investigate this question.

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APPENDIX A: THE INSTRUMENT

1. In general, in working with THIS team, do you feel that you are really part of the team?
   A. Really part of the team.
   B. Included in most ways.
   C. Included in some ways, but not others.
   D. Don't feel I really belong too much.
   E. Don't feel I belong at all.

In working with THIS team:
To a very little extent To some extent
To a very great extent

2. Are team members committed to the goals and objectives of the team (during the project)?
   1 2 3 4 5 6 7

3. To what extent is trust exhibited within the team?
   1 2 3 4 5 6 7

4. Do members have a strong sense of belonging to the team?
   1 2 3 4 5 6 7

5. Do team members recognize and respect individual differences and contributions?
   1 2 3 4 5 6 7
6. Were team members open and frank in expressing their ideas and feelings?
   1 2 3 4 5 6 7
7. What are the *negative* aspects of working on a task in virtual team mode, or ways in which the process could be improved?
8. What are the *positive* aspects of working on a task in virtual team mode?

Biographies

Merrill Warkentin is an Associate Professor and Head of MIS in the College of Business Administration at Northeastern University in Boston, MA, USA. He has written over 80 papers and book chapters. His research has appeared in such journals as *Decision Sciences*, *MIS Quarterly*, *Journal of Knowledge Engineering & Technology*, *Expert Systems*, *ACM Applied Computing Review*, *AI and Medicine* and *Journal of Computer Information Systems*. Professor Warkentin has served as a consultant to numerous companies and organizations and has been a featured speaker at over 100 industry association meetings, executive development seminars and academic conferences. He has been a lecturer at the US Army Logistics Management College, and, since 1996, he has served the Association for Computing Machinery (ACM) as a National Distinguished Lecturer. Professor Warkentin holds BA, MA and Ph.D. degrees from the University of Nebraska, Lincoln, USA.

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