RONALD E. RICE
GAIL LOVE

Electronic Emotion

Socioemotional Content in a Computer-Mediated Communication Network

This article investigates a new communication medium—public computer conferencing—by separately and jointly analyzing two basic aspects of human communication: (1) content, the extent to which such systems can support socioemotional communication, and (2) connectivity, communication patterns among system users. Results indicate that (1) computer-mediated communication systems can facilitate a moderate exchange of socioemotional content and (2) basic network roles did not generally differ in percentage of socioemotional content. Some fundamental issues in analyzing content and networks in computer-mediated systems, such as structural equivalence versus cohesion network approaches, are discussed in light of these results.

Computer-mediated communication (CMC) systems are becoming alternative media for communication as organizations implement electronic mail, computer conferencing, computer bulletin boards, videotex systems, and related systems. The commmunication aspects of these systems share certain attributes: Text may be entered into a computer file from a hardcopy or video terminal at the place and time of the sender's choosing; the creation, storage, format, distribution, and receipt of the text may be

Authors' Note: We would like to acknowledge the helpful comments of Dayna Finet, Peter Monge, and two anonymous reviewers, for their suggestions on earlier versions of this article.

COMMUNICATION RESEARCH, Vol. 14 No. 1, February 1987 85-108

processed by using the capabilities of the computer; and the receiver may scan, read, print, forward, copy, edit, or delete the text at the place and time preferred.[1]

A general question raised by the diffusion of CMC systems is the extent to which human communication is altered by such media. Much research on CMC systems considers their influence on the quality of group decision, emergence of group leadership, participation, and time to decision (Finn, 1986; Johnson-Lenz, Johnson-Lenz & Scher, 1978; Kerr & Hiltz, 1982; Kling, 1980; Rice, 1980a; Rice & Associates, 1984, chap. 6) The present research considers two other ways in which CMC systems may affect human communication.

The first category of impact concerns the nature of communication *content*. There are many constraints and influences on the sending and receiving of communication: roles, norms, structure, procedures, rewards, politics, and so on (Farace, Monge, & Russell, 1977; O'Reilly & Pondy, 1979; Rogers & Agarwala-Rogers, 1976). The new medium of CMC will likely remove some of these constraints, while creating others. As a consequence, the content of CMC systems may differ from that of traditional organizational communication. Vallee, Johansen, and Spangler (1975), for example, describe CMC as an "altered state of communication" (p. 12). CMC may "change the psychology and sociology of the communication process itself" (Turoff, 1978, p. 10), including the concept of friendship (Cathart & Gumpert, 1983). Kochen (1978) goes even further by suggesting that the form of linguistic communication used in CMC may very well be neither conversational nor written, but a "new linguistic entity with its own vocabulary, syntax, and pragmatics" (p. 22).

The second general category concerns the *structure* of communications. CMC systems remove many of the traditional limitations on communication because it is freed from the constraints of time and space (Olson & Lucas, 1982; Williams, Rice, & Dordick, 1985). Users are able to expand personal and professional networks worldwide at minimal cost, and to use conferencing systems to substitute for the prior absence of communication (Hiemstra, 1982). Most studies report increased communication among users following implementation of CMC systems (see Freeman, 1980; Hiltz, 1983; Rice & Associates, 1984, chap. 8; Rice & Case, 1983; Tapscott, 1982).

Few of these studies have considered content and structure simultaneously. Typically they either ignore the patterning of message flows or assume that the nature of the network is best captured by all content and measure only the actual linkages among users. These may, for particular research purposes, be appropriate decisions. However, a few studies have combined these two emphases. One approach is to complement the study of the changing structure with archival measures of content. Danowksi and Edison-Swift (1985) analyzed the content of an administrative CMC system to explain the significant increases in communication messaging and structuring on the system—both indicated a bureaucratic crisis. Another approach is to conceptualize the network as the co-occurrence of similar words. Danowski (1982) suggests that CMC moderators could keep a conference focused on a topic by sending messages matched to the clustering of concepts in others' messages. A third approach is to compare directly the content of messages that constitute the linkages of the communication network.

Amount and Types of Computer-Mediated Communication Content

One basic assumption about computer-mediated communications is that they transmit less of the natural richness and interaction of interpersonal communication than face-to-face interaction. Therefore, users of CMC systems exhibit fewer of their natural communication behaviors.

The simplest implication of this assumption relates to a person's amount of communication. Two simple indicators of a CMC user's communication behavior are duration and frequency of messaging. Duration is analogous to the psychological trait of "response duration" (Koomen & Sagel, 1977)—how long one talks between conversational turns—while frequency is analogous to the trait of "latency of verbal response" (Willard & Strodtbeck, 1972), or how quickly one responds to an opportunity to begin a conversational turn. These personality traits are quite reliable and highly correlated with the extent of one's participation in group discussions (Hiltz & Turoff, 1978, p. 107). The general concept of "sociability" implies that people who are socioemotionally oriented also show greater response duration and shorter latency of verbal response. If a CMC system is significantly different from the interpersonal communication channel, it may alter relationships between duration of latency.

A more complex effect would be on the types of content people would exchange in a CMC system. Dominant in the teleconferencing literature, for example, are laboratory experiments comparing various media with face-to-face (FTF) interaction (for reviews, see Fowler & Wackerbarth, 1980; Hiemstra, 1982; Johansen, 1977; Short, Williams, & Christie, 1976; Williams, 1978). These studies have tended to focus on the narrow bandwidth and lack of nonvisual cues of nonvideo media. The typical conclusion is that as bandwidth narrows, media allow less "social presence"; communication is likely to be described as less friendly, emotional, or personal and more serious, businesslike, or task oriented. If the social presence concept is accepted, CMC, because of its lack of audio or video cues, will be perceived as impersonal and lacking in sociability and normative reinforcement, so there will be less socioemotional (SE) content exchanged.

Some research suggests that computer-mediated communication is *not* necessarily completely unemotional, however. Hiltz (1978a) cites a "letting down" and a good deal of honest expression in CMC messages. Phillips's (1982) informal content analysis of messages from three computer conferences indicated a "stream of consciousness flow of thoughts" that exhibited creativity and spontaneity (p. 214). Hiemstra's (1982) analysis of four users over 43 days concluded that much of the same "face-saving" content of face-to-face communication appears in CMC as well, although there was a shift in strategy to negative politeness and "bald on record" comments in CMC transcripts rather than the "off-record" strategy more common in interpersonal communication. Steinfield (1986) concluded that a considerable amount of electronic messages in a large organization concerned SE topics, and that this content was functional, particularly for new employees. Hiltz and Turoff (1978, p. 109) found an average of 14% SE content in eight CMC groups, compared to 33% SE content of three FTF groups, in a controlled experiment where the groups were each trying to reach a joint decision. Chesebro (1985) studied the most recent 10 messages from 14 public computer bulletin boards (CBBs) and found 32% were interpersonal in nature. Meyers (1985) analyzed two CBBs and found half of all messages were "general discussion"; jokes, insults, sexual topics, games, stories, and personal information constituted 29% and 39%, respectively, of the content of the systems.

Moreover, CMC may have clear advantages over the typically socioemotionally rich content of face-to-face communication, and users may be able to adapt to the inherent narrow bandwidth. Hiltz and Turoff (1978) contend that CMC is better thought out, better organized, and richer than natural conversation, and experienced users develop an ability to express missing nonverbal cues in written form. They later showed that users' attitudes toward the appropriateness and diversity of uses for a CMC system did in fact become more positive with increased use, indicating that the amount of SE content deemed "appropriate" in such systems is partially a function of experience and familiarity (Hiltz & Turoff, 1981). Rice and Case (1983) similarly found that experienced computer personnel rated a CMC system as significantly more appropriate for SE tasks than did novice managers.

Paradoxically, extreme SE content—"disinhibition" or "flaming"—may occur precisely because of the lack of social control that nonverbal cues provide (Edinger & Patterson, 1983; Hiltz, Turoff, & Johnson, 1985; Kiesler, Siegel, & McGuire, 1984; Sproull, 1986). The lack of nonverbal cues about physical appearance, authority, status, and turn-taking allows users to participate more equally and with more extreme affect on CMC systems than in many face-to-face interactions.

A crucial qualification of this body of research is that the nature of the group *task* greatly affects whether social presence influences users' evaluation of CMC. Several studies have concluded that CMC is competitive with audio and video conferencing for nonsocioemotional tasks such as giving and receiving information, exchanging opinions, and generating ideas, where factual or cognitive skills and outcomes are involved (Hiltz, 1978b; Hiltz & Turoff, 1978; Kerr & Hiltz, 1982; Rice, 1980b; Rice & Case, 1983). CMC, along with other media, did not rate as appropriate for getting to know someone, bargaining, and persuasion. Table 1 provides results from several studies on how satisfied respondents were with the use of CMC for a set of tasks presumed to require increasing amounts of SE content.

Thus users' experience with CMC systems, group norms, and communication tasks all influence the proportion of socioemotional content in CMC systems.

Connectivity and Social Structure in CMC Systems

With the advent of packet-switched computer networks and CMC systems, geographically dispersed researchers, organizational peers, or people just looking for conversation can expand their networks with others having similar interests (Turoff, 1978).

TABLE 1
Summary of Satisfaction Ratings from Several Sets of Computer Conferencing Users

Task	*Confravision*[a]	*Conferencing*[a]	*PLANET*[b]	*PLANET*[b]	*MACC Telemail*[c]	*Experienced EIES Users*[c]	*Staff EIES Users*[d]	*Student EIES Users*[d]	*Experienced Student EIES Users*[d]	*Average*
Exchanging opinions	1.9		1.5	2.1	1.9	2.3	3.5	3.1	2.7	2.4
Exchanging information	2.0	2.6	1.3	2.1	2.0	2.4	3.6	3.2	2.8	2.4
Generating ideas	2.7		1.8	2.6	3.8	2.8	3.1	3.4	3.0	2.9
Problem solving	2.7	–	3.0	3.4	4.0	3.9	4.4	4.1	2.8	3.5
Resolving disagreements	–	–	3.2	4.3	3.5	4.1	4.5	3.5	4.1	3.9
Bargaining	3.6	3.9	3.3	4.2	4.4	4.1	4.4	4.2	3.8	4.0
Persuasion	3.6	3.9	3.4	4.6	4.3	4.2	4.1	3.9	4.0	4.0
Getting to know someone	4.0	5.1	3.8	4.5	4.8	3.3	3.9	4.6	4.3	4.3

SOURCES: (a) Pye and Williams (1977); (b) Vallee, Johansen, Randolph, and Hastings (1978); (c) Hiltz (1981); (d) Hiltz, Johnson, and Agle (1978).
NOTE: Ratings based on average of responses to 7-point scale; 7 = completely unsatisfactory. Tasks and groups not generally comparable across studies. Cross-system averages are not weighed for study sample sizes. This table appeared originally in Rice and Associates (1984, p. 132).

A network is generally defined as the patterning or structure of a specific type of relation linking a defined set of nodes (Mitchell, 1969). Network analysis is the systematic study of relationships of nodes, their network behavior, their roles, and the larger social structure that both represents this interaction and is generated by it. A network group is generally defined as a set of nodes who share either (a) the majority of their links with each other or (b) similar relationships with other nodes (Knoke & Kuklinski, 1982; Rice & Richards, 1985; Rogers & Kincaid, 1981). The first approach is called the *cohesion* approach; the second is called the *structural equivalence* approach.

Unlike face-to-face communication, where relations among individuals are influenced by socioeconomic status differences, norms, physical appearance, and speech behavior, individuals using CMC are not required to use indirect paths of interpersonal connections to communicate with other, perhaps socially distant, users: They can simply send a message to any person or set of persons on the system. Thus path distance, which is central to the cohesion network approach, is less appropriate for the study of CMC networks, while absent linkages are meaningful indicators of awareness and choice by CMC users. It is a theoretical and empirical question as to which approach is the most useful in testing relationships between CMC content and roles.

One specific application of CMC networks has been in research communities, which are typically geographically dispersed yet in great need of shared information. Hiltz (1983) showed how a number of research communities used such a system for two years, and concluded that increased productivity, awareness of developments in the field, and new ideas about research topics were some of the results. Freeman (1980, 1984) studied one of the communities, concluding that "the computer, it seems, can perhaps take the place of protracted face-to-face interaction and provide the sort of social structure out of which a scientific specialty can grow" (1984, p. 201). Rice (1982) focused on how the entire set of research communities interacted. They occupied network roles defined by inter- and intragroup communication patterns over time, and displayed a significant trend toward reciprocal relations over time. Further, task-oriented groups became system isolates, while non-task-focused groups became central nodes in the system, exchanging high amounts of information.

Thus users of CMC systems can become more connected with people who share common interests but who would otherwise be unknown. As in face-to-face interpersonal communication, the extent and pattern of connections on CMC systems are indicators of social structure. Concerns about participants and isolates in human social structure may readily be applied to similar roles in CMC systems.

Research Hypotheses

From the above discussions on content, structure, and networks in CMC systems, the following hypotheses are derived:

Hypothesis 1: The duration of communication as measured by the number of sentences, and the frequency of communication as measured by the number of messages, will be positively correlated.

Hypothesis 2: The amount of socioemotional content in users' messages and the total number of messages sent to others on the system will be positively correlated.

Hypothesis 3: The percentage of SE content in users' messages will increase over time.

Hypothesis 4: Socioemotional content will constitute a moderate amount (around one-third) of the total message content in a CMC network. While many studies argue that CMC systems do allow forms of SE content, only a few have explicitly measured the amount, usually between 20% and 30%. Theoretically, the null hypothesis concerning content of CMC systems is that their limited bandwidth prevents users from exchanging SE content; that is, the amount of SE content will be negatively correlated with more text-based media. Practically, as this study does not compare CMC to face-to-face interaction, it can offer only a descriptive expectation.

Hypothesis 5: Group participants will send more socioemotional content than will nonparticipants in the CMC network, and content among group members will be more socioemotional than communication among non-group members. This hypothesis extends Hypothesis 2 by focusing on content within and between network roles.

Method

Data

The data analyzed for this study are six weeks' worth of transcripts from a computerized bulletin board of a nationwide public computer conference system (Medsig/Compuserv). The system memory was purged after eight days, so data collection consisted of weekly printouts of all public messages. This particular CMC system has been in operation since early 1982 and is the largest system currently in use for persons directly involved in the medical field or associated with the field. Users of this CMC system have the capability to send and retrieve messages, participate in on-line conferences, and access information from several data bases. Membership in this conference consists primarily of physicians, though students, nurses, and others also participated.

This sample was taken in the eighteenth month of the system's existence, by which time approximately 1,000 people had used it. The sample of 112 people from a population of approximately 1,000 represents a user rate of approximately 11%. While this is not as large a sample of users as would be desirable, it is larger than samples used for CMC content analysis by Hiemstra (1982), Phillips (1982), or Spelt (1977). This proportion is an "arbitrary slice" from a time series, representing a census of users within that time frame. The total of 112 persons sent or received a total of 388 messages during the six-week period. Of these users 35 were "sent" a message in this time period but had not responded within the period. Thus analyses of actual messages *sent* are based upon 77 users.

Content Analysis

In order to detect differences in SE and task content, some prior studies have used a content-analytical scheme common in studies of small groups: interaction process analysis (Bales, 1950). *Socioemotional content* is defined as interactions that show solidarity, tension relief, agreement, antagonism, tension, and disagreement. *Task-dimensional content* is defined as interactions that ask for or give information or opinion. The data were content analyzed using Bales's categories, with one alteration. The categories for giving information and for receiving information were expanded to differentiate between professional (task) and personal (socioemotional) information. Thus the fourteen categories included eight for SE and six for task-related interactions. The unit of analysis for coding was the sentence. A total of 2,347 sentences were coded. The phi coefficient for intercoder reliability, based upon a second, 10% random sample of sentences categorized by another trained coder, was .98.

The percentage of socioemotional content was measured as the number of SE sentences divided by the total number of sentences, to control for the total amount of each user's communication.

Bivariate Analysis

Kendall's tau was used for correlational analysis of content and message variables, because of the usual skewed distributions associated with communication variables, and the considerable possibility of tied ranks. Spearman's rho was used for correlational analyses involving structural equivalence network measures (see below) because of the more continuous but still skewed values.

Network Analysis

Role membership using the cohesion approach was identified by NEGOPY, because it is a linkage-based, pattern-recognition program suitable for classifying nodes of the network into several role categories (Richards & Rice, 1981). NEGOPY classifies nodes into group members, liaisons, "tree nodes," isolated dyads, and isolates. NEGOPY was run twice, first using all 112 nodes and second with only the 77 sending nodes. Network position using the structural equivalence approach was identified by extracting one principal component (PA1 in SPSS) from the matrix of network interactions. Principal component analysis was run once on the 77 sending nodes. Except for the appropriate node number settings and forced reciprocation between linked nodes, NEGOPY was set at default settings.

Factor scores for the structural equivalence analysis were created in the following fashion. Each message involved a sender (i) and a receiver (j). Not all users sent a message; neither did all users receive a message. And some who sent only one message sent it to one of the 35 who did not, so once the 35 were dropped, some other users became "nonsenders." The data of i-j links were processed through a routine that created a nonsymmetric valued matrix, which was converted into a symmetric binary matrix, whereby the i, j and j, i cells were each set to the sum of the i, j and j, i cells, then converted to a one. This matrix may be less than full order because of some of the artifactual "nonsenders." Therefore, principal components factor analysis (PA1 in SPSS) was used, as it does not invert the matrix and thus does not require a matrix of full order. The factor score for node (row value) i was produced by SPSS, based upon the principal components loading of sender (row) i multiplied by the standardized score of receiver (column) i. The factor score represents the extent to which the sender was a member of the primary position in the network.

When role membership and factor loadings were identified, each node was further classified into participants (group member, or loadings greater than or equal to zero) and nonparticipants (liaisons, dyads, tree nodes, isolates, or loadings less than zero). Each message was then allocated to three patterns of communication flow according to the sender's network role: among participants, among isolates, or between participants and isolates. Percentage of SE content for these patterns was determined by the average percentage of all the messages within that flow.

Mean differences in percentage of SE content across roles and patterns of information flow were tested for significance by the Duncan multiple range statistic in PROC GLM of the Statistical Analysis System (SAS).

Longitudinal Analysis

Longitudinal use of the system was measured by the sequential message number for each individual. That is, each person's messages were ordered, by time of transmission, into a sequential ranking, from 1 up to 55 for the person who sent 55 messages. This ordering was then correlated with the percentage SE for each message.

Results

Preliminary Results

The first NEGOPY run identified 55 isolates, 8 dyads, 4 tree nodes, and 4 liaisons, 36 member in Group 2 and 3 members in Group 1 (36 participants, 41 nonparticipants). Because the 3 members in Group 1 did not in fact reciprocate messages among each other, this result is an artifact of the need to force reciprocation (a procedure required in most cohesion-based network analysis programs). Therefore its members will be considered liaisons or nonparticipants. The second NEGOPY run identified 67 isolates, 2 dyads, 2 tree nodes, 27 liaisons, and 12 group members (12 participants, 65 nonparticipants). The factor scores ranged from 7.93 to

–.38, with a standard deviation of .93. The 14 users with factor scores above 0 were categorized as participants, and the other 63 as nonparticipants.

Reasons for this large number of isolates include the fact that several of the members indicated by their messages that they were new to the conference and were having some problems learning proper techniques. They tended to limit their communication to messages to the system managers asking for assistance (i.e., task-oriented content). Also, several more experienced members tended to communicate with the same members almost exclusively, indicating that they used the conference to reinforce existing networks rather than create new ones.

The content of the 2,347 sentences was categorized as follows: 28% of the content consisted of positive SE sentences, .4% consisted of negative SE sentences, and 71% consisted of task-oriented sentences. The primary SE content was "shows solidarity" (18%) and the next most frequent was "gives personal information" (8.4%); the primary negative SE content was "shows antagonism" (.2%); the primary task content was "gives nonpersonal information" (57%) and the next most frequent was "asks for nonpersonal information" (6.1%).

Table 2 shows how the content of the 2,347 sentences was distributed across the roles from the first NEGOPY analysis. These sentence-level data, and similar data from the other NEGOPY analysis, were then aggregated to the message level of analysis.

Table 3 displays how the average number of messages and the average percentage of socioemotional content of those messages were distributed across the roles from the two NEGOPY analyses and the principal components analysis. Obviously, group participants sent more messages than did other roles (9.2 compared to less than 1.5 for all other roles). This difference is significant only when nonsenders are not included in the network analysis; the average then is 13.4 for group members, 6.6 for liaisons, and slightly more than 1.0 for all other roles. The linear equations of the GLM procedure used to detect differences in group means were all significant at $p < .01$, however ($F[4, 72] = 4.1$, $F[4, 72] = 5.3$, $F[1, 75] = 46.9$, respectively). Similar distinctions hold for the average percentage of SE content. The structural equivalence analysis indicates far greater differences in the average number of messages sent: 17 for participants, 2.4 for nonparticipants. However, the difference in percentage of SE content is not significant. None of the three linear equations was significant ($F[4, 72] = .2$, $F[4, 72] = 1.1$, $F[1, 75] = 2.4$). Average component loadings are also shown to

TABLE 2
Content of Sentences by Network Roles, for NEGOPY Analysis Based on 112 Nodes

	Content of Sentences						
	Socioemotional			Task			Total
Roles	Number	% of Role	% of Total	Number	% of Role	% of Total	Total for Role
Isolates	74	35	3.2	138	65	5.9	212
Dyads	6	27	0.3	16	73	0.7	22
Tree nodes	10	28	0.4	26	72	1.1	36
Liaisons	11	27	0.5	30	73	1.3	41
Group 1	2	15	0.0	11	85	0.5	13
Group 2	569	28	24.2	1454	72	62.0	2023
Grand Total	672		28.6%	1675		71.4%	2347

TABLE 3
Relationships of Content, Number of Messages, and Structure for Cohesion and Structural Equivalence Analysis

Network Approach	Role	N	Mean Messages X = 5.0, SD = .92	Mean % SE Content X = .32, SD = .26	Mean Component Loadings X = .01, SD = .93
Cohesion					
NEGOPY, based upon senders and receivers	group	36	9.2	.31	
	liaison	6	2.0	.30	
	tree	3	2.0	.36	
	dyad	5	1.3	.25	
	isolate	27	1.0	.34	
NEGOPY, based upon senders only	group	12	13.4^{a}	$.30^{ab}$	.68
	liaison	27	6.6^{ab}	$.31^{ab}$	.05
	tree	2	1.0^{b}	$.48^{a}$	−.24
	dyad	2	1.0^{b}	$.00^{b}$	−.34
	isolate	34	1.3^{b}	$.34^{ab}$	−.27
Structural Equivalence					
Principal component, dichotomized, based upon senders only	participants	14	17.0^{a}	.22	
	nonparticipants	63	2.4^{b}	.34	

NOTE: N for all comparisons was 77 senders of messages. Superscripts show significant differences in group means, $p < .05$, according to Duncan Multiple Range test, from GLM procedure in Statistical Analysis System.

indicate how they correspond to role categorizations. The mean loadings are not significantly different, but the linear equation predicting equivalence loading from cohesion roles was significant at $p < .05$ ($F[4, 72] = 2.6$).

Results of Hypotheses

Results are based on the 77 users who *sent* messages, although results from the first NEGOPY analysis are influenced by the interrelationship of all 112 nodes. Descriptive values and correlations for content and message variables appear in Table 4.

Hypothesis 1. The correlation between number of messages and percentage of SE content was .75, $p < .001$. Removing those users who sent only one message, the correlation for total number of sentences with total number of messages was .66, $p < .001$. These correlations show support for Hypothesis 1.

Hypothesis 2. Correlations of the total number of SE sentences with number of messages and number of messages greater than one were .59 and .61, respectively, both significant beyond the .001 level. That is, the more one sends messages, the more one sends a larger number of SE sentences.

There is no relationship, however, between sending more messages and sending a greater *percentage* of SE content, for all users (tau = -.02). But when those users who sent only one message are not included, then the correlation is .20, $p < .05$. This indicates that, except for the most infrequent users, there is a slight tendency for users with a higher CMC response duration to communicate more SE content. There is specified support for Hypothesis 2.

Hypothesis 3. For all 77 users (388 messages), and for those 38 users who sent 2 or more messages (305 messages), the correlations between sequential ordering of message and the percentage of SE sentences were .01 and .00, respectively—neither, of course, significant. While the analysis of Hypothesis 2 showed that active users who send more messages send a greater number and a greater proportion of SE content, the proportion of SE content does not increase over time (as measured by the ordinal sequential message number). This result implies that users do not "warm up" to a CMC system to display their propensity toward sending SE messages, at least when using the simpler messaging capabilities, but rather display their communication style early on. Thus this analysis does not support Hypothesis 3.

TABLE 4
Correlations of Content Variables with Message Variables

Message Variables		*Content Variables* Number of SE Sentences	Total Sentences	Percentage SE
Number of Messages				
Mean	4.8	8.3	29.0	.31
SD	8.8	17.6	61.5	.25
N = 77 senders				
Kendall's tau		.59**	.75**	–.02
2 or More Messages				
Mean	9.1	15.7	56.2	.27
SD	11.5	23.6	82.0	.18
N = 38 senders				
Kendall's tau		.61**	.66**	.20*
Sequential Messages				
Mean	10.9			.33
SD	12.7			.32
N = 388 messages				
Kendall's tau		–	–	.01
2 or More Sequential Messages				
Mean	13.6			.33
SD	13.1			.32
N = 305 messages				
Kendall's tau		–	–	.00

*$p < .05$; **$p < .001$.

Hypothesis 4. Nearly 30% of the total message content was socioemotional. This is a generous amount in light of suggestions that CMC systems are low in "social presence" or could be seen as "information poor" media, especially considering the professional orientation of the conference members, and is in line with prior studies of SE content of CMC. Overall this analysis provides replication of the few other studies of CMC content, as stated in Hypothesis 4.

Hypothesis 5. Table 5 shows the distribution of percentage of SE content within and among participation roles. Remember that in Table 4 there were no significant differences in percentage of SE content by the first and third network analyses. Nor were the component loadings correlated with percentage of SE content (Spearman rho = –.13, $p < .24$). In general, network roles differed significantly only by amount of messages sent (for component loadings, Spearman rho = .71, $p < .001$). Here, the patterns of SE flow also do not show significant differences in the two cohesion analyses,

TABLE 5
Percentage of Socioemotional Messages Sent Within and Between Network Roles

(1) From NEGOPY, based on senders and receivers.[b]

	Participants	Nonparticipants	
Participants	.32/290[a]	.40/41	
Nonparticipants	.36/36	.27/21	N = 388

(2) From NEGOPY, based on senders.[b]

	Participants	Nonparticipants	
Participants	.36/109	.33/46	
Nonparticipants	.32/45	.31/156	N = 356

(3) From dichotomized principal component loading, based on senders.[c]

	Participants	Nonparticipants	
Participants	.33/139	.32/86	
Nonparticipants	.37/98	.22/33	N = 356

a. Cell values are (percentage of SE messages)/(number of messages).
b. No significant differences among percentage of SE messages.
c. Cells 2, 3, 4 significantly lower ($p < .05$) than cells 1, 2, 3 by Duncan Multiple Range Test.

but *do* show significantly lower percentage of SE content for messaging between nonparticipants in the structural equivalence analysis.

The cohesion approach (NEGOPY) and the structural equivalence approach (principal components) are not equivalent conceptualizations of network structure. Structural equivalence is based upon the presence and absence of interactions of all the network's nodes, while the cohesion approach uses only present links between nodes. In that sense, structural equivalence perhaps was better able to pick up the slight differences in patterns of content relations among participants and nonparticipants in the CMC network. Thus the use of two different approaches to network analysis indicated that the ability to detect differences in SE content among frequent and similar network members may depend upon the conceptualization of network structure in a CMC system.

Summary and Discussion

The present research supports some but not all of the hypotheses generated from prior literature and notions about content and structure in CMC systems, and suggests additional avenues of inquiry.

Increased frequency of messaging is associated with increased duration of messaging. That is, the highly reliable and correlated personality traits of response duration and response latency, insofar as they are indicated by length and frequency of messages, are reflected in users' CMC behavior.

There is a slight but significant tendency for more active users to send more SE content. While a CMC allows more communicative users also to be more socioemotional, users do not become more so over time. This may imply either that the simple messaging aspects of this particular system do not prevent users from displaying their particular styles right from the start, or that the sampling period is too short to identify possible developmental trends in message content.

Even a professionally oriented CMC system involving users who do not otherwise know each other can support a reasonable amount of socioemotional content; here, nearly 30% of the sentences sent were of this nature.

But communication among participants, and by group members, was not significantly more socioemotional. While the null hypothesis predicts no differences, and the hypothesis based upon a notion of generalized increased socioemotional orientation among group members predicts a positive relationship, there is an alternative rationale that would suggest relationships between content and structure. The theoretical basis of Rice's (1982) study of over 700 users of a nationwide CMC system for two years argued that users, in a sense, compete for information resources in this new nonmaterial social environment. Part of that process requires seeking out linkages early on, but quickly converting them into useful, continuing, and reciprocal linkages in order to survive in an information-based environment without depleting resources (time, energy, and computer accounts). Under that framework, the results of this analysis suggest that continuing users tend slightly to develop patterns of usage—both in amount and content—that are similar to the patterns and content of other continuing users. That is, for continuing users (those who sent more than one message), increased messaging was more socioemotional, and participants tended to exchange more SE content than did nonparticipants. But this relationship is only hinted at by the structural equivalence approach, and is not supported by the cohesion approach.

The wider implication of this possible interpretation is that CMC systems *can* support socioemotional communication and the communication reflects the inherent communication traits of the users, but that this may not be the appropriate focus if overemphasized or if others on the system see the network as a research community oriented to exchanging task-oriented information. Kerr and Hiltz (1982) and Hiltz (1983) make a similar argument, showing from large-scale surveys of their computer conferencing systems that researchers are not likely to use such a system if they have other, more important activities; if they do not feel that there are many people on the system they already know; if people on the system are of lower status; or if they have expectations of low eventual usage. In other words, benefits from using a CMC network can be rather self-fulfilling. As mentioned earlier, the impacts are heavily influenced by the norms, goals, and structure of the user community.

From a methodological perspective, combining the study of content and structure in the context of computer-monitored data from a CMC system offers opportunities as it presents challenges. (For other settings, analyses, and issues concerning computer-monitored data and network analysis, see Barnett & Rice, 1985; Danowski, 1982; Danowski & Edison-Swift, 1985; Ettema, 1985; Rice, 1982, in press; Rice & Barnett, 1986; Rice & Borgman, 1983; Sproull, 1986.)

While it is relatively easy to capture longitudinal data, questions of appropriate intervals for aggregation arise. There are at least three aspects of this longitudinal aggregation problem. First, how much of a time slice is sufficient? Without delving into the literature on time-series sampling, it is clear that some evidence must be collected to determine if equilibrium in the network has been achieved. The analysis by Rice (1982) showed that the overall structure of a large CMC network stabilized after a few months, while Rice and Barnett (1986) used the same data to show that there were multiple levels of network relationships, and not all of them stabilized. In this study, no information was available as to length of time the sampled persons had been using the system. This lack of temporal context makes network roles less valid, as members' roles may change over time. This is particularly a threat to the validity of nodes classified as isolates in this study. While a person may fulfill the definition of isolate for this six-week period of time, he or she may very well be classified in another role given a longer time period. However, six weeks is a sufficiently long period to expect an "active" group member to send more than one message, and the structural equivalence approach tends to embed the isolate in the wider network structure more than does the cohesion approach.

Second, if longitudinal network data are aggregated into intervals, what affect does this have on the meaning of *reciprocity*? We are so trained to consider reciprocity as an enduring mental representation from our respondents that we do not have good theories to guide us in establishing the criterion for reciprocity across time. Future research may attempt to consider this question in greater detail by smoothing reciprocity data across aggregated time periods, or using log-linear models that test assumptions of reciprocity (as in Rice, 1982).

And third, to what extent are messages sent at a later time influenced by messages sent early on? The research on real-time conversational sequencing may not be of great relevance for this question precisely because of attributes of CMC systems such as low social presence, asynchroneity, "mediated friendship," and the possibility that the target is unknown to the sender. However, future research might take advantage of a complete computer-monitored data set by analyzing the lagged effect of earlier patterns and content of messages on subsequent patterns and content.

Indeed, a conceptual question arises: Is a "network" of individuals on a CMC system the same theoretical entity as a "network" of individuals in the interpersonal sense? Much of the framework of network analysis assumes the relevance of path distances, weak ties, diffusion of information, two-step flows, and liaisons (Rice & Richards, 1985; Rogers & Kincaid, 1981). However, in a CMC system, any user can send a message directly to anyone else on the system. This ease of access does not imply reciprocity—people are also freer to choose *not* to respond—but precisely because communication is freed from the constraints of demographic and visual homophily, much of the research on the factors influencing network ties seems less relevant in an electronic environment. Thus the structural equivalence approach may be more appropriate for analyses of CMC system structure, as it does not assume the importance of direct paths between users. Future analyses of CMC networks should develop conceptual and empirical comparisons of these alternate approaches to network analysis.

With respect to the validity of CMC data, while even a complete set of computer-monitored, network data from a CMC system can be analyzed, these communication behaviors cannot constitute all the forms of communication among the system's users. It may well be that a national public computer bulletin board provides the most "controlled" situation—users may in fact not communicate in other ways—but rigorous analyses would include at least interviews with randomly selected members of high-communication groups as well as with isolates. It would be helpful to know whether communication levels on CMC systems are full substitutes or partial complements to traditional interpersonal and mediated communication.

These results suggest a rich source of study within public computer-based communication systems (as first suggested by Danowski, 1982). Efforts must be made to overcome problems associated with this type of data and communication environment. However, the effort is undoubtedly warranted when one considers the rapid growth of CMC systems and the role that public CMC systems will play as nationwide yet informal electronic organizations and communities.

Note

1. For descriptions of functions, markets, uses, and impacts of these computer-mediated communication systems, see Blankenhorn (1986), Burstyn (1983), Chesebro (1985), Glossbrenner (1983), Hiltz (1983), Hiltz and Turoff (1978), Kerr and Hiltz (1982), Link Resources (1985), Mosco (1982), Neustadt (1982), Panko (1984), Rice (1980a, 1980b), Rice and Associates (1984, chaps. 6, 8), Rice and Case (1983), Sandler (1983), Tydeman, Lipinski, Adler, Nyhan, and Zwimpfer (1982), Tydeman, Lipinski, and Spang (1980), Uhlig, Farber, and Bair (1979), Vallee (1984), and Vallee, Johansen, and Spangler (1975).

References

Bales, R. F. (1950). *Interaction process analysis: A method for the study of small groups.* Reading, MA: Addison-Wesley.

Barnett, G., & Rice, R. E. (1985). Longitudinal non-Euclidean networks: Applying Galileo. *Social Networks, 7*(4), 287-322.

Blankenhorn, D. (1986, July-August). Is computer conferencing finally beginning to mature? *Business Communications Review*, pp. 18-22.

Burstyn, H. (1983). Electronic mail: Evolving from intracompany to intercompany. In A. Smith (Ed.), *AFIPS conference proceedings: 1983 national computer conference* (Vol. 52, pp. 379-383). Arlington, VA: AFIPS Press.

Cathart, R., & Gumpert, G. (1983). Mediated interpersonal communication: Toward a new typology. *Quarterly Journal of Speech, 69,* 267-277.

Chesebro, J. (1985). Computer-mediated interpersonal communication. In B. Ruben (Ed.), *Information and behavior* (Vol. 1, pp. 202-224). New Brunswick, NJ: Transaction.

Danowski, J. (1982). Computer-mediated communication: A network-based content analysis using a CBBS conference. In M. Burgoon (Ed.), *Communication yearbook 6* (pp. 905-924). Newbury Park, CA: Sage.

Danowski, J., & Edison-Swift, P. (1985). Crisis effects on intraorganizational computer-based communication. *Communication Research, 12*(2), 251-270.

Edinger, J., & Patterson, M. (1983). Nonverbal involvement and social control. *Psychological Bulletin, 93*(1), 30-56.

Ettema, J. (1985). Explaining information system use with system-monitored vs. self-reported use measures. *Public Opinion Quarterly, 49,* 381-387.

Farace, R., Monge, P., & Russell, H. (1977). *Communicating and organizing.* Menlo Park, CA: Addison-Wesley.

Finn, T. A. (1986). Process and structure in computer-mediated group communication. In B. Ruben (Ed.), *Information and behavior* (Vol. 2). New Brunswick, NJ: Transaction.

Fowler, G., & Wackerbarth, M. (1980). Audio teleconferencing versus face-to-face conferencing: A synthesis of the literature. *Western Journal of Speech Communication, 44,* 236-252.

Freeman, L. (1980). Q-analysis and the structure of friendship networks. *International Journal of Man-Machine Studies, 12*(3), 367-378.

Freeman, L. (1984). The impact of computer-based communication on the social structure of an emerging scientific specialty. *Social Networks, 6,* 201-221.

Glossbrenner, A. (1983). *The complete handbook of personal computer communications.* New York: St. Martin's.

Hiemstra, G. (1982). Teleconferencing, concern for face, and organizational culture. In M. Burgoon (Ed.), *Communication yearbook 6* (pp. 874-904). Newbury Park, CA: Sage.

Hiltz, S. R. (1978a). Controlled experiments with computerized conferencing: Results of a pilot study. *Bulletin of the American Society for Information Science, 4*(5), 11-12.

Hiltz, S. R. (1978b). The computer conference. *Journal of Communication, 28*(3), 157-163.

Hiltz, S. R. (1981). *The impact of a computerized conferencing system on scientific research communities.* Newark: New Jersey Institute of Technology Computerized Conferencing and Communications Center.

Hiltz, S. R. (1983). *Online communities: A case study of the office of the future.* Norwood, NJ: Ablex.

Hiltz, S. R., Johnson, K., & Agle, G. (1978). *Replicating Bales problem-solving experiments on a computerized conference system* (Report 8). Newark: New Jersey Institute of Technology Computerized Conferencing and Communication Center.

Hiltz, S. R., & Turoff, M. (1978). *The network nation: Human communication via computer.* Reading, MA: Addison-Wesley.

Hiltz, S. R., & Turoff, M. (1981). The evolution of user behavior in a computerized conferencing system. *Communications of the ACM, 24*(11), 739-751.

Hiltz, S. R., Turoff, M., & Johnson, K. (1985). *Disinhibition, deindividuation and group process in computerized conferences: A controlled experiment comparing pen name and real name conferences in a large corporation.* Newark: New Jersey Institute of Technology Computerized Conferencing and Communications Center.

Johansen, R. (1977). Social evaluations of teleconferencing. *Telecommunications Policy, 1*(5), 395-419.

Johansen, R. (1984). *Teleconferencing and beyond: Communications in the office of the future.* New York: McGraw-Hill.

Johansen, R., & DeGrasse, R. (1979). Computer-based teleconferencing: Effects on working patterns. *Journal of Communication, 29*(3), 30-41.

Johnson-Lenz, P., Johnson-Lenz, T., & Scher, J. M. (1978). How groups can make decisions and solve problems through computerized conferencing. *Bulletin of the American Society for Information Science, 4*(5), 15-17.

Kerr, E., & Hiltz, S. R. (1982). *Computer-mediated communication systems.* New York: Academic Press.

Kiesler, S., Siegel, J., & McGuire, T. (1984). Social psychological aspects of computer-mediated communication. *American Psychologist, 39*(10), 1123-1134.

Kling, R. (1980). Social analyses of computing: Theoretical perspectives in recent empirical research. *Computing Surveys, 11*(1), 61-110.

Knoke, D., & Kuklinski, J. (1982). *Network analysis.* Newbury Park, CA: Sage.

Kochen, M. (1978). Long-term implications of electronic information exchanges for information science. *Bulletin of the American Society for Information Science, 4*(1), 22-23.

Koomen, W., & Sagel, P. (1977). The prediction of participation in two-person groups. *Sociometry, 40,* 369-373.

Link Resources. (1985). *Electronic messaging* (Continuous Information Services Report). New York: Author.

Meyers, D. (1985). *Home computer communication networks: A first look at BBS.* New Orleans: Loyola University, Department of Communications.

Mitchell, J. C. (1969). The concept and use of social networks. In J. C. Mitchell (Ed.), *Social networks in urban situations* (pp. 1-50). Manchester, England: Manchester University Press.

Mosco, V. (1982). *Pushbutton fantasies: Critical perspectives on videotex and information technology.* Norwood, NJ: Ablex.

Neustadt, R. (1982). *The birth of electronic publishing: Legal and economic issues in telephone, cable and over-the-air teletext and videotext.* White Plains, NY: Knowledge Industry.

Olson, M., & Lucas, H., Jr. (1982). The impact of office automation on the organization: Some implications for research and practice. *Communications of the ACM, 25*(11), 838-847.

O'Reilly, C., & Pondy, L. (1979). Organizational communication. In S. Kerr (Ed.), *Organizational behavior* (pp. 119-149). Columbus, OH: Grid.

Panko, R. (1984). Electronic mail. In K. Takle-Quinn (Ed.), *Advances in office automation* (Vol. 1). New York: John Wiley.

Phillips, A. (1982). Computer conferencing: Success or failure? *Systems, Objectives, Solutions, 2,* 203-218.

Pye, R., & Williams, E. (1977, June). Teleconferencing: Is video valuable or is audio adequate? *Telecommunications Policy,* pp. 230-241.

Rice, R. E. (1980a). Impacts of organizational and interpersonal computer-mediated communications. In M. Williams (Ed.), *Annual review of information science and technology* (Vol. 15, pp. 221-249). White Plains, NY: Knowledge Industry.

Rice, R. E. (1980b). Computer conferencing. In B. Dervin & M. Voigt (Eds.), *Progress in communication sciences* (Vol. 2, pp. 215-240). Norwood, NJ: Ablex.

Rice, R. E. (1982). Communication networking in computer conferencing systems: A longitudinal study of group roles and system structure. In M. Burgoon (Ed.), *Communication yearbook 6* (pp. 925-944). Newbury Park, CA: Sage.

Rice, R. E. (in press). Communication technology networks. In B. Dervin (Ed.), *Paradigm dialogues: Vol. 2. Exemplars.* Newbury Park, CA: Sage.

Rice, R. E., & Associates. (1984). *The new media: Communication, research, and technology.* Newbury Park, CA: Sage.

Rice, R. E., & Barnett, G. (1986). Group communication networks in electronic space: Applying metric multidimensional scaling. In M. McLaughlin (Ed.), *Communication yearbook 9* (pp. 315-326). Newbury Park, Ca: Sage.

Rice, R. E., & Borgman, C. (1983). The use of computer-monitored data in information science and communication research. *Journal of the American Society for Information Science, 34,* 247-256.

Rice, R. E., & Case, D. (1983). Computer-based messaging in the university: A description of use and utility. *Journal of Communication, 33*(1), 131-152.

Rice, R. E., & Richards, W., Jr. (1985). An overview of network analysis methods. In B. Dervin & M. Voigt (Eds.), *Progress in communication sciences* (Vol. 6, pp. 105-165). Norwood, NJ: Ablex.

Richards, W., Jr., & Rice, R. E. (1981). *NEGOPY network analysis program. Social Networks, 3*(3), 215-333.

Rogers, E. M., & Agarwala-Rogers, R. (1976). *Communication and organizations.* New York: Free Press.

Rogers, E. M., & Kincaid, D. L. (1981). *Communication networks: A new paradigm for research.* New York: Free Press.

Sandler, C. (1983). Electronic mail: The paperless revolution. *PC: The Independent Guide to IBM Personal Computers, 1*(9), 52-58.

Short, J., Williams, E., & Christie, B. (1976). *The social psychology of telecommunications.* New York: John Wiley.

Spelt, P. (1977). Evaluation of a continuing computer conference on simulation. *Behavioral Research Methods and Instrumentation, 9*(2), 87-91.

Sproull, L. (1986). Using electronic mail for data collection in organizational research. *Academy of Management Journal, 29*(1), 159-169.

Steinfield, C. (1986). The social dimensions of computer-mediated communications. In M. McLaughlin (Ed.), *Communication yearbook 9* (pp. 777-804). Newbury Park, CA: Sage.

Tapscott, D. (1982). *Office automation: A user-driven method.* New York: Plenum.

Turoff, M. (1978). The EIES experiment: Electronic information exchange system. *Bulletin of the American Society for Information Science, 4*(5), 9-11.

Tydeman, J., Lipinski, H., Adler, R., Nyhan, M., & Zwimpfer, L. (1982). *Teletext and videotext in the United States.* New York: McGraw-Hill.

Tydeman, J., Lipinski, H., & Spang, S. (1980). An interactive computer-based approach to aid group problem formulation. *Technological Forecasting and Social Change, 16,* 311-320.

Uhlig, R., Farber, D., & Bair, J. (1979). *The office of the future: Communications and computers.* New York: North-Holland.

Vallee, J. (1984). *Computer message systems.* New York: McGraw-Hill.

Vallee, J., Johansen, R., Randolph, R., & Hastings, A. (1978). *Group communication through computers* (Vols. 4, 5). Menlo Park, CA: Institute for the Future.

Vallee, J., Johansen, R., & Spangler, K. (1975). The computer conference: An altered state of communication. *Futurist 9*(6), 116-121.

Willard, D., & Strodtbeck, F. (1972). Latency of verbal response and participation in small groups. *Sociometry, 35*(1), 161-175.

Williams, E. (1978). Teleconferencing: Social and psychological factors. *Journal of Communication, 28,* 125-131.

Williams, F. Rice, R. E., & Dordick, H. (1985). Behavioral loci of the information society. In B. Ruben (Ed.), *Information and behavior* (Vol. 1, pp. 161-182). New Brunswick, NJ: Transaction.