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Usage and Outcomes of Electronic Messaging at an R&D Organization: Situational Constraints, Job Level, and Media Awareness

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SUMMARY

This paper is an individual-level analysis of the adoption and use of an electronic messaging system (EMS) by nearly 500 members of an R&D organization. It complements the network-level analysis reported by Eveland and Bikson in 1988 and the qualitative analysis reported by Markus in 1987. The present paper develops and tests hypotheses about relationships among job categories, perceived social presence of an electronic messaging system (a measure of media awareness), self-reported and computer-monitored use of the system, and outcomes such as changes in work effectiveness, communication flows, and use of extant media. The primary conditions associated with non-adoption of electronic mail were physical proximity of a respondent's contacts and the lack of accessibility to needed contacts through the system. Higher-level organizational members used the system more, and reported more improvements in outcomes, counter to predictions by information richness theory. Usage was weakly correlated with outcomes, but was generally more strongly correlated for those respondents who were more aware of the appropriateness of the EMS for a variety of communication activities. The paper ends by discussing the lessons learned about the adoption and outcomes of an EMS in this one organization, based on three studies with very different methods and perspectives.

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INTRODUCTION

Communication is a central process underlying much research on organizations, including studies of how organizational roles communicate information and authority [1], how flows of communication affect performance [2], and how communication structures help organizations respond to environmental demands [3]. To the extent that various media differentially affect these and other organizational processes, the influences on an individual's media choices, and the consequences of those choices, should be of significant concern.

The present research analyzes some reasons for the adoption and outcomes associated with a new organizational medium, an electronic messaging system (EMS) in an R&D organization. Because an EMS combines the capabilities of both computers and transmission networks, and so can reduce situational constraints inherent in more traditional organizational communication channels such as memos and telephones, they have characteristics with considerable implications for organizational communication [4–6].

This paper is an individual-level companion piece to two other studies of the EMS at the same organization. Eveland and Bikson's [7] network-level study analyzed the patterns of usage across departments, programs, and among a subsample of 100 users. They were concerned with electronic communication networks in the organization as part of their more general concern with how an EMS may support cooperative work and interactions among R&D personnel. Using the computer-monitored records of 800 computer account holders, their analyses showed that (a) a small proportion of users were responsible for most of the message traffic, (b) there were no significant differences in usage between departments, research programs, or job categories, (c) approximately 75% of the messages were sent across departmental boundaries but only 40% of messages were sent across program boundaries, and (d) the number of messages sent between individuals was highly correlated with the physical proximity of the individuals.

A qualitative study of the same organization [8] found that usage was generally rather low, due partially to the policy of charging an individual's budget directly for usage of the system while providing nearly all other communication media free of charge.

This paper provides a complementary perspective on EMS usage in this R&D organization. This individual-level quantitative study applies the related theories of social presence and information richness to the question of whether usage of an EMS is necessarily associated with specific outcomes, or whether the relationship is affected by how aware users are of the theoretical appropriateness of an EMS for different kinds of communication activities. It also contributes to the understanding of the reasons for use and non-use of the EMS in this organization.

THEORETICAL FOUNDATION: SOCIAL PRESENCE AND INFORMATION RICHNESS

Social presence theory and information richness theory are concerned with characteristics of media and information processing requirements of organizational

tasks. They may be integrated to help researchers understand potential effects of different media on communication content and task performance.

Social presence is the degree to which a communication medium conveys the actual physical presence of the participants communicating [9]. It is dependent upon particular communication contexts as well as perceived and intrinsic characteristics of the medium. Social presence has typically been measured by a set of semantic differential items measuring warmth, closeness, personalness, etc. [9, 10], or by a ranking of various media according to their appropriateness for a variety of typical organizational communication activities (see a review by Rice and Love [11]). Empirical results show a fairly consistent ordering of media along the social presence scale, with face-to-face communication ranked highest in social presence, video next, telephone next, and business memos the lowest.

Information richness is the extent to which media can bridge different frames of reference, make issues less ambiguous, or provide opportunities for learning in a given time interval [12]. There has been considerable theoretical elaboration of the conditions (such as organizational structure and hierarchical level) under which variations in information richness should affect organizational performance [12, 13].

There are few empirical analyses of information richness other than the work by Daft, Lengel, Trevino and colleagues, since Bodensteiner's initial research [14]. Trevino et al. [15] asked approximately 100 managers to choose one medium as best for each of 18 common workplace situations, and found that the choices were generally in accord with information richness theory. Electronic mail was chosen by the managers primarily only when there were situational constraints that an EMS could overcome, but not when the activity required symbolic or ambiguous communication. Markus [16], Fulk and Schmitz [17], and Zmud et al. [18] have all used different measures, although they have found generally comparable rankings of media. Zmud et al. ranked one-on-one communication highest in information richness, followed by telephone, group meeting, voice messaging, computer report, electronic mail, and handwritten note. Fulk and Schmitz's results ranked media accordingly: face-to-face, telephone, memo, electronic mail, document/report, and computer report.

Both social presence theory and information richness theory place text-based media such as business memos and EMS low on their respective scales because users cannot readily convey nonverbal regulatory and social context cues (such as facial expressions or style of dress), symbolic meaning, or real-time interactive discourse. Thus, theoretically an EMS is more appropriate for communication activities that require only low social presence or information richness (transmission communication activities such as exchanging information, asking questions, and asking for opinions). But theoretically an EMS is less appropriate for communication activities that require high social presence or information richness (socio-emotional communication activities such as getting to know someone, bargaining, and resolving disagreements) [19].

A variety of questions concerning EMS arise from this literature on media differences and outcomes. The remainder of the paper analyzes just four: (a) Are job category and situational constraints associated with usage of an EMS?; (b) Is usage associated with theoretically expected outcomes?; (c) Is job category associated with reported outcomes?; (d) Does awareness of the (theoretically proposed) appropriateness of EMS for various communication activities influence the associations between usage and outcomes?

HYPOTHESES

Job category and EMS usage

Information richness theory predicts that usage of an EMS is likely to be influenced by an individual's job category, because of the differing information-processing requirements of different tasks. Many studies have documented how information workers allocate their time to various channels (reviewed in [20]): managers spend most of their time communicating (75–80%), about 60% of which is oral (phone or face-to-face). Clerical workers spend less total time communicating, but a greater proportion of their communication involves written media such as letters. Higher-level organizational jobs involve more interpersonal communication, ambiguity, and equivocality, which require symbolic cues and development of shared meanings. Daft and Lengel [12, 13] explicitly propose that because higher-level managers have more equivocal tasks, they will be less likely to use information-lean media such as an EMS. However, Markus [16] found that higher-level managers in her sample of 500 managers used an EMS more than did lower-level managers. These findings tentatively suggest the following hypothesis:

H1: Lower-level organizational members will use an EMS more than will higher-level members.

Certainly, there are many other influences on the decision to adopt an EMS or not (as considered in the discussion section). Descriptive analyses will explore some of these through a general research question: What are some reasons why individuals do not use an EMS?

Potential communication outcomes of using an EMS

Prior research has proposed and found a wide range of potential outcomes attributable to the increased capabilities and reduced constraints of EMSs [4, 21–23]. We focus on only three of those categories of EMS outcomes that may be related to an individual's use of an EMS.

One possible category of communication outcomes is *substitution* effects: decreased use of media such as letters, memos and telephone. Such substitution for these media is likely because an EMS can overcome situational constraints (temporality, geography, accessibility) imposed by traditional media [5]. Practically, such a reduction could lead directly to reduced communication costs and indirectly

to reduced shadow costs associated with playing 'telephone tag,' setting up appointments, and preparing and distributing memos [20].

A second category of outcomes is *communication* effects: an EMS may increase and improve communication between and among organizational members, which may lead to an increased stock of ideas and exposure to research, of particular value in a R&D organization [2, 24]. An EMS may also facilitate communication that would not otherwise have occurred [25].

A third category of outcomes is *augmentation* effects: an EMS may augment an individual's information processing capabilities by improving (a) feedback and thus the rate of task completion, (b) the quality and rate of work by being able to consider fully a request before responding, or (c) concentration on one's task by being able to avoid interruptions such as internal telephone calls. Being able to communicate at the sender's convenience without constraining the receiver to store and retrieve messages through the computer instead of by paper files, and to keep in contact with developments even while away from one's desk, may contribute to improved work effectiveness. Some researchers have argued that a scarce organizational resource is managerial attention—the time and capacity to analyze and decide [26, 27]. That is, the extent to which information is usefully summarized, modified, routed or delayed is a measure of the value added to the original information [28].[1] Based on these findings, we propose the following hypotheses:

H2a: Usage of an EMS will be associated with reductions in the use of memos, letters, and the telephone.

H2b: Usage of an EMS will be associated with increases in communication flows and the ability to get a message to needed contacts.

H2c: Usage of an EMS will be associated with increases in the rate, quality and quantity of work.

Moderating influences on the association between usage and outcomes

We do not assume that these outcomes will necessarily follow from usage of an EMS. Based upon the prior discussions, we propose two moderating influences: job category and media awareness.

Job category. As discussed above, workers in different job categories typically use different media and have different information processing requirements, and thus are differentially likely to use an EMS. Once adopted, however, an EMS still must match those requirements in order for the user to perceive the outcomes noted above. Clerical workers should be more likely to perceive changes in work media use, communication, or effectiveness because an EMS is more likely to support their activities. We therefore propose the following hypothesis:

H3: Lower-level organizational members will report more changes associated with use of an EMS than will higher-level members.

Media awareness. Applying information richness theory, Daft et al. [30] proposed that individuals who are more aware of the suitability of various media for

various communication activities should display better job performance. Based upon a sample of 30 managers, they concluded that "high performing managers are more sensitive to the relationship between message ambiguity and media richness" [30, p. 355]. Their measure of job performance was a single, unoperationalized four-point scale provided by that particular organization, dichotomized into high and low values. Performance, especially when measured independently from the user's perceptions, is an important outcome. However, the three categories of outcomes described above can be seen as a few of the many aspects of one's work that contribute to the multi-dimensional construct of 'performance'. The rate, quality, quantity of work performed, the ability to communicate with needed others, and the reduction of time and costs associated with traditional organizational media, either are just some of the direct criteria or are aspects of work that contribute to the direct criteria, by which employees' performance may be evaluated, by themselves, co-workers, supervisors, customers, and others. Thus the present research expands the applicability of information richness and social presence theory, by considering some potential components of improved task performance rather than only the one unoperationalized and organization-specific measure of job performance used by Daft et al. [30].

However, the main argument remains: individuals who are more media aware are more likely to choose the medium that best matches the information-processing requirements of their tasks. Therefore we propose the following hypothesis:

H4: Individuals who are more 'media aware' are more likely to perceive more changes associated with EMS usage.

This general hypothesis leads to two specific subhypotheses:

H4a: The relationship between usage and outcomes will be stronger for respondents who rate an EMS as *more* appropriate for tasks with *low* requirements for social presence (i.e. transmission communication activities).

H4b: The relationship between usage and outcomes will be stronger for respondents who rate an EMS as *less* appropriate for tasks with *high* requirements for social presence (i.e. socio-emotional communication activities).

DATA AND METHOD

Sample and data collection

The R&D organization of approximately 900 employees was in many ways a matrixed organization, because externally funded research programs frequently crossed departmental boundaries. The organization developed a UNIX-based electronic mail system in 1983. The design philosophy called for a system that supported work groups and the existing cross-departmental organizational structures. Users could enter the name of an employee as the address for a message; hardcopies would be printed off and delivered if the intended recipient did not have a system account; and the system provided gateways to national and international computer networks (see [7] and [8] for more details).

All 780 holders of computer accounts at this R&D organization, which had been using the EMS for less than four years, received a questionnaire through interdepartmental mail which they completed and returned to the researchers in a sealed envelope. Of these, 508 returned usable responses, for a response rate of about 65%.[2]

Measures

The measures of media awareness (ratings of EMS appropriateness), EMS outcomes, and self-reported usage on the questionnaire, as well as other measures not reported here, replicated those by Kerr and Hiltz [4], Rice and Case [19], Ruchinskas [31], Svenning [32] and Steinfield [10]. Table 1 provides descriptions of the items. The questionnaire also asked respondents to indicate which reasons for not using the EMS applied to them.

Job position. Respondents indicated whether they belonged to one of 54 job descriptions. Following Eveland and Bikson [7], these responses were coded as belonging to one of three broad job categories, ranked in order of organizational level. Each had the following numbers of self-reported EMS users and non-users: managers (29, 8), researchers and technicians (146, 106), administrators and clerical workers (87, 74), and unidentified (38 combined).

Media awareness. Media awareness was measured by an item that read: "For each task listed below, indicate your current assessment of the appropriateness of electronic mail given other alternatives (such as meetings, phone calls, memos, etc.)", using 1 = appropriate and 2 = inappropriate. The task included (a) transmission activities labeled *exchanging information*, *asking questions*, and *exchanging opinions*, which were used by Short et al. [9] to indicate communication activities requiring less social presence, and (b) socio-emotional activities labeled *bargaining*, *getting to know someone*, and *resolving disagreements*, which indicated communication activities requiring more social presence.

A principal components analysis, with varimax rotation, of these responses (see Table 2) confirmed that these were two separate dimensions. To create two summary scales, responses were recoded so that inappropriate = -0.5 and appropriate = +0.5 to represent the directional orientation of each dimension, and the mean of each set of three items was computed (appropriateness for transmission communication activities $M = 0.30$, S.D. = 0.31, appropriateness for socio-emotional communication activities $M = 0.37$, S.D. = 0.25). Thus high 'media awareness' is indicated by a high value for the first scale, and a low value for the second scale. There were no significant differences in the means of these two scales by job category ($F(3,453) = 0.34$, 1.96, respectively).

EMS usage. The questionnaire also asked respondents to indicate the number of minutes per day they spent using the EMS. Those respondents who reported using electronic mail for at least one minute per day were categorized as *self-reported users* ($N = 291$).

The system's host computer also monitored individual account usage continuously, including the number of days since the account was first used, the number of

TABLE 1. Descriptive statistics for computer-monitored users ($N = 291$)

Appropriateness of EMS for . . .	*% Responding "Appropriate"*	
Transmission communication activities:		
Exchanging information	92	
Asking questions	87	
Exchanging opinions	76	
Socio-emotional communication activities:		
Resolving disagreements	14	
Bargaining	16	
Getting to know someone	12	
Outcomes	*M*	S.D.
Augmentation factor items (Change in):		
Number of contacts initiated by others	3.2*	0.6
Number of contacts initiated by you	3.5*	0.7
Rate of work	3.6*	0.8
Communicating with other depts, programs	3.2*	0.6
Ability to get a message to someone	3.9*	1.0
Quality of work	3.3*	0.7
Quantity of work	3.3*	0.7
Substitution factor items (Change in):		
Number of memos, letters you send	2.3*	1.0
Number of phone calls you make	2.1*	0.7
Amount of other paper you produce	2.5*	0.8
Usage of EMS	*M*	S.D.
Self-report:		
Minutes per day	21.1	38.5
Computer-monitored:		
Days since first use	455.8	127.0
First period messages sent	6.7	29.9
First period messages received	4.4	10.6
Second period messages sent	7.8	30.9
Second period messages received	6.4	13.1
Third period messages sent	7.7	24.3
Third period messages received	6.0	12.8
Fourth period messages sent	6.7	21.5
Fourth period messages received	6.0	14.6
Fifth period messages sent	8.3	24.3
Fifth period messages received	6.4	15.5
Total messages sent	143.8	350.8
Total messages received	114.0	207.1
Messages sent per day since first use	0.36	0.76
Messages received per day since first use	0.28	0.53

*Outside two-tailed confidence interval around 3.0 (no change), $p < 0.01$.

TABLE 2. Principal components analysis of media awareness and outcome items

Items	*Factors and loadings*	
Appropriateness of EMS	*Transmission*	*Socio-emotional*
Transmission communication activities:		
Exchanging information	0.80	0.05
Asking questions	0.82	0.06
Exchanging opinions	0.76	0.14
Socio-emotional communication activities:		
Resolving disagreements	0.10	0.76
Bargaining	0.14	0.72
Getting to know someone	0.01	0.69
Variance explained	32%	27%
Outcomes	*Augmentation*	*Substitution*
Augmentation factor items (Change in):		
Number of contacts initiated by others	0.74	-0.15
Number of contacts initiated by you	0.70	-0.23
Rate of work	0.66	-0.26
Communicating with other depts., programs	0.60	0.04
Ability to get a message to someone	0.60	-0.28
Quality of work	0.59	-0.17
Quantity of work	0.55	0.26
Substitution factor items (Change in):		
Number of memos, letters you send	0.02	0.80
Number of calls you make	-0.28	0.71
Amount of other paper you produce	-0.13	0.68
Variance explained	29%	19%

messages sent and received in each of five four-week periods, and the total number of messages ever sent and received. The present data were retrieved from the archive tapes for five periods from April 1983 to July 1984, and were then merged with the questionnaire data.[3] The fifth period of usage occurred several months before the administration of the questionnaire. After merging the questionnaire data with the computer-monitored records, there were 488 usable cases. Those respondents who sent at least one message in any of the five periods were categorized as computer-monitored users (also $N = 291$, but not necessarily the same individuals as the 291 self-described users[4]). Variables measuring the number of messages sent and the number of messages received per day since first using the system were also computed. Because all the computer-monitored usage measures were highly skewed (as is typical; see [34, Chapter 6]), they were transformed into ordinal values and then into a normal distribution. Table 1 provides the raw values of these measures, but the analyses use the transformed values.

About 17% of the sample sent messages in any two consecutive monthly periods, and about 15% of those who sent a message in period 1 also sent a message in period 5 a year later. 24% of those who ever sent at least one message also sent at least one in period 5. However, from 15% to 22% who sent messages in a particular time period did not send one in either the prior or subsequent period, and 42% sent a message in earlier time periods but not in period 5. 8% of the sample sent messages in one period, not in the subsequent period, but then again in some following period; 19% sent messages in one period but then never again; and 14% sent messages in one period and in all subsequent periods. Correlations between the number of messages sent in period 1 and period 3 was 0.57, between period 3 and period 5 was 0.43, and between period 1 and period 5 was 0.36 ($p<0.001$). These patterns present a picture of a small group of enduring users, and of a larger group with varying usage patterns.

Outcomes associated with EMS usage. Respondents were asked to assess the extent to which the EMS had an impact on ten general areas of their work and communication performance. The items included number of contacts initiated by others, number of contacts initiated by the respondent, rate of work, communication with other departments and programs, ability to get a message to someone, quality of work, quantity of work, number of memos and letters sent, number of calls made, and the amount of other paper produced. Each item was rated on a five-point scale where 1 = significantly reduced, 3 = no change, and 5 = significantly increased. Table 2 shows that principal components analysis, with varimax rotation, of these responses identified two dimensions, labeled "augmentation" and "substitution". Individual factor scores for these two dimensions were computed using the regression method.

RESULTS

Usage of electronic messaging

Table 1 shows that there were 291 self-reported or computer-monitored users.[4] Why did nearly 40% of the sample never use the EMS? The questionnaire included six items concerning possible reasons for non-use. The primary reason for non-users was that the people with whom they had to communicate were already close physically (54.4% "always significant", 22.1% "somewhat significant", with the other choice "not significant"). The second most frequent reason was that the people respondents had to communicate with did not use the system (44.3%, 20.7%). Note that both of these primary reasons strike at the heart of the utility of an EMS. An EMS makes it easier for individuals not close to each other to communicate [5], and the value of an EMS is related to the extent to which a 'critical mass' of other users also utilizes the system [35, 36]. Other reasons, such as lack of training, a perception that electronic messaging is too impersonal (that is, low in social presence or information richness), and inadequate funds to pay for use of the system [8], were 'always' significant reasons for only about 20% of the respondents.

Finally, *t*-tests showed that users were more likely to perceive EMS as appropriate for the three information transmission activities (85%) than were non-users (77%) ($p<0.05$), but that users and non-users were not significantly different in their perception of the appropriateness of the EMS for socio-emotional activities.

The 291 users reported spending an average of about 20 minutes per day using the electronic messaging system. There were no statistically significant differences by job category for self-reported use of the EMS, although managers reported slightly higher usage (27.2 minutes per day) than the research/technical staff (24.2) and both reported almost twice as much usage as did the clerical/administrative staff (14.6).

Tests of differences in means of the computer-monitored usage measures showed consistently higher usage of the EMS by managers for both total messages sent (managers = 378.3, researchers/technicians = 73.0, clerical/administrators = 69.7, $F(3,280)=17.7$, $p<0.001$) and total messages received (296.8, 73.4, 58.4, respectively, $F(3,280)=29.2$, $p<0.0001$). Comparisons for messages sent per day since first using the system were similarly statistically significant at $p<0.0001$ (sent = 1.11, 0.22, 0.22; received = 0.85, 0.23, 0.18, respectively).

Thus, contrary to **H1**, and in agreement with Markus' [16] results, self-reported usage data provide directional evidence, and computer-monitored usage data provide directional and statistical evidence, that managers in this organization use the EMS more.

Outcomes from using the EMS

Usage and outcomes. Table 1 shows that the mean for each of the 10 outcome items is significantly different from the value of 3.0 ("no change") in the predicted directions, except for changes in the number of phone calls made. Thus the respondents felt that usage of the EMS lead to improvements in 9 of the 10 outcomes. The number of computer-monitored messages sent was weakly correlated with the augmentation factor ($r=0.15$, $p<0.01$), and with the substitution factor ($r=-0.20$, $p<0.001$). For self-reported usage, the correlations were 0.31 and -0.25 ($p<0.001$), respectively. These results provide weak but statistically significant support for hypotheses **H2a**, **H2b** and **H2c**, that usage is associated with perceived increases in media substitution, work effectiveness, and communication flows.

Differences in reported outcomes among job categories. Managers reported the most changes in the activities loading on the augmentation factor ($M=0.54$), followed by researchers/technicians ($M=0.16$), and clerks/administrators ($M=-0.15$) ($F(3,280)=5.22$, $p<0.01$). There were no statistically significant differences in the means of the substitution factor score across job categories. As with **H1**, these results are in the opposite direction from that predicted by **H3**, that lower-level individuals would report more changes in these task components.

Relating media awareness, job category, and usage to outcomes. First, a separate multiple regression was conducted for each of the two orthogonal outcome factors (augmentation and substitution). Then, to test the hypotheses that media awareness—perceived low or high appropriateness of EMS—would mitigate these

relationships (**H4a, H4b**), the two regressions were run separately for each of the two subsamples with higher than average and lower than average scores on the two media awareness scales.[5] This procedure provides, then, four regression results for each of the two dependent outcome variables. The two measures of computer-monitored usage (number of messages sent and received) were taken from the fifth aggregated usage period, the one closest to administration of the questionnaire. Table 3 presents the results. The alphabetic label for the following four sections correspond to the similarly labeled columns in the table.

TABLE 3. Regression of outcome scores on normalized computer-monitored messages sent and messages received, self-reported minutes per day using EMS, and dummy-coded job categories, by high/low splits of media awareness scales

	Dependent variables, by high/low splits on media awareness							
	H4a: Transmission				H4b: Socio-emotional			
	D: Less		C: More		A: More		B: Less	
Independent variables	*Media aware*		*Media aware*		*Media aware*		*Media aware*	
	Augm.	Subst.	Augm.	Subst.	Augm.	Subst.	Augm.	Subst.
Computer-monitored:								
EMS msgs sent	-0.10	0.20	-0.05	-0.10	-0.04	0.02	0.10	-0.37
EMS msgs received	0.07	-0.24	0.18	0.11	0.04	-0.12	0.56[a]	0.37
Self-reported:								
Minutes/day	0.67[b]	0.13	0.29[b]	-0.31[b]	0.48[b]	-0.31[b]	0.07	-0.35
Job category:								
Manager	-0.38[a]	-0.13	-0.02	0.02	0.03	0.00	-0.43	0.01
Clerical/admin	-0.15	0.16	-0.06	0.10	-0.07	0.31[b]	-0.01	-0.29
Adjusted R^2	0.34[c]	0.00	0.08[a]	0.07	0.22[b]	0.22[b]	0.14	0.04
F-ratio	3.9	0.4	2.3	2.2	5.0	5.0	2.1	1.2
N	28	28	77	77	73	73	32	32

[a] $p<0.05$; [b] $p<0.01$; [c] $p<0.001$; values are standardized beta coefficients. Augm., augmentation factor score: high value means increased rate, quality, quantity of work, communication with others and ability to reach someone. Subst., substitution factor score: high value means increased use of memos, letters, phone calls, paper.

Results based on media awareness about the appropriateness of an EMS for socio-emotional communication activities

A. Results for more 'media aware' respondents. The equation predicting increases in *augmentation* was statistically significant. The only statistically significant independent variable was self-reported usage of the EMS. The equation predicting

decreases in *substitution* was statistically significant. Statistically significant independent variables were self-reported usage of the EMS and not having a clerical/administrative job.[6]

B. Results for less media aware respondents. The equation predicting increases in augmentation was not statistically significant, but the independent variable of computer-monitored number of messages received was. The equation predicting decreases in substitution outcomes was not statistically significant, nor were any independent variables.

Thus all four of the overall equations were as predicted, providing support for **H4b**.

Results based on media awareness about the appropriateness of an EMS for transmission communication activities

The story for transmission communication activities is not as clear-cut.[7]

C. Results for more media aware respondents. The equation predicting increases in augmentation was statistically significant, with self-reported usage the sole statistically significant independent variable. The equation predicting decreases in substitution was not statistically significant, but the independent variable of self-reported use was.

D. Results for less media aware respondents. The equation predicting increases in augmentation was statistically significant. Self-reported EMS usage, and not having a managerial job, were statistically significant independent variables. The equation predicting decreases in substitution was not statistically significant.

Thus only two of the four overall equations were as predicted, providing mixed support for **H4a**.

DISCUSSION

Summary of the results

Nearly half of the respondents from this R&D organization never used the EMS. The two primary reasons indicated were that the necessary communication contacts either were already close by, or were not on the system. Further, individuals did not necessarily use the system continuously over time, except for a small group of frequent users. And managers used it more than did lower-level employees, contrary to **H1**.

The mean levels of changes in reported outcomes—reductions in use of substitutable media, increases in communication flows, and increases in quality, rate and quantity of work—were greater than the null hypothesis level of "no change" (except for reductions in telephone calls) (providing support for **H2a**, **H2b**, **H2c**). The association of EMS use with reported outcomes was statistically significant, supporting **H2a**, **H2b** and **H2c**, though the relationships were quite weak. Managers were more likely to report these changes, contrary to **H3** predicted by information richness theory.

Finally, for respondents who were more media aware about the theoretically proposed (in)appropriateness of an EMS for various communication activities, in all four regression equations predicting outcomes, self-reported usage had a statistically significant beta coefficient in the correct direction, and three of the four equations were statistically significant overall (supporting **H4b**). For respondents who were less media aware, in three of the equations neither usage nor the overall equation was statistically significant (supporting **H4a**). In the fourth, the equation relating usage to increased augmentation was statistically significant (not supporting **H4a**).

Limitations of the present research and challenges for future research

Stepping aside from the tests of predictions made by social presence and information richness theory, it is clear that the independent variables did not generally explain much variance in the reported outcomes of EMS usage. If most of the variance in EMS usage and in individual perception of EMS outcomes is not coming from the specified variables, where is it coming from? At least two possible avenues for future research exist.

One possibility is that respondents are not able to assess outcomes retroactively or subjectively with sufficient reliability, so that reported outcomes are contaminated by differential memory factors. This interpretation is implied by studies that show people have considerable difficulty in accurately recalling a wide variety of everyday as well as special events and communication activities [37]. Dealing with this problem calls for much more sophisticated over-time objective monitoring of organizational communication and performance than we were capable of providing in this study. While the use by Daft and colleagues of a single-item performance rating is a step in the right direction, future research should use a variety of measures. These measures should include a continuum of measures from self-report measures of augmentation and substitution effects up through multiple, explicitly operationalized indicators of overall performance.

The analyses also showed considerable discrepancies between the self-reported usage measure of minutes per day, and the computer-monitored usage measures of messages sent and received. As Williams et al. [34, Chapter 6] and Rice and Shook [38] discuss, these and other typical discrepancies between self-report and computer-monitored usage data should encourage researchers to collect both kinds of data. However, we must consider the possibility, intimated by the lack of significant effect of the computer-monitored variables, that when we do use more reliable and valid measures, we may find less evidence of the generalized outcomes associated with use of EMS than the literature to date implies [5]. Perceptions of outcomes may not be so much inaccurate assessments of real changes, as they are largely attitudinal responses artifactually correlated with self-reports of EMS usage. This is an alternative hypothesis that of course cannot be rejected by this study (or by many other EMS studies), due to the cross-sectional, correlational nature of the research design. However, the use of longitudinal, unobtrusive computer-monitored usage data in

this study allows us the preliminary investigation of the question, rather than the limited speculations allowed by cross-sectional self-report data.

The second alternative source of outcome variance in this study, of course, lies in other, unmeasured variables specified by a variety of theories of organizational communication and media use. To this end, future research should also include measures such as accessibility of the EMS [24, 38, 39], the individual's participation in organizational networks [7, 36, 40], social information processes that establish norms and evaluations of the benefits of using new organizational media [41–43], the critical mass of users [10, 24, 35, 42], supervisory support for adoption [44], task requirements [45], implementation policies [8, 46], and organizational norms and expectations about information seeking and sharing [47, 48].

Integrating the results of the three studies

This final section provides a few propositions, with supporting discussions, about adoption and outcomes of an EMS, based on an integration of the three studies of this R&D organization.

Implementation policies and situational constraints affect adoption of an EMS

The fact that over half of the non-users claimed physical proximity as a reason for not using the EMS appears to be at odds with the positive correlation that Eveland and Bikson [7] found between usage and physical closeness for their 100 users. It seems that if individuals are co-located, the constraints on communication are already low enough that EMS does not necessarily provide a considerable advantage. Once people *do* adopt an EMS, however, it can facilitate communication and task accomplishment among those in different departments but working on the same projects, by overcoming a variety of constraints on communication [5, 10].

However, the perceived value of the system will be low if (a) the people with whom one needs to communicate are not accessible through the system or (b) the access and usage costs are high relative to traditional media [8, 35, 36, 38]. Eveland and Bikson [7] found that users did not primarily use the EMS to communicate *across* project boundaries or *within* departmental boundaries. These patterns of usage are likely due to two characteristics of this R&D organization: (a) it is necessary to coordinate tasks with fellow project members, so (b) in a project-oriented, matrixed R&D organization, departmental boundaries represent constraints to project communication that an EMS can help overcome.

Markus [8] showed that a respondent's decision not to adopt the system was often a reasonable cost-benefit evaluation, as mirrored by the open-ended question responses in this study. After all, personnel did not have to pay for copying machines, telephones, and mail in order to conduct their business. However, terminals, connect time, printouts and computer storage were charged directly to the users, who could see the exact amount presented on their screens at the end of a session. As Markus [8, p. 60] concluded, "Individuals appear to have considerable discretion about whether and how much to use office communication systems

because few firms require their employees to use these systems and because employees typically have many convenient and low-cost (to them) alternatives for accomplishing the same means."

Information richness and social presence theories help explain relationships of usage, media awareness and outcomes, but not levels of managerial usage of an EMS

Markus [8, p. 57] concluded that one of the reasons (in addition to the chargeback policies noted above) why so many personnel at this organization did not adopt the EMS was that individuals tended not to consider "the suitability of the medium to the purpose of the message or the characteristics of the work task and environment." Indeed, social presence and information richness theory have served moderately well in helping to predict the contingent effects of this media awareness, predicting six of the overall regression equation results and seven of the beta coefficients for EMS usage. It seems that being less media aware about the appropriateness of an EMS for socio-emotional communication activities matters, because an EMS does *not* provide much information richness or social presence. However, being less media aware about EMS for transmission communication activities does not matter as much, because in fact an EMS *can be* helpful for these activities whether one thinks so or not.

An EMS may well support some managerial work, and increase clerical work, in spite of propositions about the inappropriateness of this medium for the information-processing requirements of upper-level personnel and its appropriateness for clerical tasks

The theories have served less well in explaining relationships between job category and EMS usage.

For clerical/administrative respondents who were more media aware about the appropriateness of an EMS for socio-emotional communication activities, use of the EMS was associated with less reduction in the use of paper, memos and phone calls (see note 6). It is possible that individuals in other job categories can more easily use an EMS to substitute for the use of paper or phone calls because they use those channels primarily as a means to communicate a message. Clerical and administrative workers, however, must continue to use textual media as part of the product and record of their work.

Part of the influence on augmentation outcomes in the condition of being less media aware about the appropriateness of an EMS for transmission activities is due to job category. Managers rate EMS equally as appropriate on both media awareness scales as do respondents in the other job categories, use the EMS more than do the respondents in the other categories, and report greater improvements in augmentation and substitution. However, when they *do* perceive EMS as inappropriate for tasks for which EMS is theorized to be appropriate—that is, they are less media aware about the EMS—they report smaller increases in augmentation outcomes. This effect may exist only for managers because they are presumably

better able to perceive consequences of organizational activities on outcomes that may affect performance, compared to lower-level employees [30].

The first reason is that, as noted earlier, EMS can be used in situations of high social presence to *prevent* social cues from being transmitted. Precisely because of the filtering of social cues, an EMS may lead to deregulated communication, such as more self-absorbed communication, communication undifferentiated by organizational status, less conformity, and new kinds of information [25]. But an EMS does not filter out all such cues. Some studies have shown that a fair amount of communication supposedly involving social presence or information richness, such as discussing personal matters and displaying humor, may in fact be contained in EMS messages [11]. Thus, higher-level managers may wish to avoid biasing some organizational interactions with their higher positional status, by sending EMS messages instead of making personal visits [25].

The second and more likely reason is that the frequent constraints to communication inherent in traditional organizational media (such as organizing meetings, playing telephone tag, or retrieving and deciphering memos) are more costly to managers than to others, so higher-level users may well turn to an EMS to reduce some of these situational constraints.

Summary conclusion from the three studies

Overall, the results from this individual-level analysis of EMS usage, along with the network study [7] and the qualitative study [8] of the same R&D organization, support two general conclusions. The first is that adoption of an EMS by all organizational members cannot be guaranteed, but both are results of rational decisions. Both usage and non-usage of the EMS can be explained on the grounds of respondents' assessments of the utility of the system, which is affected by organizational implementation policies and task demands. The second is that outcomes associated with EMS usage are not technologically determined. They are moderated by situational constraints, job category, and users' awareness of the match between the capabilities of an EMS and theoretically proposed information-processing requirements of a variety of communication activities.

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NOTES

[1] However, such increased quantity and rate of information may also lead to task overload, and much information is not meaningful, useful or used [29].

[2] About 60% of the non-respondents indicated that they thought the questionnaire was too personal or that they were too busy; about 40% were never accessible due to travel.

[3] Rice and Borgman [33] discuss the types of computer-monitored data, advantages and disadvantages of such data, and prior studies using such data. The present data represent five four-week samples from the first 18 months of usage (June 1983, September 1983, January 1984, April 1984 and July 1984) on the two host machines where electronic messaging had not previously been offered. That is, users were familiar with computers, but did not have prior experience at the R&D firm with electronic messaging [7]. The usage data were collected by the computer, and processed into usable form by J.D. Eveland and a programmer at the organization. Usage accounts and questionnaire IDs were blind-randomized before merging, to protect the confidentiality of the respondents.

[4] The 291 self-reported users (those who reported using EMS for at least one minute on an average day) are *not* necessarily the same as the 291 computer-monitored users (those who sent at least one message). Indeed, of the 439 respondents for which there were self-report and computer-monitored usage data, 84 (19%) had zero usage for both variables, 71 (16%) sent at least one message but did not report any minutes of usage, 64 (15%) reported using the EMS for at least one minute per day but sent no messages, and 220 (50%) had both self-reported and computer-monitored usage. There are at least three explanations for these discrepancies: (a) some respondents who may have sent small or irregular numbers of messages perhaps as much as a year ago may not have responded that they were using the EMS at any level per day, even if they remember sending those messages (and of course they would be likely to forget such occasional usage), (b) the discrepancy may reflect the use of the EMS to receive messages (146 [33% of all respondents] of the respondents received messages but did not send any messages), and (c) some self-reported adopters may be representing themselves as more socially acceptable than they are.

The essential difference between self-report and computer-monitored measures of system use for our study is that the former are collected at the same time as the outcome measures, whereas the latter are collected unobtrusively and longitudinally. Thus we can (a) make causal claims from the computer-monitored data but not from the self-report data and (b) reject common-method bias or a halo effect as alternate explanations for any associations involving the computer-monitored data.

[5] There are other procedures for testing such differences in relationships, such as using interaction terms or partial correlations. We felt that dichotomizing the media awareness variable at the median was the most straightforward and conservative approach.

[6] The means of two of the three "substitution" items were statistically lower than "no effect", indicating a reduction in use of paper media, so a positive beta coefficient implies *less substitution* effect with greater usage of EMS by clerical/administrative personnel, not necessarily an *increase* in use of paper media.

[7] It was pointed out to the authors that allowing the principal components analysis to generate the two factor scores (augmentation and substitution), instead of using a mean score of the three sets of conceptually related outcome items, may have clouded the relationships. So we created three mean scores: (a) media reduction (change in phone, memo, paper use), (b) communication (contacts initiated, out-of-workunit communication, ability to get message to a contact), and (c) work (rate, quality and quantity of work). The overall multiple regression equations for all six high media aware conditions were statistically significant, with self-reported usage of the EMS a statistically significant independent variable in all six. The overall equations for five of the six low media aware conditions were not statistically significant. Only the work equation in the low media aware condition was statistically significant,

with self-reported EMS usage and not having a managerial job the significant independent variables. Thus, 11 of the 12 equations were as predicted. However, the mean scales had low alpha reliabilities (0.57–0.66) and the dependent variables were no longer orthogonal ($r = -0.25$ to 0.54). Thus, separating out the conceptually related outcome items provides more persuasive but less rigorous and consistent results. Details of this analysis are available from the senior author.

REFERENCES

1 H. Mintzberg, *The Nature of Managerial Work*. Harper and Row, New York, 1973.
2 T. Allen, *Managing the Flow of Technology*, MIT Press, Cambridge, MA, 1977.
3 J. Galbraith, *Organization Design*. Addison-Wesley, Reading, MA, 1977.
4 E.B. Kerr and S.R. Hiltz, *Computer Mediated Communication Systems*. Academic Press, New York, 1982.
5 R.E. Rice, Computer-mediated communication and organizational innovation. *Journal of Communication, 37*(4) (1987) 65–94.
6 R.E. Rice, Mediated group communication. In: R.E. Rice and Associates (Eds.), *The New Media: Communication, Research and Technology*. Sage, Beverly Hills, CA, 1984.
7 J.D. Eveland and T.E. Bikson, Evolving electronic communication networks: an empirical assessment. *Office: Technology and People, 3* (1988) 103–128.
8 M.L. Markus, Chargeback as an implementation tactic for office communication systems. *Interfaces, 17*(3) (1987) 54–63.
9 J. Short, E. Williams and B. Christie, *The Social Psychology of Telecommunications*. Wiley, New York, 1976.
10 C. Steinfield, Computer-mediated communication in an organizational setting: explaining task-related and socio-emotional users. In: M. McLaughlin (Ed.), *Communication Yearbook, Vol. 9*. Sage, Beverly Hills, CA, 1986, pp. 777–804.
11 R.E. Rice and G. Love, Electronic emotion: a content and network analysis of a computer-mediated communication network. *Communication Research, 14*(1) (1987) 85–108.
12 R. Daft and R. Lengel, Organizational information requirements, media richness and structural design. *Management Science, 32*(5) (1986) 554–571.
13 R. Daft and R. Lengel, Information richness: a new approach to managerial behavior and organization design. *Research in Organizational Behavior, 6* (1984) 191–233.
14 W. Bodensteiner, Information channel utilization under varying research and development project conditions: an aspect of inter-organizational communication channel usage. Unpublished Ph.D Dissertation. University of Texas, Austin, TX, 1970.
15 L. Trevino, R. Lengel and R. Daft, Media symbolism, media richness and media choice in organizations: a symbolic interactionist perspective. *Communication Research, 14*(5) (1988) 553–575.
16 M.L. Markus, Information richness theory, managers, and electronic mail. University of California Graduate School of Management, Los Angeles, CA, 1988. Paper presented to Academy of Management, Anaheim, August, 1988.
17 J. Fulk and J. Schmitz, Rich or poor: it's how we see it. University of Southern California, Los Angeles, CA, 1988. Paper presented to the Academy of Management, Anaheim, August, 1988.
18 R. Zmud, M. Lind and F. Young, An attribute space for organizational communication channels. *Journal of Management Studies, 27*(3) (1990) in press.

19 R.E. Rice and D. Case, Computer-based messaging in the university: a description of use and utility. *Journal of Communication, 33*(1) (1983) 131–152.
20 R.E. Rice and J. Bair, New organizational media and productivity. In: R.E. Rice and Associates (Eds.), *The New Media: Communication, Research and Technology.* Sage, Beverly Hills, CA, 1984.
21 R. Kling, Social analyses of computing: theoretical perspectives in recent empirical research. *Computing Surveys, 12*(1) (1980) 61–110.
22 R.E. Rice, Computer conferencing. In: B. Dervin and M. Voigt (Eds.), *Progress in Communication Sciences, Vol. 2.* Ablex, Norwood, NJ, 1980, pp. 215–240.
23 R.E. Rice, Impacts of organizational and interpersonal computer-mediated communication. In: M. Williams (Ed.), *Annual Review of Information Science and Technology, Vol. 15.* Knowledge Industry Publications, White Plains, NY, 1980, pp. 221–249.
24 S.R. Hiltz, *Online Communities: A Case Study of the Office of the Future.* Ablex, Norwood, NJ, 1984.
25 L. Sproull and S. Kiesler, Reducing social context cues: electronic mail in organizational communication. *Management Science, 32*(11) (1986) 1492–1512.
26 H. Simon, Applying information technology to organizational design. *Public Administration Review, 33*(3) (1973) 268–278.
27 P. Strassman, Managing the costs of information. *Harvard Business Review* (September/October, 1976) 133–142.
28 G. Huber, Organizational information systems: determinants of their performance and behavior. *Management Science, 28*(2) (1982) 138–155.
29 M. Feldman and J. March, Information in organizations as signal and symbol. *Administrative Science Quarterly, 26* (1981) 171–186.
30 R. Daft, R. Lengel and L. Trevino, Message equivocality, media selection and manager performance: implications for information systems. *MIS Quarterly, 11*(3) (1987) 355–366.
31 J. Ruchinskas, *Communicating in organizations.* Unpublished Ph.D Dissertation. University of Southern California Annenberg School of Communications, Los Angeles, CA, 1982.
32 L. Svenning, *Predispositions toward a telecommunication innovation.* Unpublished Ph.D Dissertation. University of Southern California Annenberg School of Communications, Los Angeles, CA, 1982.
33 R.E. Rice and C. Borgman, The use of computer-monitored data in information science and communication research. *Journal of the American Society for Information Science, 34*(1) (1983) 247–256.
34 F. Williams, R.E. Rice and E.M. Rogers, *New Methods and New Media.* Free Press, New York, 1988.
35 M.L. Markus, Toward a "critical mass" theory of interactive media: universal access, interdependence and diffusion. *Communication Research, 14*(5) (1987) 491–511.
36 R.E. Rice, Communication networking in computer conferencing systems: a longitudinal study of group roles and system structure. In: M. Burgoon (Ed.), *Communication Yearbook, Vol. 6.* Sage, Beverly Hills, CA, 1982, pp. 925–944.
37 H. Bernard, P. Killworth, D. Kronenfeld and L. Sailer, The problem of informant accuracy: the validity of retrospective data. *Annual Review of Anthropology, 13* (1984) 495–517.
38 R.E. Rice and D. Shook, Usage of, access to, and outcomes from an electronic messaging system. *ACM Transactions on Office Information Systems, 6*(3) (1988) 255–276.

R.E. Rice and D. Shook, Relationships of job categories and organizational levels to use of communication channels, including electronic mail: a meta-analysis and extension. *Journal of Management Studies, 27*(3) (1990) in press.

39 M.J. Culnan, The dimensions of accessibility to online information. *ACM Transactions on Office Automation Systems, 2*(2) (1984) 141–150.

40 R.E. Rice and W. Richards, Jr., An overview of network analysis methods. In: B. Dervin and M. Voigt (Eds.), *Progress in Communication Sciences, Vol. 6.* Ablex, Norwood, NJ, 1985.

41 J. Fulk, C. Steinfield, J. Schmitz and G. Power, A social information processing model of media use inorganizations. *Communication Research, 14* (1987) 529–552.

42 R.E. Rice, A. Grant, J. Schmitz and J. Torobin, A network approach to predicting the adoption and outcomes of electronic messaging. Paper presented to the International Communication Association, New Orleans, May, 1988. University of Southern California, 1988.

43 G. Salancik and J. Pfeffer, A social information processing approach to job attitudes and task design. *Administrative Science Quarterly, 23* (1978) 224–253.

44 B. Johnson and R.E. Rice, *Managing Organizational Innovation: The Evolution from Word Processing to Integrated Office Systems.* Columbia University Press, New York, 1987.

45 M. Withey, R. Daft and W. Cooper, Measures of Perrow's work unit technology: an empirical assessment and a new scale. *Academy of Management Review, 26* (1983) 45–63.

46 R.E. Rice, Organic organizations and centralized units: use, contexts, and outcomes of word processing. In: J. Morell and M. Fleischer (Eds.), *Advances in Implementation and Impact of Computer Systems, Vol. 1.* JAI Press, New York, 1989.

47 H. Dewhirst, Influence of perceived information-sharing norms on communication channel utilization. *Academy of Management Journal* (September, 1971), 305–315.

48 C. O'Reilly III, Variation in decision makers' use of information sources: the impact of quality and accessibility of information. *Academy of Management Journal, 25*(4) (1982) 756–771.