Relational Development in Computer-Supported Groups

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Abstract

This study examines how group attitudes and outcomes evolve over time with repeated use of a group support system. Social Information Processing (SIP) theory, which suggests that relational intimacy may take longer to develop in computer-supported groups, was used as the basis for testing a temporally bounded model of group behavior. The basic argument underlying this model is that computer-supported groups, given adequate time, will exchange enough social information to develop strong relational links. Thus, while computer support was expected to limit group interactions initially, the model predicted that, over a period of time, such constraints would dissipate. The results show evidence of such shifts among computer-supported groups. Attitudes of GSS users changed over time from highly negative to somewhat positive; outcomes improved more slowly. The turnaround in attitudes of users—toward each other and the interaction process—support the SIP perspective that repeated use of computer support— despite some inherent initial restrictions—can help groups affiliate.

Keywords: Group support systems (GSS); social information processing; media richness; affiliation motive in groups; relational development

ISRL Categories: AA0903, HA11, HA1101, HA0301

Introduction

As corporate hierarchies give way to networked teams, managers are increasingly relying on information technology to empower these teams (Business Week, 1993). The use of such technologies as electronic mail, group support systems (GSS), and other forms of groupware has increased, sometimes dramatically, in organizations (Lloyd, 1994). The increasing use of groupware has attracted a growing body of research aimed at understanding its antecedents and consequences. However, group behavioral research in general, and GSS research in particular, have focused on single-session studies and ignored the effect of time on group processes and outcomes. As McGrath, et al. (1993) state,

... a very large proportion of past research on small groups has been done on a one-shot basis—study of groups newly formed for purposes of research, with the study extending only for a short interval during a single interaction occasion. No matter how methodologically sound that work may have been, it has given us little information about which, if any, of the obtained effects persist over time, which ones diminish or disappear, and which ones increase in their impact (p. 415).

Purpose of the study

Specifically, this paper addresses the issue of how intragroup relational links evolve over a period of time with repeated use of a group support system (GSS). It thereby tests the conventional wisdom that computer support increases task focus and simultaneously minimizes socioemotional interaction. This view of
group support systems may be derived from the preponderance of single session studies, which imply that effects of the first (and in many cases, the only) interaction with a technology are static and hence, generalizable over the life of the group.

The next two sections describe the theoretical underpinnings of this study and review relevant research. The third section presents the proposed research model, while the fourth section outlines the research methods used in this study. The last two sections discuss the key findings and examine their implications for theory and practice.

Theoretical Background

Two opposing theoretical viewpoints exist in the literature about the impact of computer support on teams. One viewpoint suggests that technology imposes certain invariant constraints that restrict, and ultimately determine, the outcomes of actors. Such a view, implicit in the many theories of media richness (e.g., Daft and Lengel, 1986) and social presence (e.g., Short, et al., 1976) suggests that computer-mediated group interaction—because of its inherent inability to share a variety of cues—is less "rich" (in terms of socioemotional exchanges) and has lower social presence than face-to-face communication (Daft, et al., 1987; Sproull and Kiesler, 1986). This stream of research also contends that the limited channels in computer-supported media tend to keep the group interaction process more task-focused compared to traditional face-to-face meetings (e.g., Hiltz, et al., 1986).

An alternative theoretical explanation proposes that while computer support does indeed lower relational intimacy initially among teams using such technology, these teams will eventually develop ways of exchanging socioemotional communication (e.g., Walther and Burgoon, 1992). This school of thought argues that computer-supported groups take longer to exchange socioemotional cues and given adequate time, will reach the same relational level as face-to-face groups. Thus, at the heart of this alternative explanation is the explicit recognition of temporal boundaries, i.e., the rate of information transmission. However, empirical tests of this thesis have been lacking with a few notable exceptions (e.g., Walther, 1995). This study is an attempt to gather evidence about the validity of this explanation.

Several researchers (e.g., Culnan and Markus, 1987; Walther and Burgoon, 1992) have referred to the work of the deterministic school, including media richness theories, as "cues-filtered-out" research. A majority of such research seeks to explain outcomes on the inability of certain media—like computer conferencing, e-mail, and GSS—to transmit visual and auditory cues. This research stream views media as constraining and the effects of the media as constant. However, media effects are likely to be transitory, and the role of time cannot be ignored in the study of group communication and behavior (Walther, 1992a):

If the relational tone effects of the cues-filtered-out research are indeed limited to initial interactions among strangers, what changes take place when such communicators continue their interactions over time? The development of relationships in CMC [computer-mediated communication], it will be argued, is predicated on the passage of sufficient time and message exchanges. It also requires that users adapt their remaining communicative cues—language and textual display—to the processes of relational management (p. 67).

At the heart of this argument are two key propositions:

1. Computer-supported teams need longer time to develop close relations compared to face-to-face teams. Given limited time for task accomplishment and the fact that typing takes longer than talking, less information—particularly of a personal nature—is exchanged in computer-mediated environments than in traditional face-to-face interactions (Walther, et al., 1994). With longer periods of interaction, computer-supported teams can exchange more social information, which will then help them develop relational ties. This viewpoint is
articulated by Social Information Processing (SIP) theory and is discussed later.

2. **Over time, users of computer media will adapt the medium to meet their relational needs.** Adaptive Structuration Theory suggests that repeated use of a technology—even with all its attendant restrictions—by rational players can change the very nature and essence of the technology (Poole and DeSanctis, 1990). Thus, technical systems can be viewed as being "semiotically ambiguous," i.e., they are equivocal in content and need to be defined by users (Dubinskas, 1993). Outcomes are the result of users interacting repeatedly with the system and thereby defining and redefining its meaning. Such adaptation implies that, over time, new forms of use may arise, old structures that were restrictive may become less so, and innovative ways of overcoming inherent structural barriers may emerge.

While both these constructs explicitly recognize the role of time in altering group outcomes, the primary focus of this study is on the first proposition. This proposition is best described in the SIP perspective, articulated by Walther (1992a), which focuses on the role of time and the evolution of interpersonal relations. This emerging theoretical perspective proposes that the rates of social information exchange among face-to-face and computer-supported groups differ. Since computer-supported groups, unlike face-to-face groups, have only one channel to exchange information, all communication—social and task-related—has to occur via the keyboard. This, coupled with the fact that typing is slower than talking, implies that computer-supported groups will take longer to exchange information than face-to-face groups. These restrictions tend to slow the process of developing relational intimacy. However, over longer periods, as participants exchange more interpersonal information and form impressions about each other, they are likely to improve their socioemotional links.

Thus, **SIP proposes that the restrictiveness of the computer medium, while hindering relational intimacy initially among unfamiliar participants, will dissipate over time.** In fact, the theory predicts that repeated interactions via the computer will lead to the exchange of enough inter-personal communication that can eventually encourage the development of strong, stable relations. Hence, from an SIP perspective, the generalizations about the inadequacy of computer media in fostering relationships are limited to initial interactions among zero-history groups. In summary, SIP suggests that the recurrent use of a technology—even with all its attendant restrictions—is not likely to stunt relational development in groups.

**Review of Relevant Research**

Evidence of changing relational and task interactions over time has been documented in non-technology settings by group development researchers (e.g., Gersick 1988; 1989; 1991). These studies of naturally occurring teams and lab groups led to the conclusion that groups follow a "punctuated equilibrium" model, i.e., groups alternate between relatively stable periods of activity, punctuated by intense changes in behavior. These changes in behavior, which (in Gersick’s examination) occurred during the half-way mark of a group’s life, were triggered by the realization of time pressures and the awareness of impending deadlines. Thus, the half-way point proved to be the critical juncture where a group’s equilibrium was shattered and a new level of activity and a different set of behaviors were established.

Evidence of such behavioral changes has been confirmed in some technology settings as well (Kelly and McGrath, 1988; McGrath, 1991; McGrath and Kelly, 1986). These studies of the social psychology of time and technology suggest that social entrainment, i.e., the synchronization of various processes over time among group members, is a key determinant of group behavior and outcomes. For instance, when a particular activity begins, how long it lasts, and how often it occurs, etc.,

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2 See Chidambaram and Bostrom (forthcoming) for a complete review of such research.
are all processes that need coordination by group members. These coordination behaviors are induced by various stimuli such as changes in team membership, familiarity with technology, looming deadlines, and life expectancy of the group. These studies underscore the importance of time in studying group processes.

Other studies of technology use by groups also suggest that certain behaviors and perceptions are, in general, not immutable. For instance, Burke and Chidambaram (1995), in a study of dispersed and face-to-face groups using a GSS, found that relational factors evolve over time. Initial levels of cohesiveness and influence behaviors, while different across groups, were not invariant over time; they tended to converge with repeated use of the system. Miranda (1991) also reports similar results with respect to conflict management. In her study, the ability to manage conflict improved over time among computer-supported groups.

In the CMC area, Fulk and her colleagues (Fulk, 1993; Fulk, et al., 1990) have studied and articulated the role of social factors, including experience, in media choice and use. Their studies of e-mail use suggest that experience with the medium can affect the extent of use and users' perceptions of the medium. In a related study, Foulger (1990) found that experienced participants in computer-mediated communication reported that the medium was at least as rich as face-to-face meetings. Other CMC studies in more controlled settings also suggest that experience with a technology can alter users' perceptions. For instance, Walther and Burgoon (1992) compared face-to-face groups with computer-supported groups at three different points in time. Their basic hypothesis, based on the SIP perspective, was that groups in both conditions would converge in terms of their relational development. In general, they found evidence of increasing relational intimacy over time among computer-mediated groups.

Despite some encouraging results, support for SIP has not been unequivocal. In the study discussed above (Walther and Burgoon, 1992), computer-mediated groups improved over time along some relational dimensions such as attempted influence and social orientation. However, along other dimensions such as similarity/depth, they started out higher than face-to-face groups; and along yet other dimensions such as formality, CMC groups actually regressed over time. Both these results were in contrast to the predictions of SIP. In more recent longitudinal investigations by Walther (1994), not all computer-supported groups were equally willing or able to develop relational intimacy. Anticipation of a group's longevity was an important moderator of a group's willingness to develop relational closeness. These findings suggest that the applicability of SIP may be limited to certain types of groups. Further research, such as this study, is needed to more precisely identify these boundary conditions.

Research Model

The model this study proposes to test is predicated on SIP's arguments that, over a period of time, groups using computers will gradually develop close relational ties, despite some initial difficulties. Thus, as groups grapple with using the technology, they will—in addition to exploiting the ability of the medium to support the task—explore ways of exchanging socioemotional communication with other participants. The use of "emoticons" (such as smiley faces) when sending electronic messages, typing in capitals to denote dominance, or the use of exclamation points to "shout" are instances of such adaptive behavior (Walther, 1992b; Walther and Burgoon, 1992). Researchers (Bell and Daly, 1984; Burgoon, et al., 1984) have identified the "affiliation motive"—the need to like and be liked by others—as a key human need underlying such behavior. Other relational needs can also be important motivators: image projection, desire to dominate, tension release, and conflict management (Miranda, 1991; Sproull and Kiesler, 1986; Walther, et al., 1994).

Implicit in the SIP perspective is the idea that users of computer media are driven by these needs just as much as those in non-computer settings. While a computer medium, such as a
GSS, may not easily permit the fulfillment of these social needs, users—as they interact repeatedly with the technology and become adept at using it—will nevertheless attempt to fulfill these needs. This is the basic premise of the model being tested in this study. The model, in line with the approach used in other studies (Goodman, et al., 1987; Gopal, et al., 1992-93; Sambamurthy, et al., 1993), utilizes an input -> process -> output framework to describe the key factors and their relationships.

Input: sociotechnical structures

While different GSSs have different tools—and thus, different structures—to support group interaction, many systems (e.g., GROUPSYSTEMS® and MeetingWorks®3) share certain generic structures. These include: (1) anonymous input and evaluation, (2) simultaneous data entry, (3) electronic recording and display, and (4) structured interaction. Each of these structures and how it is likely to be used over time for improving relational ties is described briefly below.

Anonymity

Anonymity can enable members of GSS groups to focus on an idea, independent of who generated it. In general, anonymous input and evaluation have proven to be beneficial to groups (Jablin and Seibold, 1978), although in some instances they have increased “flaming” behaviors (Connolly, et al., 1990; Diehl and Stroebe, 1987). This structure, while initially sharpening the task focus of groups, can eventually improve relational aspects such as conflict management by diverting attention away from personalities and on to issues.

Simultaneity

Simultaneity provides every team member equal access to communicate concurrently with the group. Unlike in traditional meetings, where yielding the floor is an integral part of the process, in GSS meetings the technology provides members the ability to “talk” at the same time. In single-session meetings, simultaneity has helped groups increase participation and improve creativity (Fellers, 1989). Over a period of time, however, the ability to interact simultaneously may thwart traditional claims that fewer communication exchanges occur in computer-mediated settings. This feature may accelerate relational development among users of “lean” media such as a GSS.

Electronic Recording and Display

Electronic recording and display refers to the structure of a GSS that provides a predominantly writing-intensive channel of communication versus a predominantly oral channel as in traditional meetings. At the heart of the “cues-filtered-out” research stream is the notion that the written channel precludes the ability to exchange non-verbal and visual cues necessary for socioemotional interaction (e.g., Daft and Lengel, 1986). While this may in fact be true initially, the SIP perspective predicts that groups, given enough time, will exchange enough social information electronically to help them develop strong relational links (Walther, 1992b).

Process Structuring

Process structuring provides groups with a vehicle for regulating interaction. Effectively channeling group interaction is a key ingredient in improving group outcomes (Van de Ven and Delbecq, 1971; 1974) and managing intra-group conflict (Putnam, 1986). Research suggests that ongoing use of a GSS can help groups manage conflict better (Miranda and Bostrom, 1993). Other relational factors such as cohesiveness and satisfaction have also been shown to improve over time as members interact continuously within electronically defined structures (Burke and Chidambaram, 1995; Miranda, 1991).

3 GROUPSYSTEMS is a registered trademark of Ventana Corporation, and MeetingWorks is a registered trademark of Enterprise Solutions.
The model proposed in this study does not isolate the individual structures described above. Rather, it suggests that from an SIP perspective, the collection of structures embedded in a GSS is, over time, likely to result in increased relational development among computer-supported groups. Three reasons underlie this proposition: (1) Some GSS structures are geared toward improving task-oriented aspects; groups need time to adapt these for relational issues; (2) Certain structures, being more complex and unfamiliar than others, need time to be appropriated effectively by groups. Once members have appropriated these structures, they can then use the medium to affiliate with others in the group; (3) The traditional constraints of a lean medium apply to a GSS as well. Thus, the rate of relational development will be slower in GSS groups than in face-to-face groups. Over a period of time, however, one can expect improved socioemotional interaction among GSS groups.

Process: attitudes

Relational proximity and socioemotional interactions are defined by group members' attitudes and perceptions (Gopal, et al., 1992-93; Poole and DeSanctis, 1990; Walther, 1992a; 1992b). The choice of attitudinal variables—cohesiveness and perceptions of process—in this study was based on a comprehensive review of the group development literature (e.g., Chidambaram and Bostrom, forthcoming; Walther, et al., 1994) and the assessment that these key factors were most likely to be affected by time.

Cohesiveness

Cohesiveness describes the extent to which members are attracted to the group and to each other and is closely related to Walther's (1992a) "affiliation motive." In their meta-analysis of the relationship between group cohesiveness and performance, Evans and Dion (1991) report of at least 18 studies that have examined the construct of cohesiveness. In many instances, group cohesiveness has been linked to a number of positive outcomes, including a heightened awareness of problems, a proclivity to change, enhanced motivation, increased morale, better decisions, and greater creativity (Budman, et al., 1993; Keller, 1986; Mabry and Barnes, 1980). Cohesive groups also tend to work harder to achieve group goals, communicate more openly, exert stronger pressures on members to conform to group norms, and display higher job satisfaction than non-cohesive groups (Burke, et al., 1995; Keller, 1986; Miranda, 1991; Seashore, 1954).

Perceptions of Process

Perceptions of process refer to group members' assessment of the interaction process and include such aspects as trust, openness, and participatory equality; some of these measures have been used to evaluate relational proximity in other studies (e.g., Burke, et al., 1995; Walther and Burgoon, 1992). Positive perceptions of the process are likely to be associated with process gains, while negative perceptions are likely to be associated with process losses (Steiner, 1972). Process losses—a term coined by Steiner (1966) to denote reduced motivation in groups to affiliate and perform—can be gauged by self-assessments of the interaction process. Numerous causes of process losses have been identified including production blocking (Diehl and Stroble, 1987), group size (Steiner, 1966), and social loafing (Harkins, 1987; Harkins, et al., 1980) to name a few.

The model described in this study, in line with systems thinking, reiterates that attitudes—including cohesiveness and perceptions of process—affect outcomes. The model further proposes that these attitudinal measures that describe the relational proximity of groups are expected to vary over time. Initially, as SIP predicts (Walther, 1992a; 1992b; Walther, et al., 1994), relational proximity among computer-supported groups would be low. However, with adequate time and the exchange of enough social information, group members will likely overcome traditional media constraints and improve their socioemotional ties. In other words, merely introducing a GSS will not
immediately improve group interaction; novice groups, new to group technologies, may need repeated exposure to a GSS before they can begin exhibiting relational improvement (Burke, et al., 1995).

**Output: satisfaction with outcomes**

Measuring various forms of user satisfaction has been the focus of numerous studies in the IS field (e.g., Bailey and Pearson, 1983; Ives, et al., 1983; Jenkins and Ricketts, 1985). However, this area of inquiry and the methods employed have come under increasing scrutiny. For instance, Melone (1990) points out that studies of user satisfaction have often ignored the dynamic nature of attitudes; she states, 

> Attitudes form, and in some cases they change. The research designs of many user-satisfaction studies fail to recognize this fact. An obvious mechanism for rectifying this omission is to use longitudinal designs that track user attitudes and behavior (p. 88).

This study took the approach advocated above and examined, over a period of time, changes in group attitudes regarding satisfaction.

Hiltz and Johnson (1990) report on a seminal study of user satisfaction in the context of computer-supported groups. Their study of CMC users showed that the best predictors of the socioemotional dimension of satisfaction—similar to the construct employed in this study—were the frequency of previous communication among group members and their attitudes toward the task. The model described here augments this idea with the role of time; it suggests that over a period of time, the growing interaction among members of GSS groups and their increasingly positive attitudes will elevate satisfaction levels.

**Summary of the model**

The above model, based on the ideas of SIP, suggests that inputs to group interaction (GSS structures) will initially constrain relational development (cohesion and attitudes); this, in turn, will negatively affect outcome aspects (satisfaction). The combined effect of having less time to communicate socially (given the writing-intensive channel) and needing more time to adapt new structures for relational uses (given their task-oriented nature) will slow relational development in GSS groups. However, the model predicts, with the passage of adequate time and the exchange of enough socioemotional information, that GSS groups will overcome traditional media constraints and develop relational ties. Thus, with repeated use of a GSS, relationships will start to strengthen, members will become cohesive, and groups will be more satisfied. Such temporally determined changes in group perceptions are at the heart of the model tested here.

**Research Methods**

**Procedures**

Data for testing the model was obtained from a laboratory experiment with 28 five-member groups. Half the groups had GSS support, and the other half did not; all groups met four times over four weeks. Subjects, drawn from multiple sections of an undergraduate management class, had the option of writing a term paper or participating in an experiment to fulfill a course requirement. Participation in all four tasks was essential for getting full course credit. This requirement helped reduce absenteeism and mortality.

Subjects were randomly assigned to groups, and groups were randomly assigned to treatments; once assigned, subjects remained in the same group, and groups remained in the same treatment throughout the duration of the study. Post hoc tests revealed no significant differences in demographic variables such as GPA, age, sex, and work experience between the two treatment conditions. None of the subjects had any previous experience with the technology or experimental methods used in the study. Using a pretested script, subjects in both treatments were trained in the process of structured decision making either with or without the technology as appropriate.
The actual sequence of events was the same for computer-supported and "manual" groups: Read case -> Generate ideas -> Discuss alternatives -> Evaluate choices -> Propose solution. Computer-supported groups used a GSS (GROUPSYSTEMS®) in a laboratory where each member had access to a networked computer. These computers were linked to a facilitator's workstation, which in turn was connected to a public screen that displayed relevant data. Electronic tools embedded in GROUPSYSTEMS® were used to generate ideas (Electronic Brainstorming), discuss alternatives (Issue Analyzer), and evaluate choices (Voting). Manual groups made decisions in a room similar to the one used by the computer-supported groups. However, in place of the public screen, a flip chart was provided for recording ideas, evaluating them, and making a choice. Members were also provided with papers and pencils.

Tasks

Four cases—simulating a board of directors of a multinational winery meeting on a regular basis—were used in this study. Each board meeting involved making a decision about a specific problem facing the firm; the problems had no a priori right or wrong answers, only answers of varying quality. These cases were pretested for comprehension and comparability in a separate pilot study. In order to ensure that differential task complexity did not account for differences in performance, the order of the tasks was randomized for all groups with computer support; the same order was matched for groups without computer support. Post hoc analysis confirmed that neither task complexity nor task order accounted for variations in performance.

Controlled variables

Group size, a variable of interest in other studies (e.g., Fellers, 1989), was held constant at five in this study. In addition to controlling group size, facilitator effects were also controlled. Groups with and without computer support had the assistance of a facilitator, who assisted with the experiment but did not influence the content of the discussions. In both settings, the facilitator followed a pretested script and a predetermined agenda. The maximum time available to make decisions was 90 minutes—the same for both treatments. An ex post analysis of subject responses revealed no significant differences in facilitator roles or impacts between groups in the two treatment conditions.

Measures

The research model, discussed earlier, included three dependent variables: cohesiveness, perceptions of process, and satisfaction with outcome. These variables were measured after every session via a pretested, validated instrument (included in the Appendix).

- **Cohesiveness** was measured using an updated version of Seashore's (1954) Index of Group Cohesiveness—a measure that has been used widely in several studies (e.g., Burke, 1994; Keller, 1986; Miranda 1991). This measure had a reliability (Cronbach's ) of 0.89. Scores can range from five to 25, with higher scores indicating greater cohesiveness.

- **Perceptions of Process** was measured using a five-item construct with a reliability of 0.89. A seven-point Likert-type scale was used to measure such items as openness, respect, and trust exhibited during the meeting. As with cohesiveness, higher scores reflected more positive perceptions of the process.

- **Satisfaction with Outcome** was measured using a four-item construct with a reliability of 0.95. As with the earlier construct, a seven-point Likert-type scale was used to measure such items as satisfaction with the decision, perceived effectiveness of the results, and agreement with the outcome. The items were reverse coded so that higher scores meant higher levels of satisfaction.

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Analysis strategy

First, to test changes in overall relational development over time, a repeated measures MANOVA was conducted with all dependent variables across the four sessions. Next, repeated measures MANOVAs were conducted for each of the dependent variables across the four sessions. Finally, the model depicted in Figure 1 was tested by calculating the various path coefficients for each of the four periods. These coefficients, which represent the magnitude and direction of relationships between variables, are the standardized regression coefficients (or beta weights) in a multiple regression (Heise, 1975). The multiple coefficient of determination \((R^2)\) was calculated for each endogenous variable (analogous to a dependent variable in multiple regression).

As in traditional regression analyses, the value of \(R^2\) represents the strength of the association among the variables; it does not denote causal direction. The causal direction—which is assumed to be unidirectional, so the same variable cannot simultaneously be the cause and effect of another variable—is specified in the research model (see Figure 1) and is dictated by theoretical considerations (Pedhazur, 1982). Also, the use of time, a critical element in this study, permits stronger inferences about causality (Hall and Foster, 1977). For each period, the overall goodness of fit index\(^4\) \((Q)\), based on the generalized variance indices (GVIs) for the restricted and full models, was calculated as specified by Specht (1975). To facilitate comparisons across studies, the values of \(Q\) are reported directly (along with the corresponding levels of significance) as recommended by Bobko (1990).

\[ Q = 1 - \frac{GV_{full}/GV_{restricted}}{1} \]

and the value \(W_{\chi^2} = (n-d)\ln Q\) has an asymptotic chi-square distribution with \(d\) degrees of freedom, where \(d\) is the number of path coefficients set to zero and \(n\) is the sample size.

Results

Table 1 presents some descriptive statistics about the study variables, while Table 2 summarizes the results of the repeated measures MANOVA. The F-values corresponding to Pillai's trace and Wilk's \(\lambda\) (in Table 2) for the overall experiment—including all three dependent variables measured for the two treatment conditions over four sessions—were both statistically significant \((p < .001)\). Additionally, each of the dependent variables exhibited significant differences across treatment over time \((p < .01)\). Thus, the dependent variables—jointly and individually—were affected by time and treatment. These results support the SIP perspective that computer-supported groups, despite the avowed leaness of the medium, will manage, with repeated use of the system, to exchange enough social information that their initial difficulties in establishing positive relations will dissipate.

Table 3 presents the zero-order correlations among all variables, while Table 4 presents the multiple coefficients of determination \((R^2)\) for the endogenous variables in the model. Figures 2 through 5 (discussed later) depict the path coefficients of the model for each of the four sessions. The results of these analyses provide further evidence of relational development among computer-supported groups. They also provide some support for a midlife correction in group attitudes seen in other studies (e.g., Gersick, 1989; 1991).

Results of the repeated measures MANOVA and the path analyses add to the growing evidence against the technologically deterministic argument that computer support limits socioemotional interaction regardless of boundary conditions such as type of support and length of use. The discussion below explores the reasons for the changing directions and strengths of the relationships among inputs, processes, and outputs throughout the duration of this study.
Figure 1. Research Model

Table 1. Means and Standard Deviations of Study Variables

<table>
<thead>
<tr>
<th>Variables</th>
<th>Session 1</th>
<th>Session 2</th>
<th>Session 3</th>
<th>Session 4</th>
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<tbody>
<tr>
<td></td>
<td>GSS</td>
<td>Non-GSS</td>
<td>GSS</td>
<td>Non-GSS</td>
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<td>Cohesiveness</td>
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<td>(1.54)</td>
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<td>5.90</td>
<td>(.98)</td>
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<tr>
<td>Satisfaction With Outcomes</td>
<td>5.93</td>
<td>(.54)</td>
<td>6.02</td>
<td>(.52)</td>
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* Not measured during first meeting.
Table 2. Repeated Measures MANOVA of Study Variables

| Overall Multivariate Tests of Significance Across Treatments Over Time (All Variables) |
|-----------------------------------------------|-------------------|-------------------|-------------------|-------------------|
| Test Name | Value | Exact F | Hypoth. df | Error df | Sig. of F |
| Pillai's trace | .6380 | 14.10 | 3 | 24 | .000 |
| Wilk's λ | .3620 | | | | |

Tests of Significance for Differences in Cohesiveness (Between Treatments Over Time)

| Test Name | Value | Exact F | Hypoth. df | Error df | Sig. of F |
| Pillai's trace | .5509 | 9.81 | 3 | 24 | .000 |
| Wilk's λ | .4491 | | | | |

Tests of Significance for Differences in Perceptions of Process (Between Treatments Over Time)

| Test Name | Value | Exact F | Hypoth. df | Error df | Sig. of F |
| Pillai's trace | .3549 | 4.40 | 3 | 24 | .013 |
| Wilk's λ | .6451 | | | | |

Tests of Significance for Differences in Satisfaction With Outcomes (Between Treatments Over Time)

| Test Name | Value | Exact F | Hypoth. df | Error df | Sig. of F |
| Pillai's trace | .4406 | 6.30 | 3 | 24 | .003 |
| Wilk's λ | .5594 | | | | |

Period 1

Figure 2 provides a graphical representation of the path coefficients during the first session. Generally, during this period, the overall model fit the data well: The goodness of fit index, $Q$, had a value of .98, which was significant at the .05 level (i.e., $\chi^2$ was non-significant), and three of the five paths were also significant at the .05 level. The strong negative links between technology support and relational attitudes (path coefficients with group cohesion of -.61 and with process perceptions of -.55) support Walther's (1992a) reasoning that computer support initially does lower socioemotional intimacy. Inspection of the coefficients of determination (see Table 3) indicates that almost a third of the variation in relational attitudes (cohesiveness, .37 and perceptions of process, .30) was explained by the impact of technology. (Both coefficients were significant at the .01 level.) Thus, the links between input and process were significant and in the direction postulated by SIP.

Other links—between input and output, and between process and output—were less clear, although they were all positive. Of the various constructs, cohesiveness had the strongest association with outcome (.36). This provides some support for the argument that cohesiveness is an important predictor of group outcomes (Keller, 1986). The weak link between technology support and satisfaction with outcomes are in line with the results from Hiltz and Johnson (1990), which indicated that user attitudes are likely to strengthen with increased frequency of system use. Nevertheless, as the low coefficient of determination indicates, the attitudes about outcomes are not conclusive.
Table 3. Zero-Order Correlations Among Exogenous and Endogenous Variables

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<th>10</th>
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<th>12</th>
<th>13</th>
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<tbody>
<tr>
<td>1. Technology</td>
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<tr>
<td>2. Cohesiveness (I)</td>
<td>-.61**</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>3. Perceptions of Process (I)</td>
<td>-.55**</td>
<td>.22</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>4. Satisfaction with Outcomes (I)</td>
<td>-.08</td>
<td>.27</td>
<td>.04</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td>5. Cohesiveness (II)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>-.40*</td>
<td>.31</td>
<td>.31</td>
<td>-.01</td>
<td></td>
<td></td>
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<td>6. Perceptions of Process (II)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>-.21</td>
<td>.16</td>
<td>.15</td>
<td>.01</td>
<td>.32</td>
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<td>7. Satisfaction with Outcomes (II)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>.18</td>
<td>.01</td>
<td>.07</td>
<td>-.06</td>
<td>-.02</td>
<td>.02</td>
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<tr>
<td>8. Cohesiveness (III)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>.35</td>
<td>-.11</td>
<td>-.12</td>
<td>.12</td>
<td>-.43*</td>
<td>.05</td>
<td>-.08</td>
<td></td>
<td></td>
</tr>
<tr>
<td>9. Perceptions of Process (III)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>.35</td>
<td>-.18</td>
<td>-.31</td>
<td>-.19</td>
<td>-.43*</td>
<td>.12</td>
<td>-.11</td>
<td>.68**</td>
<td></td>
</tr>
<tr>
<td>10. Satisfaction with Outcomes (III)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>.45*</td>
<td>-.11</td>
<td>-.51**</td>
<td>.08</td>
<td>-.68**</td>
<td>-.16</td>
<td>.05</td>
<td>.57**</td>
<td>.68**</td>
</tr>
<tr>
<td>11. Cohesiveness (IV)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>.55**</td>
<td>-.37*</td>
<td>-.38*</td>
<td>-.11</td>
<td>-.68**</td>
<td>-.38*</td>
<td>.29</td>
<td>.10</td>
<td>.33</td>
</tr>
<tr>
<td>12. Perceptions of Process (IV)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>.15</td>
<td>-.05</td>
<td>-.05</td>
<td>-.15</td>
<td>-.29</td>
<td>-.09</td>
<td>.20</td>
<td>-.19</td>
<td>.16</td>
</tr>
<tr>
<td>13. Satisfaction with Outcomes (IV)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>.72**</td>
<td>-.44*</td>
<td>-.34</td>
<td>-.14</td>
<td>-.32</td>
<td>-.27</td>
<td>.33</td>
<td>.01</td>
<td>.05</td>
</tr>
</tbody>
</table>

Note: (Roman Numerals) denote session numbers. * Denotes correlations significant at 0.05. ** Denotes correlations significant at 0.01.

Table 4. Multiple R² for Endogenous Variables and Overall Indices of Fit

<table>
<thead>
<tr>
<th></th>
<th>Period 1</th>
<th>Period 2</th>
<th>Period 3</th>
<th>Period 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Multiple R²</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cohesiveness</td>
<td>.37**</td>
<td>.17*</td>
<td>.14</td>
<td>.33**</td>
</tr>
<tr>
<td>Perceptions of Process</td>
<td>.30**</td>
<td>.05</td>
<td>.16*</td>
<td>.04</td>
</tr>
<tr>
<td>Satisfaction with Outcomes</td>
<td>.09</td>
<td>.04</td>
<td>.53**</td>
<td>.62**</td>
</tr>
<tr>
<td>Goodness of Fit Index (Q)</td>
<td>.98***</td>
<td>.80***</td>
<td>.59</td>
<td>.83***</td>
</tr>
</tbody>
</table>

(0=no fit; 1=perfect fit)

* Denotes F values significant at α = 0.10. ** Denotes F values significant at α = 0.01.
*** Denotes values of Q significant at α = 0.05 (i.e., non-sig. χ²).
and suggest that other factors may be influencing group outcomes.

**Period 2**

Figure 3 provides a graphical representation of the path coefficients during the second session.

The strong negative links between technology support and relational attitudes seen earlier began dissolving during this period (path coefficients with group cohesiveness of -.33 and with process perceptions of -.19). This evidence further supports the claims of SIP (see Walther, 1992a; 1992b) that, over time, groups will begin to exchange social information in an attempt to overcome the constraints of relational inadequacy imposed by the media. Thus, while computer support did in fact lower socioemotional intimacy initially (as seen during the first session), this effect began to dissipate during this session.

As in the first period, the links with outcome were less clear. For instance, the lack of a strong relationship between technology support and outcome satisfaction (.20) persisted as did the negligible association between process and outcome. In addition, the expected link between previous attitudes and current attitudes, seen in other studies (e.g., Gopal, et al., 1992-93), was not evident. Overall, the goodness of fit index (Q=.80) was also lower than in the first session.

**Period 3**

Results for this period, represented in Figure 4, were a mirror image of the results during the previous period.

Evidence of a growing tendency to affiliate (i.e., the three significant path coefficients) was seen in this period. Computer support had a strong positive impact on attitudes (.38 on cohesiveness and .39 on process perceptions, both of which were statistically significant at
Figure 3. Path Model for Period 2

Figure 4. Path Model for Period 3
the 0.05 level). As the coefficients of determination indicate, on an average, about 15 percent of the variation in attitudes was explained by the impact of technology. However, previous attitudes still had no significant impact on current attitudes.

The connections between attitudes and outcomes also became stronger during this period. Perceptions of the process were positively and significantly related to outcome satisfaction (.50), while cohesiveness was positively, although not significantly, related to it (.16). However, technology still had no significant impact on outcome (.22). Overall, slightly more than half the variation in outcomes was attributable to the combined effect of group attitudes and technology support (see Table 4). For GSS groups, this period marked a turnaround in attitudes compared to the first two periods. Nevertheless, the low value of Q (.59) indicated that other factors were affecting relationships in the model.

**Period 4**

The results of the final meeting, depicted in Figure 5, indicate a general improvement of several attitudinal measures. Computer support, as in the previous period, had a significantly positive impact on cohesiveness (.50), but surprisingly, had no significant impact on perceptions of the process. As in Gersick's (1988; 1991) studies, the changed pattern of behavior seen after the halfway point of a group's life (in session 3) persisted until the end. However, during this period, neither perceptions of the present nor perceptions of the previous processes had a significant impact on other endogenous variables. As the results from Table 4 suggest, almost one third of the variation in cohesiveness (a statistically significant percentage), was attributable to the combined impact of computer support and previous attitudes.

In a related result, for the first time in four meetings, the association between outcome and computer support was significantly posi-
tive (.52) as was the association between outcome and cohesiveness (.36). As Table 4 indicates, over 60 percent of the variation in outcome satisfaction was explained by the combination of computer support and attitudinal changes, primarily due to an increase in cohesiveness. During this final session, links among variables became stronger, and the overall goodness of fit index, $Q$, increased to .83.

**Discussion**

The above findings add to theoretical (Contractor and Eisenberg, 1990) and empirical (Walther, et al., 1994) arguments against deterministic theories of technology, which propose that computer support reduces relational intimacy unconditionally. The shifts in groups' attitudes over the four periods confirm some aspects of the research model and consequently reject the notion of constancy of media effects. While groups using a GSS did indeed find the media constraining initially, with increased use and greater opportunity to exchange interpersonal information, they were able to reduce the relational distance among members.

**Implications for theory**

Results of this study are reviewed in light of two theoretical explanations referred to earlier: (1) the SIP theory (Walther, 1992a; 1995), and (2) the punctuated-equilibrium model (Gersick, 1988; 1989; 1991).

**Social Information Processing Theory**

In this study, as predicted by SIP, some evidence of relational affiliation was detected over time among groups using GSS. However, the context in which this result was discovered (GSS) differs from the original context in which it was first detected (CMC) on one structural criteria, i.e., anonymity. In the case of CMC, members were aware of who was authoring messages. This awareness subsequently helped individuals form impressions of others in the group (Walther, 1992a). However, in this study, the tendency to affiliate among computer-supported groups emerged despite the anonymity afforded by the GSS.

This result suggests that repeated electronic interactions (i.e., the accumulation of messages, opinions, and votes) among members of a group, will gradually reveal group feelings and attitudes. This information can then help members construct social impressions of the group (and not necessarily of individuals). Such an argument extends the theory by proposing that GSS users—despite being “hampered” by their inability to identify individual viewpoints—will, over a period of time, build a representation of the group that will help them affiliate. This theoretical extension to SIP suggests that even in relatively impersonal (or anonymous) electronic environments, relational development can occur, if enough time passes and sufficient information exchange occurs. Further empirical research is needed to verify the applicability of this claim to other systems and settings.

**The Punctuated Equilibrium Model**

Some temporally determined behaviors exhibited by GSS groups—the strong and lingering effects of initial impressions, the midpoint shift in attitudes, and the persistence of these attitudes until the end—partly conform to the “punctuated equilibrium” model proposed by Gersick (1988). However, the stable equilibria exhibited by groups in Gersick’s studies (1988; 1989) during the first and second parts of their lives were absent in this study. While a midpoint transition did occur among GSS groups, their behaviors changed from session 1 to session 2 (instead of being stable) and further from session 3 to session 4. In other words, of the two concepts implicit in the “punctuated equilibrium” model, results of this study supported the first idea of temporal “punctuation,” but not the second idea of temporal “equilibrium.” Future studies need to examine communication interacts to uncover the underlying
Some cautionary notes

Results of this study suggest that among users of new technologies, new attitudes may take a while to form, and old attitudes will dissipate slowly. The slow change in attitudes is likely a reflection of how strong initially formed opinions can be (Gersick, 1988), especially if they are negative, as they were in this case. Thus, it is not surprising when media researchers—based on one-shot studies—report that computer support hampers relational intimacy, reduces satisfaction and decreases socioemotional interaction. These effects were seen in this study as well—strongly in the first session and less strongly in the second session. However, the effects reversed themselves in the final two sessions. These results reinforce the cautionary message about extrapolating results from single-session studies to ongoing work groups (Hollingshead, et al. 1993).

While the results presented in this paper offer some evidence of social information processing among computer-supported groups, care should be used in interpreting them. As with any lab experiment, the task dependency of results, the use of student subjects, and the type of technology and treatment used limit the applicability of results to other settings and populations. Also, since control groups were used in this study, the developmental stages of GSS groups at each session were not explicitly measured. Future research needs to examine groups at various developmental stages to determine if the pace of relational development differs among nascent, middle-aged, and mature groups.

The use of a repeated measures design, as in this study, can raise the threat of reactivity by subjects (who respond to the same instruments repeatedly), which can then result in a convergence of measures. However, a factor analysis of scores at each of the four periods in this study revealed the independence of various measures. Finally, this study used an input -> process -> output model that relied on perceptual measures of relational intimacy. Future studies should consider using process tracing methods and protocol analysis to study interaction processes more directly.

Implications for practice

Research on organizational adaptation of technologies raises some doubts about how long behavioral changes are likely to last. In a study by Tyre and Orlikowski (1994), users of technology went through an initial period of intense experimentation. At the end of this period, their pattern of use “congealed,” and they were reluctant to change this pattern easily. This study examined groups over four periods and found some evidence of changing interpersonal relations. Further research over a longer period of time in “real world” settings is needed to verify whether these changes are temporary or lasting. Also, in an organizational milieu, factors such as impending deadlines, predominance of task needs and other pressures may influence the extent to which groups will use electronic media to affiliate.

Preconceived notions about technology (which were not explicitly measured in this study) may prolong the demise of old attitudes. Thus, to effectively implement group support systems, organizations need to convey the message to users that such systems are flexible and can be adapted for a variety of purposes, including improving task performance (Chidambaram and Bostrom, 1993), communicating with peers (Burke, 1994), and socializing with teammates (Walther, 1995) to name a few. Other mechanisms for accelerating the organizational diffusion of groupware may include hands-on training, the use of skilled facilitator services, and user support hotlines (Lloyd, 1994). Whatever the specific mechanism adopted, firms cannot simply install a GSS and hope to reap all the vendor-extolled virtues of the new technology instantaneously.

5 See Walther, 1995, for a detailed discussion.
In conclusion, results of this study add to the mounting evidence against the technologically deterministic argument that GSS structures are immutable and limit interpersonal communication. Humans, being remarkably resourceful, will—given time and despite hurdles—find imaginative ways to transform these structures to fit all their needs, including socioemotional ones.

References


Walther, J.B. "A Longitudinal Experiment on Relational Tone in Computer-Mediated and


About the Author

Laku Chidambaram is an associate professor of decision sciences at the University of Hawaii's College of Business Administration. He is also the College's faculty director of the Electronic Meeting Room (EMR). Dr. Chidambaram received his Ph.D from Indiana University with a double major in information systems and international business. He also has an MBA from the University of Georgia and has worked as an international trade consultant. He has taught various information systems courses at the undergraduate, masters, doctoral, and executive levels, and has won several awards for teaching excellence. His research publications have appeared in such journals as MIS Quarterly, Journal of Organizational Computing, and Journal of MIS. His current research interests include longitudinal examinations of group support systems and cross-cultural studies of computer-mediated communication.
Seashore's Index of Group Cohesiveness (Adapted for student work groups):

Do you feel that you are really a part of this work group?

- Really a part of my work group.
- Included in most ways
- Included in some ways, but not in others
- Don't feel I really belong too much.
- Don't feel I belong at all.

If you had a chance to do the same kind of work in another student work group how would you feel about moving?

- Would want very much to stay where I am.
- Would rather stay where I am than move.
- Would make no difference to me.
- Would rather move than stay where I am.
- Would want very much to move.

How does this group compare with other student groups on each of the following points?

<table>
<thead>
<tr>
<th></th>
<th>Very much better</th>
<th>Better than most</th>
<th>About the same</th>
<th>Worse than most</th>
<th>Very much worse</th>
</tr>
</thead>
<tbody>
<tr>
<td>The way people:</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- get along together</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>- work together</td>
<td></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- help each other</td>
<td></td>
<td></td>
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</tbody>
</table>

Perceptions of Process:

<table>
<thead>
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<th>To a very little extent</th>
<th>To some extent</th>
<th>To a very great extent</th>
</tr>
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<tbody>
<tr>
<td>Were group members well committed to the goals and objectives of</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>the group (during this meeting)?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>To what extent was trust exhibited within the group (during</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>this meeting)?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Did members have a strong sense of belonging to the group (</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>during this meeting)?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Did group members recognize and respect individual differences</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>and contributions (during this meeting)?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Were group members open and frank in expressing their ideas and</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>feelings (during this meeting)?</td>
<td></td>
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Satisfaction with Outcomes: (Reverse coded in the analysis)

<table>
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<th>Strongly Agree</th>
<th>Undecided</th>
<th>Strongly Disagree</th>
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<tr>
<td>1</td>
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<td>3</td>
</tr>
<tr>
<td>4</td>
<td>5</td>
<td>6</td>
</tr>
<tr>
<td>7</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Overall, I was personally satisfied with this decision meeting.

<table>
<thead>
<tr>
<th>Overall, I was personally satisfied with this decision meeting.</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
</tr>
</thead>
</table>

This group produced effective and valuable results during this meeting.

<table>
<thead>
<tr>
<th>This group produced effective and valuable results during this meeting.</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
</tr>
</thead>
</table>

I agree with the final decision of the group.

<table>
<thead>
<tr>
<th>I agree with the final decision of the group.</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
</tr>
</thead>
</table>

Overall, the quality of this meeting was high.

<table>
<thead>
<tr>
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<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
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</table>