The Mediating Effect of Group Development on Satisfaction in a Virtual and Mixed-Mode Environment

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Abstract

This study explores the mediating effect of two aspects of group development (workgroup cohesion and conflict management) on five aspects of satisfaction (solution satisfaction, solution confidence, interaction process satisfaction, perceived decision quality, and level of teamwork). The independent variable, interaction mode, has two treatments: mixed-mode, a combination of face-to-face (FtF) and computer-mediated communication (CMC), and pure CMC (no FtF interaction). Members of mixed-mode groups rated their groups higher in terms of cohesiveness, the ability to manage conflict, and all aspects of satisfaction. Members of more highly developed groups rated themselves higher on all satisfaction variables compared to members of lesser-developed groups. Findings indicate that workgroup cohesion mediated all satisfaction variables, while conflict management mediated all satisfaction variables except for solution confidence.

1. Introduction

Increased global competition and differences in labor costs are driving Lucent, Sun Microsystems and others toward geographically distributed software development (Anthes, 2000). In addition to reduced labor costs, other corporate benefits of virtual teams include such things as having an around-the-clock workforce and greater access to expertise. However, drawbacks associated with virtual teams include cultural issues, differences in business processes and workflow, communication and coordination problems, and the cost and complexity of, and the driving need for, technical support.

To diminish “virtualness,” some companies are interspersing face-to-face (FtF) meetings in an otherwise virtual environment. For example, virtual teams at Sun Microsystems are advised to meet FtF at the beginning to “jump-start” a project, at the mid-point to assess and review the group’s work prior to completion, and at the end so members can bring closure to the project and celebrate their accomplishments (Lipnack and Stamps, 1997). The large body of literature on group support systems (GSS) has primarily investigated groups interacting synchronously while that of computer-mediated communication (CMC) has explored asynchronous group interaction (Fjermestad & Hiltz, 1999). However, there is a paucity of research studying the relatively recent development of interspersing face-to-face (FtF) meetings in an otherwise virtual group environment – that is, to combine asynchronous CMC and FtF communication. This paper describes the third in a series of studies comparing purely virtual, CMC groups with groups interacting via a combination of virtual and FtF communication. These groups are tasked with developing software requirements and a high-level design for an application system (see Ocker et al., 1998 and Ocker & Fjermestad, 1998 for previous studies).

This study explores individual group member perceptions regarding various aspects of satisfaction. Although member satisfaction has been the second most ‘studied’ dependent variable in GSS and CMC studies, included in over 200 studies (Fjermestad & Hiltz, 1999), inconclusive results have been obtained. However, by categorizing the studies according to the amount of FtF interaction, it appears that member satisfaction is increased when groups work in a decision room (participants meet FtF and are supported by an electronic meeting system) compared to groups working in a purely asynchronous CMC context. These results have been attributed to aspects of the group’s interaction (i.e., communication) mode only, such as reduced social presence in CMC and the increased communication and coordination difficulties requiring CMC groups to exert more effort. The current study looks at satisfaction not only with respect to interaction mode, but argues that the level of group development, as influenced by the interaction mode, in turn, influences individual perceptions regarding satisfaction. That is to say, perceptions of group development mediate the relationship between interaction mode and satisfaction.

1 It is not so much that satisfaction has been studied, but rather included as a dependent variable in studies.
2. Theoretical Model, Literature Review and Hypotheses

Figure 1 shows three relationships. Path $a$ depicts the association between the interaction mode of groups (mixed, a combination of FtF and virtual interaction, and purely virtual) and their perceived level of group development. Two constructs are used to represent group development: cohesiveness and conflict management. Path $b$ depicts the association between perceived group development and outcome variables associated with member satisfaction (i.e. satisfaction with the group solution, confidence in the solution, satisfaction with the interaction process, perceived quality of discussion, and level of teamwork). Path $c$ represents the relationship between group interaction mode and the outcome variables. In the following sections, relevant literature is presented as these relationships are explored and hypotheses are formulated. Path $c$ is discussed first followed by paths $a$ and $b$.

Path $C$ – Interaction Mode and Satisfaction

Interactivity and shared interpretive context

The interactive model of the communication process (Rogers 1986) describes individuals as creating and sharing information in order to develop a mutual understanding. Fundamental to the model is the idea of shared interpretive context. For communication to be effective, individuals must share an adequate level of knowledge, referred to as interpretive context. Zack (1993) proposes that when shared interpretive context is low, the ambiguity level of communication is high and necessitates a rich and interactive communication mode. Conversely, when shared interpretive context is high, ambiguity is greatly diminished so that a less interactive mode of communication is effective.

In this theory, communication media are described on a continuum of interactivity, defined as the degree to which a communication mode enables interaction that resembles human conversation (Rogers 1986). Several critical characteristics distinguish the interactivity of communication modes. These include: simultaneous and continuous exchange of information; use of multiple, non-verbal cues; potentially spontaneous, unpredictable, and emergent progression of remarks; ability to interrupt; mutuality (messages are mutually constructed and coordinated); and patterns of turn-taking.

Based on these criteria, FtF interaction supports the highest level of interactivity as it uses multiple communication channels simultaneously, is highly interruptible, provides continuous feedback during the interaction, and enables unpredictable and spontaneous remarks. In contrast, virtual communication is not as interactive as FtF; it is not interruptible, communication by definition is not simultaneous, multiple communication channels are not employed, and instantaneous feedback is virtually non-existent.

The interactive model predicts that FtF communication is most appropriate for situations where a shared context or understanding does not already exist and thus, must be created. FtF best supports the iterative, interactive exchanges needed in these situations (Goffman 1981; Goldberg 1990; Rogers 1986; Tannen 1989; Trevino, Lengel, and Daft 1987). On the other hand, electronic media are most appropriately used when a shared context has already been established and where simple exchanges are required (Brown and Yule 1983; Schegloff 1987; Trevino et. al. 1987).

Zack (1993) compared the use of FtF communication with electronic mail in a field study of
Temporal Milestones in Group Development

Group development is the study of how groups mature over time and is a topic that has been of interest to social psychologists since the 1950s (e.g., Bales, 1950; Bennis & Shepard, 1956; Moscovici, 1974; Festinger, 1950). According to Bennis and Sheppard (1956), “a mature group knows very well what it is doing. The group can resolve its internal conflicts, mobilize its resources, and take intelligent action... group development involves the overcoming of obstacles to valid communication among the members, or the development of methods for achieving and testing consensus.” (p. 415)

There are three fundamental categories of models that explain how groups develop: sequential, cyclical, and non-sequential (Mann, Gibbard & Hartman, 1967; Mennecke et al. (1992); Chidambaram and Bostrom, 1996a). Essential to sequential development models is the belief that groups go through a linear series of stages as they mature (e.g., Bennis & Sheppard, 1956; Tuckman, 1965; Bales & Strodbeck, 1951), while cyclical models (e.g., Mann, Gibbard & Hartman, 1967; Mills, 1967; Braaten, 1974) propose that groups repeatedly encounter the same issues. More recently, non-sequential models emphasize that group development is less deterministic and that groups are part of a larger environment (Gersick, 1988; McGrath, 1991). Despite fundamental differences among these model categories, commononality exists with respect to the presence of critical periods in a group’s development (e.g., Bales, 1950; Braaten, 1974; Mills, 1964; Gersick, 1988, 1989; see Chidambaram & Bostrom (1996a) for a summary). These temporal development groups (Finholt et al., 1990), Galegher (1990) states that “…participants felt meetings of this type were necessary, or at least desirable, to converge on a common perspective…” (p. 205).

In the interim periods between the temporal milestones, group members work individually or in small groups to accomplish their assigned tasks (Galegher, 1990). The primary need of the group between these FtF meetings is to coordinate and communicate with all members, sharing work and information as tasks are completed. The needs of the group do not center on intense interaction, but rather one-to-one or one-to-many communication. Kiesler and Sproull (1992) speculate that groups can benefit from mechanisms, such as virtual communication, that allow for the quick and frequent transmission of information in a form that will permit other members to interpret and use it.

Predicated upon this discussion of the delineation of groupwork according to temporal milestones and interim periods, and the associated desirable interactivity level, a mixed-mode of interaction that temporally sequences FtF and virtual communication is suggested. Groups interacting in this fashion will be referred to as mixed-mode groups.

Based on this ostensibly effective matching of interaction mode to group activity, it is expected that the satisfaction of members of mixed-mode groups will be higher compared to virtual groups. Therefore, it is hypothesized that

\[ H1. \text{ Members of mixed-mode groups will be more satisfied compared to virtual groups.} \]

Specifically:

\[ H1a. \text{ Members of mixed-mode groups will be more satisfied with the group solution compared to virtual groups.} \]
H1b. Members of mixed-mode groups will have more confidence in the group solution compared to virtual groups.

H1c. Members of mixed-mode groups will be more satisfied with the group interaction process compared to virtual groups.

H1d. Members of mixed-mode groups will be more satisfied with the quality of discussion compared to virtual groups.

H1e. Members of mixed-mode groups will perceive a higher level of teamwork compared to virtual groups.

Path a - Interaction Mode and Group Development
Characteristics of well-developed groups

In their review of the group development literature, Chidambaram and Bostrom (1996a) found agreement across models concerning characteristic behaviors that distinguish between well and not-so-well developed groups. These characteristics include cohesiveness and conflict management.

Cohesiveness is considered by many to be the most important construct representing group development and has been extensively studied within the field of social psychology. Cohesiveness characterizes how close members are to one another and their level of attraction to the group. A well-developed group exhibits cohesiveness such that group members are tightly coupled to one another and to the group as a whole (McGrath, 1991). A cohesive group works together toward the same goal and achieves a higher level of performance compared to less cohesive groups, as long as the level of cohesiveness does not lead to groupthink (Janis, 1982).

Similar to cohesiveness, how a group handles conflict is a critical determinant of group effectiveness. Conflict can be characterized as positive or negative. Productive differences of opinion and constructive debates are examples of positive conflict. The absence or suppression of such conflict can result in groupthink with disastrous consequences (Janis, 1982). On the other hand, negative conflict is exhibited in personality conflicts between group members, refusal to cooperate, and belligerence on the part of one or more members. A well-developed group is adept at managing conflict – the group is open to positive conflict and works to minimize negative conflict.

FtF interaction should increase the level of cohesion within a group as members have the opportunity to meet each other, share information about themselves and interact in an environment rich in social cues (Rogers 1986). Mixed-mode interaction should allow conflict to be managed better -- misunderstandings that can arise under conditions of reduced social context (Short et al., 1976) should be diminished due to regular interaction in the richer FtF environment. This intertwining of interaction modes should result in more effective communication as the different needs for interaction are fulfilled within each period of group work. Finally, it has been argued that FtF communication speeds up group development (Chidambaram & Bostrom, 1996a). Therefore it is hypothesized that:

H2. Members of mixed-mode groups will perceive their group as more highly developed compared to virtual groups.

Specifically, with regard to perceptions:

H2a. Members of mixed-mode groups will be more cohesive than virtual groups.

H2b. Members of mixed-mode groups will manage conflict more effectively than virtual groups.

Path b - Group Development and Satisfaction
Satisfaction

Porter and Lawler (1986), in their model of motivation, link satisfaction and performance. Specifically, they explain that effective performance leads to satisfaction. Various behavioral theories focus on the needs of an individual, explaining that as certain needs are met, an individual’s satisfaction level increases (e.g., Alderfer, (1972); Maslow, 1943; McClelland, 1961). These theories discuss an individual’s need to interact with others. In his Needs Hierarchy Theory, Maslow (1943) describes this need as belongingness while Alderfer’s ERG Theory (1972) refers to it as relatedness. Similarly, in the Learned Needs Theory, McClelland (1961) discusses an individual’s need for affiliation.

It is expected that more mature groups will interact frequently, be more cohesive and better able to handle conflict, and exhibit more off-task, interpersonal behavior compared to their lesser-developed counterparts. It is expected that mature groups will better satisfy a group member’s need for high performance as well as the need to interact, compared to less developed groups. In terms of McGrath’s TIP theory (1991), mature groups attend to their performance function as well as their member well-being function compared to less developed groups. Therefore, variables relating to both performance and interaction have been included. Satisfaction with the group’s solution and confidence in the solution pertain to performance satisfaction while satisfaction with the interaction process and the perceived quality of discussion relate to satisfaction with the group interaction. Additionally, a variable relating to satisfaction with the level of teamwork was included.

It is predicted that:

H3. Members that perceive their group as more highly developed will be more satisfied compared to members that perceive their group as less developed.

Specifically, with regard to member perceptions:
H3a-1. Members of cohesive groups will be more satisfied with the solution.
H3a-2. Members of cohesive groups will have more confidence in the solution.
H3a-3. Members of cohesive groups will be more satisfied with the interaction process.
H3a-4. Members of cohesive groups will be more satisfied with the discussion quality.
H3a-5. Members of cohesive groups will achieve a higher level of teamwork.

H3b-1. Members of groups that manage conflict effectively will be more satisfied with the solution.
H3b-2. Members of groups that manage conflict effectively will have more confidence in the solution.
H3b-3. Members of groups that manage conflict effectively will be more satisfied with the interaction process.
H3b-4. Members of groups that manage conflict effectively will more satisfied with the discussion quality.
H3b-5. Members of groups that manage conflict effectively will achieve a higher level of teamwork.

Group Development as a Mediating Variable
A variable serves as a mediator to the degree that it accounts for the relation between the independent and dependent variables. In situations where a causal linkage has been determined, an attempt should be made to show that “X causes Y through Z and that once Z has been controlled, the relationship between X and Y vanishes” (Baron & Kenny, 1986:1177). In this instance, X and Y are the independent (mode) and dependent variables (satisfaction), respectively, while Z is the mediator (group development). In essence, a mediating variable explains how or why these effects occur (Baron & Kenny, 1986). Baron and Kenny state that

“A variable functions as a mediator when it meets the following conditions: (a) variations in levels of the independent variable significantly account for variations in the presumed mediator (i.e., Path a), (b) variations in the mediator significantly account for variations in the dependent variable (i.e., Path b), and (c) when Paths a and b are controlled, a previously significant relation between the independent and dependent variables is no longer significant...” (p. 1176).

Heretofore, three fundamental points have been argued. First, different modes of interaction (i.e., purely virtual versus mixed-mode) impact group member satisfaction (path c). Second, interaction mode influences the perceived level of group development (path a). Third, the perceived level of group development directly impacts the satisfaction of group members (path b).

3. Research Design and Method
Design: A 1 x 2 factorial design was employed. The single factor, mode of interaction, had two treatments: mixed-mode and virtual. The mixed-mode treatment employed a sequence of three FtF meetings spaced exactly one week apart, beginning on the first day of the experiment (FtF meetings on days 1, 8, and 15; virtual interaction on days 1-17). Group members communicated asynchronously via a computer conferencing system between FtF meetings. Groups in the virtual treatment communicated only asynchronously using the computer conferencing system during the experimental period; these groups had no FtF contact. The experiment ran for 17 days.
Task: The Computerized Post Office (CPO) was the task used in this experiment. This task was adapted from Goel and Pirolli (1989) and Olson et al. (1993). Olson et al. characterize this task as incorporating planning, creativity, decision-making, and cognitive conflict (McGrath, 1984). Groups were required to reach consensus on the requirements and high-level design for the CPO and to submit these requirements in a written report at the end of the experiment. Each group produced a single report.

Subjects & group composition: Subjects consisted of graduate students in the MBA and MSIS program at a branch campus of a large university. For their participation, all subjects received course credit. Subjects were assigned to groups randomly. Due to the study of group development, measures were taken to assure that no groups had previous experience working together.

There were a total of 83 subjects participating in the experiment: 47 in the virtual treatment and 36 in the mixed-mode treatment. Females accounted for 37% of the membership in the virtual treatment and 30% in the mixed-mode treatment. The average amount of work experience for subjects across treatments was almost identical at approximately 8 years. Similarly, the distribution across age categories was very similar. The two most populated age categories were the 23-30 year range, accounting for about 55% of the subjects in both treatments, and the 31-35 year range, with 28% of the subjects. All but six subjects were indigenous to the United States. Overall, the background characteristics of subjects across both treatments were practically identical.

Although every attempt was made to assign groups to conditions so that each condition was balanced according to number of groups, group size and academic major, this goal was not entirely achieved. Twenty groups participated in the study. The virtual treatment had 11 groups, each with a group size of four, while the mixed-mode treatment had nine groups, three
with five members and the remaining six with four members. Concerning academic major, in the mixed-mode treatment, 22% of the subjects were enrolled in the MSIS program, while MSIS students accounted for 31% in the virtual treatment.

**Technology and Facilitation:** Both the mixed-mode and virtual groups communicated electronically using the FirstClass™ computer conferencing system developed by Softarc, Inc. Each group communicated in its own conference established on FirstClass. The conferences were minimally facilitated. The conference facilitator’s role was that of a technical assistant, helping groups with equipment problems and answering questions of a technical nature.

FirstClass is a commercially available conferencing system with a GUI interface. In addition to sending and receiving messages within conferences, the conferencing software supports message sorting and threading. There is also a history file associated with each message, indicating whether a group member has read the message.

**Training:** Subjects met within their respective classes for training on the essential aspects of FirstClass. Within classes, subjects were randomly assigned to training conferences. Training was completed within one hour. All subjects were trained using the same practice problem, a modified version of “Entertainment for Dutch Visitors” (Olson et al., 1993).

**Surveys:** All participants completed various surveys (not all surveys are analyzed in this paper). The background survey was administered prior to the start of the experiment and used to collect demographic and other background data on subjects. The post-experiment survey was administered at the end of the experiment and used to collect data on the cohesion, conflict management and satisfaction.

**Pilot Study:** A pilot study was conducted with five groups per treatment. Training and experimental procedures were tested. Originally, the experimental time frame was 14 days. However, the mixed-mode groups reported that their last (3rd) FtF meeting would be more beneficial if there were several days after the meeting to incorporate modifications to their report. Thus, the length of the experiment was extended to 17 days. Also, the sound on some of the video-tapes were inaudible. Therefore, equipment use and setup was also modified.

**Procedure:** All subjects completed a consent form and a background survey prior to the start of the experiment. All mixed-mode groups met in separate rooms for their FtF meetings; an individual group remained in the same room for all three meetings. Each meeting was video-taped. All groups had access to the FirstClass computer conferencing system throughout the entire experimental period. FirstClass was available both inside and outside the university via the Internet.

Mixed-mode groups began the experiment on day 1 with their first one-hour FtF meeting. At the beginning of the second week (day 8), mixed-mode groups met for their second one-hour meeting. At the end of the 2nd week (day 15), mixed-mode subjects met for their 3rd one-hour FtF meeting. These groups used the computer conferencing system to communicate virtually between FtF meetings.

All groups had a leader who volunteered for the role at the beginning of the experiment. The leader was instructed that his/her job was to ensure that the written report was submitted in the group’s FirstClass conference by midnight of the last (17th) day of the experiment. Any other leadership responsibilities were left to the discretion of the groups. Each group determined the content and layout of the written report, although the CPO task called for analysis of several different aspects.

**Debriefing:** All groups were debriefed in a FtF session where the experimental design and research questions were explained. All participants were questioned regarding their adherence to the rules for communication. Various complaints were received, mostly from virtual groups; no one indicated failure to comply with the experimental rules.

**Measures of Satisfaction and Group Development**

Each of the following scales was previously validated and tested for reliability.

**Satisfaction:**
Solution refers to the group report regarding the CPO. Solution satisfaction was measured using Green and Taber’s (1980) five-item scale. Solution confidence was measured using a six-item scale. Interaction process refers to the method used by a group in order to reach the group solution. The five-item scale used to measure process satisfaction was developed by Green and Taber (1980). Perceptions of discussion quality were measured using an eight-item scale developed by Gouran et al. (1978). The perceived level of teamwork was measured using a three-item scale developed by Davison (1997).

**Group Development:**
Work-group cohesion is the extent that employees have close friends in their immediate work unit (Boyer, 1985; Sorensen, 1985). The measure contains five questions, each with a five-interval response scale. Conflict management ability was measured using a two-item scale with a seven-interval response scale. The measure was developed by Chidambaram et al. (1990-91).

**4. Results**

There was an unbalanced distribution of MSIS students between the two experimental treatments. Additionally, group size varied between four and five members with uneven distribution between treatments.
Table 1. Regression Equations for Mediation

Regression 1: Regress proposed mediator on independent variable

<table>
<thead>
<tr>
<th>Y</th>
<th>a</th>
<th>b</th>
<th>R²</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>cohesion as dependent</td>
<td>3.73</td>
<td>0.35***</td>
<td>0.12</td>
<td>11.08</td>
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<tr>
<td>conflict as dependent</td>
<td>3.47</td>
<td>0.32**</td>
<td>0.1</td>
<td>8.95</td>
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Regression 2: Regress dependent variable on independent variable

<table>
<thead>
<tr>
<th>Y</th>
<th>a</th>
<th>b</th>
<th>R²</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Solution Satisfaction</td>
<td>3.910</td>
<td>0.23*</td>
<td>0.04</td>
<td>4.66</td>
</tr>
<tr>
<td>Confidence</td>
<td>3.79 ,32**</td>
<td>0.09</td>
<td>9.46</td>
<td></td>
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<tr>
<td>Interaction Process Satisfaction</td>
<td>3.6738***</td>
<td>0.13</td>
<td>13.53</td>
<td></td>
</tr>
<tr>
<td>Discussion Quality</td>
<td>3.9741***</td>
<td>0.16</td>
<td>16.19</td>
<td></td>
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<tr>
<td>Teamwork</td>
<td>4.0525*</td>
<td>0.05</td>
<td>5.36</td>
<td></td>
</tr>
</tbody>
</table>

Regression 3: Regress dependent on proposed mediator and independent variable

<table>
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<tr>
<th>Y=Solution Satisfaction</th>
<th>a</th>
<th>b</th>
<th>c</th>
<th>R²</th>
<th>F</th>
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</thead>
<tbody>
<tr>
<td>cohesion as mediator</td>
<td>2.01</td>
<td>0.034</td>
<td>0.574***</td>
<td>0.34</td>
<td>20.96</td>
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<tr>
<td>conflict as mediator</td>
<td>3.16</td>
<td>0.121</td>
<td>0.355***</td>
<td>0.17</td>
<td>8.08</td>
</tr>
<tr>
<td>Y=Confidence</td>
<td>a</td>
<td>b</td>
<td>c</td>
<td>R²</td>
<td>F</td>
</tr>
<tr>
<td>cohesion as mediator</td>
<td>1.72</td>
<td>0.143</td>
<td>0.519***</td>
<td>0.34</td>
<td>20.78</td>
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<tr>
<td>conflict as mediator</td>
<td>2.75</td>
<td>0.19**</td>
<td>0.41***</td>
<td>0.26</td>
<td>13.79</td>
</tr>
<tr>
<td>Y=Interaction Process Satisfaction</td>
<td>a</td>
<td>b</td>
<td>c</td>
<td>R²</td>
<td>F</td>
</tr>
<tr>
<td>cohesion as mediator</td>
<td>0.81</td>
<td>0.165*</td>
<td>0.63***</td>
<td>0.5</td>
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<td>conflict as mediator</td>
<td>2.33</td>
<td>0.23*</td>
<td>0.49***</td>
<td>0.36</td>
<td>22.15</td>
</tr>
<tr>
<td>Y=Discussion Quality</td>
<td>a</td>
<td>b</td>
<td>c</td>
<td>R²</td>
<td>F</td>
</tr>
<tr>
<td>cohesion as mediator</td>
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<td>0.23*</td>
<td>0.52***</td>
<td>0.4</td>
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<tr>
<td>conflict as mediator</td>
<td>2.94</td>
<td>0.27**</td>
<td>0.42***</td>
<td>0.33</td>
<td>19.57</td>
</tr>
<tr>
<td>Y=Teamwork</td>
<td>a</td>
<td>b</td>
<td>c</td>
<td>R²</td>
<td>F</td>
</tr>
<tr>
<td>cohesion as mediator</td>
<td>1.72</td>
<td>0.04</td>
<td>0.6***</td>
<td>0.38</td>
<td>24.71</td>
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<td>3.17</td>
<td>0.14</td>
<td>0.36***</td>
<td>0.18</td>
<td>8.76</td>
</tr>
</tbody>
</table>

* p=.05 ** p=.01 *** p = .001

Therefore, two separate analyses of covariance (ANCOVA) were run on all satisfaction and group development variables. Neither analysis produced significant results, indicating that the unbalanced distribution and group size would not significantly impact statistical analyses. Additionally, inter-item reliabilities were calculated for all scales, and scale items were dropped where necessary to achieve an acceptable level of reliability.

Group Development as a Mediating Variable

All of the hypotheses can be assessed by testing for mediation. This requires the estimation of three regression equations. The first model regresses the dependent variable (proposed mediator - cohesion, conflict management) on the independent variable (interaction mode); the second model regresses the dependent variable (satisfaction) on the independent variable; the third model regresses the dependent variable (satisfaction) on both the independent and proposed mediator variables. The regression equations in models one, two, and three can be represented as

Regression 1: regres dependent on independent variable

\[ Y = a + bx \]

Regression 2: regress mediator on independent variable

\[ Y = a + bz \]

Regression 3: regress dependent on independent and mediator variables

\[ Y = a + bx + cz \]

where \( Y \) is the dependent variable in the first equation and the mediator in the second and third equations, \( x \) is the independent variable, \( z \) is the mediator, \( b \) is the beta coefficient for the independent variable, and \( c \) is the beta coefficient for the mediator variable.

The following conditions must be met to establish mediation (Barron & Kenny, 1986): (1) \( b \), the
beta coefficient for the independent variable, is statistically significant in equation 1; (2) $b$, the beta coefficient for interaction mode, is statistically significant in equation 2; (3) $c$, the beta coefficient for the mediator, is statistically significant in equation 3; (4) if all of these conditions hold in the predicted direction, then the effect of the independent variable on the dependent variable must be less in equation 3 compared to equation 1.

The results of the regression analysis for each of the proposed mediating and satisfaction variables are shown in Table 1. Condition 1 was met for all satisfaction variables: interaction mode significantly impacted all satisfaction variables. Specifically, members of mixed-mode groups were more satisfied with the group solution, interaction process, quality of discussion, and level of teamwork, and had more confidence in their solution. These results provide support for hypotheses H1a-H1e.

Condition 2 was met for both mediating variables: cohesion and conflict management were significantly affected by interaction mode. Also, members of mixed-mode groups rated their groups as both more cohesive and better able to manage conflict. Therefore, support was found for hypotheses H2a and H2b.

Similarly, condition 3 was met for both mediating variables: cohesion and conflict management significantly affected all satisfaction variables. Thus, hypotheses H3a1-5 and H3b1-5 were supported.

5. Discussion and Conclusion

The objective of this research was to explore the mediating effect of perceptions of group development on interaction mode and subjective satisfaction. This study is important because (1) although satisfaction has been an oft-included variable in experimental research on GSS and CMC, it is the norm to merely report these results rather than attempting to discern underlying causes and (2) there is a severe lack of studies exploring the use of both FtF and computer-mediated communication to accomplish group work.

The results of this study support the mediational model which indicates that interaction mode impacts satisfaction levels only indirectly through group development. Evidence for this was found for nine out of ten relationships. Conditions for mediation were met, namely that: (1) perceptions regarding the level of group development significantly and positively affected satisfaction levels of individuals and (2) the previously significant relationship between interaction mode and satisfaction changed to non-significant when the perceived level of group development was controlled. One mediation hypothesis was not supported: conflict management did not mediate solution confidence. Workgroup cohesion and conflict management were found to mediate all other satisfaction variables.

Perfect mediation, where a previously significant relationship between the independent and dependent variable changes to non-significant when the mediating variable is controlled, occurred for solution satisfaction and the perceived level of teamwork for both cohesion and conflict mediators. Partial mediation, where the above relationships exist except that significance is diminished rather than eliminated, occurred for interaction process satisfaction and perceived quality of discussion for both proposed mediators. The only inconsistent result between cohesion and conflict management occurred with confidence in the solution: perfect mediation occurred with cohesion, while no mediation occurred with conflict management.

Organizational Implications

As virtual project teams are increasingly used to accomplish complex organizational work, project managers must not only be cognizant of the inherent difficulties associated with geographically distributed teams, but must be informed about how to reduce these drawbacks. In international teams where there is a high cost in terms of both time and money of bringing teams together periodically in a face-to-face environment, managers need to look to other means for developing mature teams. With increases in bandwidth, videoconferencing can become a substitute for FtF interaction, however, group development techniques must also be sought to reduce the development discrepancy.

The organizational impact of unsatisfied workers should not be side-lined. Efficacy beliefs refer to judgments that individuals make concerning their ability to perform a task (Bandura, 1977, 1986; Riggs & Knight, 1994). Individuals who believe that they possess the requisite ability are more likely to endeavor to perform a task. However, workers frequently lack feedback about their performance, making perceptions of past performance critical determinants of the tasks they undertake (Greenwald, 1980) and the amount of effort they exert (Felson, 1984). Studies have shown that as people perform tasks over time, perceptions of performance influenced motivation and quality more than actual performance (Bandura & Jourden, 1991). Thus, the adage ‘perception is reality’ seems to be ‘alive and well’ in the workplace. Thus, it would seem that a relatively simple and inexpensive means to alter workers’ perceptions is to provide constructive feedback to members of virtual teams.

Limitations

The most serious limitation of this study is the relatively small number of experimental groups (i.e., 20) and subjects (83) that were employed. Therefore, the implications and generalization of results should be tentatively considered. More groups must be analyzed in order to ascertain whether these ‘true’ results. A less serious but still limiting factor is that the treatment
groups were not exactly equivalent. For example, all FtF meetings of the mixed-mode groups were videotaped which may have resulted in unintended influence.

**Future Research**

An investigation of other variables that could mediate between mode and satisfaction should be conducted. Also, co-located groups today resemble mixed-mode groups as they depend on virtual communication to support day-to-day communication. A field study of such naturally occurring groups is a natural extension to this study.

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**References**


