Cultural Diversity, Group Interaction, Communication Convergence, and Intra-group Conflict in Global Virtual Teams: Findings from a Laboratory Experiment

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Abstract
In this paper we report the findings of a laboratory experiment in which global virtual teams used IBM’s Lotus Sametime to work on decision-making tasks. We restricted our study to short-duration virtual teams. We find that national cultural diversity adversely affects interaction among team members. We also find that interaction among team members has a curvilinear (an inverted U) relationship with intra-group conflict in these teams. Our statistical analyses reveal a curvilinear relationship between the use of polling and ranking tools of collaboration technology and intra-group conflict. The findings of the study provide motivation for future research on the use of collaboration technology support and social interaction in short duration virtual teams.

1. Introduction
Virtual teams are groups of geographically, organizationally and/or temporarily dispersed individuals brought together by information and telecommunications technologies to accomplish one or more organizational tasks (Powell, Piccoli, and Ives, 2004). With the globalization of business, virtual teams have become almost indispensable for many business organizations and global virtual teams have been formed. Global virtual teams are internationally distributed groups of people with an organizational mandate to make or implement decisions with international components and implications. The members of these teams rarely meet in person. Most of their interactions and decision-making activities rely on the use of communication technology (Maznevski and Chudoba 2000). The technology mediated interaction pattern among team members is adding some challenges in the functioning of the teams. As virtual teams cut across organizational, national, and functional boundaries, diversity is an inherent aspect of these teams. Members of culturally diverse global virtual teams have differences in norms, beliefs, and experiences which affects free interaction among team members. Moreover, interaction among the members of these teams usually generates diverse views and information and thus the development of common understanding among the team members becomes critical. The problem exacerbates considerably when group members interact using collaboration technologies, which, with the exception of audio and video conferencing systems, employ lean media. The use of lean media hinders transmission of non-verbal cues (such as, gestures and facial expressions) and constrains the team members to rely primarily on written interactions to perform the group task. While these communication media usually support fast transmission of information, they have limitations regarding the processing of transmitted information (Dennis, Fuller, and Valacich, 2008). The limitation regarding information processing becomes critical in situations that do not have well-established norms and involve unfamiliar tasks (Dennis et al., 2008). The use of collaboration technology tools that support convergence of transmitted information helps the team members to develop a shared understanding in these situations. Although technology support for convergence of information is important for culturally diverse virtual teams, not many empirical studies have addressed this issue. This motivates us...
to explore the following research questions in this study:

- Does cultural diversity adversely affect interaction among the members in short-duration virtual teams?
- Does the interaction among team members affect manifestation of conflict in short-duration virtual teams?
- Does use of collaboration technology tools that facilitate convergence of information weaken intra-group conflict in short-duration virtual teams?

In this paper, we present three hypotheses that represent these research questions. We also report the findings of a laboratory experiment that was conducted to validate our hypotheses.

In the next section we review the literature on our study constructs and present our hypotheses. Next, we discuss the research method, which is followed by the presentation of the results. We end the paper with a discussion on the findings, the limitations of the study, and the conclusion.

2. Literature review
2.1. Global Virtual Teams and Cultural Diversity

Diversity within a work group refers to its composition in terms of the distribution of demographic traits and cognitive differences manifested as surface-level and deep-level attributes (Chidambaram, 2005). Surface-level diversity is defined as difference among team members in overt demographic characteristics, which include age, gender, and race/ethnicity and are often reflected in differences in physical features. Surface-level diversity is important in face-to-face teams. Team members can make reasonable estimates of age, gender, or racial/ethnic background of the other members and therefore, of that person’s (dis) similarity to themselves almost immediately (Jackson, May, and Whitney, 1995). Deep-level diversity refers to differences among team members’ psychological characteristics, including personalities, values, and attitudes (Jackson et al., 1995; Harrison, Price, and Bell, 1998). Clues to these latent individual differences are taken from members’ interactions with one another as they unfold over time. Those clues are expressed in behavioral patterns, verbal and nonverbal communications, and exchange of personal information (Harrison, Price, Gavin, and Florey, 2002).

Global virtual teams usually consist of individuals from different countries with diverse cultural backgrounds. Diversity is, thus, an inherent characteristic of global virtual teams. As the members of global virtual teams do not usually meet face-to-face, they do not immediately perceive the surface-level diversity. However, they perceive differences in cultural backgrounds through the language used in conversation, as D’Anglegan and Tucker (1973) observed that even sophisticated bilinguals in Canada sometimes fail to correctly interpret a monolingual’s message. Deep-level diversity in global virtual teams usually results from the cultural heterogeneity of the team members. Difference in culture is a major cause of perceived dissimilarity and it is manifested through different cognitive processes. Culture is defined as the set of deep-level values associated with societal effectiveness, shared by an identifiable group of people (Maznevski, Gomez, Noorderhaven, and Peichuan, 1997). Culture plays a major role in information processing of individuals. Cultural values influence the perceptual filter through which a person interprets information needed to make decisions (Adler, 1997; Hofstede, 1980). Thus, in a cross-cultural team, different members’ analyses and interpretation of facts and events can differ significantly.

National culture is the collective programming of the mind, which distinguishes one group or category (nation) from another (Hofstede, 1980). National culture helps us understand why people from different countries may think, feel, and behave differently when faced with problems. The critical question is whether the cultural differences can affect group behavior. We discuss this in the next subsection of the paper.

2.2. Diversity and its effect on group behavior

Prior research highlights both positive and negative effects of diversity on the functioning of the small groups (Jackson, 1991). Heterogeneous groups are more creative and more likely to reach high-quality decisions than homogeneous groups (McGrath, 1984; McLeod, and Lobel, 1992; Triandis, Hall, and Ewen, 1965; Willems and Clark, 1971). The people of different cultures bring a variety of perspectives and outlooks to a task (Adler, 1990). Diversity reduces the probability of groupthink (Janis, 1982), a phenomenon that occurs when homogeneous and cohesive groups dedicated to unanimity do not explore the full range of available
solutions and, hence, can make drastic errors in decision-making (Janis, 1982). Diversity is related to lower levels of interpersonal attraction, more stress, and more turnover. Diversity has the effect of greatly increasing the complexity of the process that must occur in order for the group to realize its full potential (Adler, 1990). Members of diverse backgrounds may require more time to reach a decision (Fisher, 1980). Diversity has a negative impact on communication and interpersonal attraction (Adler, 1990; Steiner, 1972; Storey, 1991; Triandis, 1959). Heterogeneous groups suffer from delayed transmission of messages, message distortion, and restriction of communication channels (Rogers and Bhowmick, 1971). Because of these hidden influences, multicultural groups may find cooperative decision-making difficult (Kirchmeyer and Cohen, 1992; Watson, Kumar, and Michaelsen, 1993). Watson et al (1993) find that heterogeneous groups are low performers in the short run; however, the performance improves in the long run.

In this paper, we focus on national cultural diversity and its influence on group interaction in global virtual teams. We attempt to build up this relationship in the next sub-section of the paper.

2.3. National Cultural Diversity and Group Interaction

Interaction among the members of a team can increase when each team member understands others’ views and has similar ways of thinking, which is the case with homogeneous teams. On the contrary, the members of multi-cultural global virtual teams have diversity in their beliefs and line of thinking, which calls for extra effort to understand others’ views. Two different scenarios can emerge in culturally diverse virtual teams. In moderately heterogeneous teams, members with similar cultural background have easy interaction amongst themselves; these members are less inclined to understand the comments of others whose cultural backgrounds are different. However, the members of completely heterogeneous teams do not get the opportunity to form sub-groups; they attempt to develop shared understanding and group identity (Early and Mosakowski, 2000). Thus, we expect that the moderately heterogeneous global virtual teams will have the minimum intra-group interaction. We, therefore, hypothesize:

**H1:** In short-duration virtual teams, national cultural diversity will have a U-shaped curvilinear relationship with group interaction such that the interaction among the team members will be low for moderately heterogeneous teams and will increase for both homogeneous and completely heterogeneous teams.

2.4. Intra-group Conflict and Global Virtual Teams

Conflict is broadly defined as perceived incompatibilities or perceptions by the parties involved that hold discrepant views or have interpersonal incompatibilities (Boulding, 1963). Thus, conflict in any team is concerned with relationship issues and with task issues (Guetzkow and Gyr, 1994; Jehn, 1997). Relationship conflicts arise from differences in personal taste, political preference, values, and ideology, whereas task conflicts are conflicts about the distribution of resources, about procedures and policies, and about judgments and interpretation of facts (De Dreu and Weingart, 2003). The relationship conflict, which is based on emotional or interpersonal issues, is detrimental to the functioning of a team. On the contrary, task conflict is actually beneficial to the team effectiveness (Van de Vliert and De Dreu, 1994). Task conflict focuses on the task content and/or process and it causes team members to consider more alternatives. Consideration of diverse opinions and strategies enable a group to arrive at a better solution (Pelled, Eisenhardt, and Xin, 1999). Jehn (1997) finds that the type of task that group members perform determines whether conflict helps, hinders, or has no significant impact on individual and group performance.

Conflicts in virtual teams are different from those of face-to-face teams. According to Hinds and Bailey (2000), virtual teams experience two direct consequences of their virtuality: mediated communication and unshared context. Mediated communication causes higher levels of affective and task conflict as group members neglect to censor their comments and to accommodate the preferences of their team members. However, Short, Williams, and Christie (1976) argue that mediated communication reduces the extent to which participants and the interpersonal relationship are salient in the interaction. Similarly, Sproull and Kiesler (1991) argue that computer-mediated communication depersonalizes the interaction,
leading to greater concentration on the message rather than the interacting persons.

However, concentration on messages may not result in common understanding unless group members have a sufficient level of interaction. The problem is critical for multi-cultural virtual teams whose members have different beliefs and norms. Inadequate exchange of messages among the members of these teams will aggravate misunderstanding and will result in conflict. We expect that an optimum level of interaction is necessary to reduce the extent of perceived incompatibility among team members. Hence:

**H2:** In short-duration virtual teams, group interaction will have an inverted U-shaped curvilinear relationship with intra-group conflict.

The members of short duration global virtual teams have limited opportunity to socialize. In addition, when these team members communicate in a synchronous mode, they do not have sufficient time to process the messages that they receive from others. Although these communication processes may convey a large volume of information, the team members cannot converge on any abstract information unless they process the transmitted information. When team members do not know each other and/or are unfamiliar with the task and communication media, the development of shared interpretation about task goal and strategies rely more on convergence processes than on conveyance processes (Dennis et al., 2008). The use of collaboration technology that offers tools to support convergence of information will help team members to negotiate and adjust differences and develop shared understanding (Dennis et al, 2008). These tools provide support for voting, ranking, and multi-attribute decision-making activities. Thus, we hypothesize:

**H 3:** In short-duration global virtual teams, the use of tools to support convergence of information is negatively related to intra-group conflict.

3. Research Method

3.1. Subjects and Tasks

In order to validate our hypotheses, we used the data collected from a laboratory experiment. We used Lotus Sametime of IBM, which is a collaboration technology that supports electronic meetings. Volunteer subjects enrolled in graduate business programs at a major Midwestern US university participated along with graduate students from a major management school in India. All subjects were experienced with information and communication technology and familiar with Internet and web-based applications. The students enrolled at the US university represented different cultural and ethnic backgrounds. Each participant was trained on Lotus Sametime. In the training sessions, the participants used Lotus Sametime to work on a task that was similar to the experimental task. Altogether 28 three-member teams participated in the experiments. However, one of these teams had only two members and was, therefore, not considered in the data analyses. Each team was assigned to one of the following two categories:

- **Homogeneous** – Participants were from the same national cultures.
- **Heterogeneous** - Participants were from different national cultures.

There were 16 homogeneous teams and 11 heterogeneous teams in the experiment.

Due to the nature of the study, the approximate 10½ hour time difference between the two countries, and the schedules of the students in each location, completely random assignment of subjects to groups was not possible. However, once the availability of the students in each location was known and the time differences, class schedules, etc. were accounted for, students were randomly assigned to either homogeneous or heterogeneous teams, based on their availability.

The teams were asked to assume the role of an advisory committee that would make recommendations to the administration of a fictitious university regarding 5-6 proper uses of the technology fees that were collected from the students of the university. There were two versions of the task: basic and modified. The modified version was created by adding an extra component to the basic version. 13 teams performed this basic version of the task, whereas the remaining 14 teams worked on the modified version. These teams suggested the allocation of technology fees to the 5-6 uses that they identified through discussion during the experiment.

3.2. Experimental Procedures

The subjects used IBM’s Lotus Sametime to work on the experimental task. Anonymity among group members was maintained. Each group was under the control of a facilitator, who communicated using the “instant messaging” option of Lotus Sametime. The facilitator monitored the discussions and dealt with any technical question that any participant had during the session; the facilitator did not interject anything into the discussion regarding the task or the decision
regarding allocation of the technology fee. Each session consisted of the following:

- **Activity 1:** Commenting on advantages and disadvantages of each option of using technology fees.
- **Activity 2:** Selecting 5-6 options of using technology fees.
- **Activity 3:** Allocating technology fees to the selected options (only fourteen groups performed this activity as an additional task in the modified version).
- **Activity 4:** Voting the final decision.
- **Activity 5:** Completing questionnaires used to collect data of the experiment.

### 3.3. Variable Identification

This study involved two independent variables (national cultural diversity of virtual teams and the use of tools to support convergence of information), and two dependent variables (group interaction and intra-group conflict). We used objective measures for the variables of our study.

**National cultural diversity:** The participants indicated their nationality in a questionnaire that they completed after the experiment. Each nationality was considered as a category of national culture. Following the standard approach for categorical variables, we calculated entropy-based indices (Teachman, 1980) to measure national cultural diversities of the teams. The entropy-based index is calculated as:

\[
\text{Diversity} = \sum -P_i \ln(P_i),
\]

where, \(P_i\) indicates the proportion of group members belonging to each category of diversity. Thus, if all three members of a group were from the same nation, the national cultural diversity would be 0.000. In a group that had two members with the same nationality, the diversity index would be 0.637.

**Group interaction:** Group interaction was measured by counting the number of messages exchanged among the team members during the course of the meeting. A researcher of this study analyzed the meeting log to count the messages that could be labeled as components of group interactions.

**Intra-group conflict:** Number of episodes of task and relationship conflicts in each session, identified through content analyses of team members’ discussions in each session.

**Use of tools to support convergence of information:** Number of times a group used polling and ranking tools of Lotus Sametime. Figure 1 shows the screens of Lotus Sametime when subjects used polling and ranking tools.

### 4. Results

#### 4.1. Hypotheses Testing

We conducted multiple regression to test our hypotheses. A level of significance of 0.05 was considered to validate each hypothesis. Any weak significance level in the range of .05 to .10 was treated as suggestive of the nature of relationship between the variables.

Since the relationships hypothesized were either an U-curve (hypothesis 1) or inverted U-curve (hypothesis 2), a quadratic model was selected:

\[
Z = \beta_0 + \beta_1X + \beta_2X^2 + \beta_3Y + \varepsilon \tag{1}
\]

The standard precautions associated with polynomial regression were adopted (Montgomery and Peck, 1980). These included keeping the order of the model as low as possible, progressive
introduction of polynomial terms, and proscriptions about extrapolating beyond the observed data range. SAS was used to develop the General Linear Models (GLM) for the regression analyses. For each polynomial regression, we also conducted linear regressions to ensure that the polynomial model was a significant improvement over the linear one in terms of adjusted R\(^2\).

Table 1 presents the regression results to test hypothesis 1. Figure 2 presents the hypothesized relationship between the national cultural diversity index and the predicted value of group interaction.

Table 2 presents the regression results to test hypotheses 2 and 3. Figure 3 presents the hypothesized relationship between group interaction and the predicted value of intra-group conflict.

Table 1. Results of regression analysis for group interaction

<table>
<thead>
<tr>
<th>Independent Variable</th>
<th>Group Interaction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intercept</td>
<td>204.500 (20.941)***</td>
</tr>
<tr>
<td>National cultural diversity</td>
<td>-274.098 (115.109)**</td>
</tr>
<tr>
<td>National cultural diversity(^2)</td>
<td>156.124 (109.049)</td>
</tr>
<tr>
<td>Adjusted R(^2)</td>
<td>0.348</td>
</tr>
<tr>
<td>F</td>
<td>7.68</td>
</tr>
<tr>
<td>Prob. (F)</td>
<td>0.003</td>
</tr>
<tr>
<td>N</td>
<td>26</td>
</tr>
<tr>
<td>Hypotheses Supported?</td>
<td>H1: Yes</td>
</tr>
</tbody>
</table>

* p<0.10; ** p<0.05; *** p<0.01; **** p<0.001

Table 2. Results of regression analysis for intra-group conflict

<table>
<thead>
<tr>
<th>Independent Variable</th>
<th>Group Interaction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intercept</td>
<td>-0.423 (1.194)</td>
</tr>
<tr>
<td>Group interaction</td>
<td>0.025 (0.014)**</td>
</tr>
<tr>
<td>Group interaction(^2)</td>
<td>-0.00004 (0.00004)</td>
</tr>
<tr>
<td>Use of tools to support convergence of information</td>
<td>-0.063 (0.101)</td>
</tr>
<tr>
<td>Adjusted R(^2)</td>
<td>0.210</td>
</tr>
<tr>
<td>F</td>
<td>3.22</td>
</tr>
<tr>
<td>Prob. (F)</td>
<td>0.04</td>
</tr>
<tr>
<td>N</td>
<td>26</td>
</tr>
<tr>
<td>Hypotheses Supported?</td>
<td>H2: Weak support</td>
</tr>
<tr>
<td></td>
<td>H3: No</td>
</tr>
</tbody>
</table>

* p<0.10; ** p<0.05; *** p<0.01; **** p<0.001

5. Discussion

In this study, we examined the effect of the cultural heterogeneity on group interaction in global virtual teams. We have found that the members of culturally homogeneous teams have the highest level of group interaction. We also found that the minimum level of group interaction took place in the teams that were moderately heterogeneous. The findings support the concept of sub-group formation in virtual teams (Early and Mosakowski, 2000). The results indicate that group interaction in completely heterogeneous teams is better than that in moderately heterogeneous teams. This is an interesting finding.
and has implications for the management of global virtual teams. The managers of global should be careful about the formation of sub-groups in these teams.

We found weak support for hypotheses 2 and did not find any support for hypothesis 3. After analyzing the results and the operationalization of variables, we realized that the voting and ranking tools could lower conflict only after these tools were used by each team (i.e. in activities 2, 3, and 4 of the experiment). In our regression analysis we included the conflict episodes for the entire session which involved discussion among the participants (with no use of polling and ranking tools) and making group decision (using polling and ranking tools). Thus, it was necessary to measure the conflict episodes that took place in the decision making phase of each session (i.e. after activity 1) and conduct two separate regressions to test hypotheses 2 and 3. We tested hypothesis 2 by regressing the number of conflict episodes in the entire session over group interaction. Hypothesis 3 was tested by regressing the number of conflict episodes in the decision making phase of the session (i.e. activities 2, 3, and 4) over the number of times the polling and ranking tools was used in the session. Our results reveal strong support for hypothesis 2 (as shown in table 3).

Table 3. Results of revised regression analysis for intra-group conflict

<table>
<thead>
<tr>
<th>Independent Variable</th>
<th>Group Interaction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intercept</td>
<td>-0.815 (1.001)</td>
</tr>
<tr>
<td>Group interaction</td>
<td>0.027 (0.013)**</td>
</tr>
<tr>
<td>Group interaction²</td>
<td>-0.00005 (0.00003)</td>
</tr>
<tr>
<td>Adjusted R²</td>
<td>0.292</td>
</tr>
<tr>
<td>F</td>
<td>4.76</td>
</tr>
<tr>
<td>Prob. (F)</td>
<td>0.02</td>
</tr>
<tr>
<td>N</td>
<td>26</td>
</tr>
<tr>
<td>Hypotheses Supported?</td>
<td>H2: Yes</td>
</tr>
</tbody>
</table>

* p<0.10; ** p<0.05; *** p<0.01; **** p<0.001

Our revised test for hypothesis 3 did reveal a significant result. However, our result indicate that intra-group conflict has a significant positive relationship with the use of polling and ranking tools of collaboration technology ($\beta=0.135$, $p=0.005$, adjusted $R²=0.025$). This contradicts the proposed negative relationship between the study variables. We conducted additional regression analyses to understand the true relationship between the study variables and identified an inverted U-curve relationship between intra-group conflict and the use of polling and ranking tools (as shown in 4). This suggests that an optimum use of polling and ranking tools leads to the reduction of intra-group conflict. Thus is an interesting finding and will be explored extensively in our future research on global virtual teams.

Figure 4. Plot for intra-group conflict and use of polling and ranking tools of Lotus Sametime

5.1. Limitations

We focused on national cultural diversity of the virtual teams in our experiment. However, these teams also had other forms of diversity, such as educational specialization diversity and diversity in the proficiency of using collaboration technology tools. We plan to examine different forms of diversities in our future research on global virtual teams.

The participants of the study were from the US and India and were separated temporally (about 10½ hours). As the meetings were synchronous, there was a variation in the actual working condition of the team members. Some members worked during their normal work hours (i.e. daytime) while others had to compromise and work at night to participate in the teamwork. This might have impacted group interaction in our study.

The findings of this study are relevant for global virtual teams that are ad hoc and are engaged in short-duration tasks. However, we recognize that cultural diversity may have a different influence on group interaction in virtual teams that are engaged in long-duration tasks.
6. Conclusions

Although this study marks the beginning of research on the group interaction, intra-group conflict, and information processing support in short-duration virtual teams, we can draw some conclusions from the results. We have found that group interaction is severely impaired in global virtual teams that have moderate level of national cultural diversity. We have also found that an optimum level of group interaction is necessary to reduce intra-group conflict in global virtual teams. Our study also indicates the importance of using communication convergence tools that help team members to overcome disagreements in online discussions. Although we did not find any support for hypothesis 3, our additional statistical analyses suggest an important polynomial relationship between intra-group conflict and the use of polling and ranking tools of collaboration technology.

7. References


