Group development in virtual teams: An experimental reexamination

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ABSTRACT

Virtual teams are thought to be experienced differently and to have poor outcomes because there is little or no face-to-face interaction and a tendency for virtual team members to use different communication techniques for forming relationships. However, the expanding use of virtual teams in organizations suggests that virtual teams in real world contexts are able to overcome these barriers and be experienced in much the same way as face-to-face teams. This paper reports the result of an experiment in which virtual teams participated in an exercise where they completed an information-sharing task ten times as a team. The results suggest that, contrary to one-shot, ad hoc virtual teams, longer-lived virtual teams follow a sequential group development process. Virtual team development appears to differ from face-to-face teams because the use of computer-mediated communication heightens pressure to conform when a virtual team is first formed, meaning trust is most strongly linked with feeling that the team was accomplishing the task appropriately. As the virtual teams developed, trust in peers was more strongly linked with goal commitment. Once the teams were working together effectively, accomplishing the task appropriately was the strongest link with trust in peers. I suggest that virtual team managers should cultivate virtual workspaces that are similar to those proven to work in face-to-face contexts: (1) teams should have clear, specific goals, (2) members should be encouraged or even required to communicate with each other, and (3) team members should feel that they might work with the other team members again.

1. Introduction

Virtual teams are an organizational form in which an overlay of information and communication technologies (ICT) enables departures from traditional, face-to-face, organizational forms. The ICT can consist of e-mail, telephony, instant messaging, and, in more sophisticated forms, videoconferencing, shared workspaces, and group decision support systems. The ICT facilitates geographic dispersal of team members and potentially allows for extensive blurring of team boundaries. It does this by allowing leaders to bring in new members, have them perform a needed task, and have them exit with little loss of resources (Mowshowitz, 1997). The use of ICT and blurring of boundaries is believed to make traditional methods of social control such as direct supervision, geographic proximity, and similarity in background less salient (Greenberg, Ashton-James, & Ashkanasy, 2007).

Working together effectively would therefore be particularly difficult for virtual teams because there is little or no face-to-face interaction with which to form relationships (Jarvenpaa, Knoll, & Leidner, 1998). Because members of virtual teams have fewer tools

available for developing relationships than face-to-face teams, they must rely on categorization processes (McKnight, Cummings, & Chervany, 1998) and their experience from other settings (Jarvenpaa & Leidner, 1999). Furthermore, because they interact via computer-mediated communication (CMC), virtual teams must take more time and/or use different techniques to develop relationships (Walther, 1992). An example of an altered technique is when team members expose more about themselves via CMC than they would when face-to-face, or becoming "hyperpersonal" (Walther, 1996).

In spite of all of the potential problems with virtual teams, their use continues to expand. Thus, either the benefits to organizations that are using virtual teams outweigh these costs, or the hardships experienced in virtual teams have been overstated by academic researchers. The purpose of this paper is illuminate key perceptions of virtual team members that enable their team to reach the point where they are able to work together effectively. I frame this study using the group development model and focus specifically on the emergence of feelings of belonging, commitment, and trust, and how those influence team performance and satisfaction with the team. The teams completed a simple, structured task over and over so I could observe group development in a controlled setting during a relatively short period of time.

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2. Theoretical background

In face-to-face contexts, a group that needs to make a decision, complete a project, or any other task has two objectives: structuring itself and completing the task (Guetzkow & Simon, 1955). When a group is formed, its members bring resources (information, expertise, physical and cognitive abilities, etc.) with them that can be used to complete the task (Goffman, 1961). Since productivity depends on how well a group is structured to use available resources (Steiner, 1972), an important element in a virtual team's productivity is its ability to develop (i.e., get organized).

2.1. Group development in co-located contexts

In co-located contexts, researchers call the set of processes that prepares a group for work "group development." The overall process of group development includes the creation of sub-structures used to accomplish group development tasks (e.g., determining that "majority rules" when making group decisions). When groups first meet, they rely on member attributes to allocate roles. As they continue to interact, further development relies on attributes that are learned from observations of role performance (Goffman, 1961). If role behavior is consistent with expectations, trust develops rapidly (Meyerson, Weick, & Kramer, 1996), otherwise conflict occurs (Wheelan, 1994). Group development in face-to-face teams has been modeled as occurring in five stages (Tuckman & Jensen, 1977; Wheelan, 1994). These stages represent the evolution of groups and are shown in Fig. 1. The first three stages; dependency and inclusion (a.k.a. forming), counterdependency and fight (a.k.a. storming), and trust and structure (a.k.a. norming), are the activities that prepare the group for work. These are characterized by different development tasks that are accomplished. The work (a.k.a. performing) stage indicates the time when the group is working effectively, and the termination (a.k.a. adjourning) stage is the time when the group assesses its performance.

The earliest stage of group development, *dependency and inclusion*, is characterized by member anxiety (Tuckman & Jensen, 1977; Wheelan, 1994). This is because the situation is new to the members and not clearly defined. Group members may be unsure of whether the group is safe, whether they belong to the group and are accepted, and what the rules of conduct and procedures will be. The tasks for group members to accomplish during this stage are to (1) ensure that they are accepted as a group member and (2) determine whether they accept the others (Wheelan, 1994).

During the second stage, *counterdependency and fight*, the group's members attempt to balance the amount of influence and responsibility possessed by individual members (Tuckman & Jensen, 1977; Wheelan, 1994). The group's tasks are to clarify goals, values, boundaries, and forge unity out of diversity. During this stage, members must: (1) reach agreement about basic values, goals, and commitment to these goals, (2) gain a desirable amount of influence over how much work they will do, and (3) obtain an
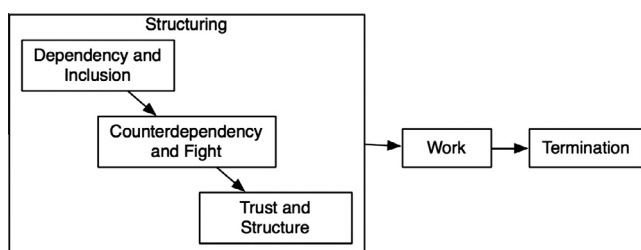
acceptable level of responsibility over the group's completing the task (Wheelan, 1994).

The third stage, *trust and structure*, is characterized as consisting of a more mature negotiation about goals and procedures (Tuckman & Jensen, 1977; Wheelan, 1994). The group is designing its structure in this stage, planning the way it will accomplish its objective(s) and laying the groundwork for productive and trusting relationships with each other. The objectives of group members during this stage are to: (1) obtain an acceptable role assignment in terms of relative amount of work and level of responsibility, (2) ensure that other members of the group have appropriate roles, and (3) establish a relationship of trust with the other members (Wheelan, 1994).

The *work* stage is a time of intense productivity and effectiveness (Tuckman & Jensen, 1977; Wheelan, 1994). Effective work depends on the group's ability to use available resources such as information, expertise, and materials. Groups that are not working as effectively as they would like have probably not resolved issues from one of the earlier stages. For example, the work in five out of twelve virtual teams in one study was evaluated as poor, and these teams were characterized as "disorganized and desperate" as their deadline approached due to incomplete development (Sarker & Sahay, 2003). When groups have a distinct ending point, they may have the fifth stage, *termination*, in which members assess the performance of the group.

2.2. Group development in virtual teams

It has been suggested that virtual teams should also follow a development process in order to effectively work together (Hertel, Geister, & Konradt, 2005; Sarker & Sahay, 2003). However, these studies note that the overlay of ICT in virtual teams creates "disadvantages due to new communication technologies" (Hertel et al., 2005, p. 72), which impede their development. Such issues might include: (1) an inability for group members to identify referent others that are similar in ability, which means that they might have more uncertainty and be less able to preserve or enhance their self esteem (Greenberg et al., 2007), (2) an increased likelihood of conforming to perceived group norms because a lack of individual identity (Lea, Spears, & de Groot, 2001), and/or (3) an increased likelihood of socially unacceptable behavior (Haines, Cao, & Haines, 2006; Kiesler, Siegel, & McGuire, 1984). In spite of this, it has been proposed that virtual teams will be experienced the same as face-to-face teams given enough time and sufficient message exchanges (Walther, 1992). Thus, ability of virtual teams to develop properly remains an open question.

For purposes of this study, I assumed that virtual teams might develop normally over a short enough time period for experimental examination if they were given a simple enough task that did not involve a large amount of information with which to make comparisons to referent others (cf., Michinov & Primois, 2005). If and when I observe potential problems due to the use of ICT in these virtual teams, a better, more holistic view of how those affect the entire group development process can be obtained. The details of the experimental task will be given later. The hypotheses follow.

In face to face teams, issues from each stage of group development must be at least attended to before the team can move on to issues of the next stage of development. Issues of subsequent stages can only be resolved to the extent that issues of the previous stage have been resolved (Wheelan, 1994). In virtual teams research, a similar flow through the development stages is assumed to be necessary for the proper function of a virtual team (Oemig & Gross, 2007; Sarker & Sahay, 2003). However, delays might occur because virtual teams are often too task-focused (Dubé & Robey, 2009; Fransen, Kirschner, & Erkens, 2011;

Fig. 1. Stages of group development.

Munkvold & Zigurs, 2007) and have trouble overcoming conflict (Dubé & Robey, 2009). In particular, problems seem to arise because members of the team are insufficiently aware of the presence (Jarvenpaa et al., 1998) and identity (Cooper & Haines, 2008) of those in the virtual workspace. However, I suggest that these problems can be overcome if virtual teams are given clear goals and objectives and are allowed to communicate freely with each other (Erez & Somech, 1996; Swigger, Hoyt, Serçe, Lopez, & Alpaslan, 2012). Thus, although the overall process might be delayed, I expect the outcomes of a later stage of group development to be linked to issues of the previous stage even in virtual teams.

Achieving acceptance as a team member, or *sense of belonging*, is an outcome of the earliest stage of group development, when members are at their most vulnerable and acceptance is most important. *Goal commitment*, on the other hand develops in the second stage, after the members have learned more about the amount of influence and responsibility that they and the other members will have in the group. In simpler terms, sense of belonging develops before goal commitment because team members need to first be sure the team is safe for them. Once a team member feels they are safe, they will be ready to become committed to the goals of the team. I hypothesize that team members with a low sense of belonging are less likely to become committed to team goals and care less about whether the team achieves them. Those with a high sense of belonging are likely to become more committed to helping the team achieve its goals.

H1. In virtual teams, the level of sense of belonging at one time period is positively linked with goal commitment at a later time period.

Feeling that others will perform their roles, or *trust in peers*, is an outcome of the third stage of group development. This feeling arises after members have negotiated about the procedures that the team will use to accomplish its goals. Goal commitment and trust in peers are tightly linked in the sense that team members who are not committed to the team's goals have less need to depend on other team members who would be the ones to help accomplish the goal (Mayer, Davis, & Shoorman, 1995). Consequently, they are less likely to exhibit trust in other team members. In other words, being committed to the team's goals is an important prerequisite for caring whether others in the team will help to achieve those goals (Wheelan, 1994).

H2. In virtual teams, the level of goal commitment at one time period is positively linked with trust in peers at a later time period.

Empirically linking levels of trust in virtual teams with team performance has been problematic for virtual teams researchers, with some concluding that the relationship is indirect (Dirks, 1999) and/or dependent mostly on the context (Jarvenpaa, Shaw, & Staples, 2004). However, the relationship implied in group development research is unequivocal: achieving trust in the abilities and reliability of other team members is an important precedent for effective work (Tuckman & Jensen, 1977; Wheelan, 1994). Thus, I hypothesize that team performance will depend on the level of trust in the other members of a virtual team.

H3. In virtual teams, trust in peers at one time period positively influences team performance during a later time period.

As is typical in virtual team studies, the teams participating in this task (described in detail later) had a distinct ending point. When a team has a distinct ending point, team members assess the overall performance of their group in terms of their assigned task and how well they got organized, or *decision scheme satisfaction* (Green & Taber, 1980). Again, because issues of previous stages

must be attended to before moving to issues of later stages, I expect that members' assessment of how well their team performed on the development task (i.e., decision scheme satisfaction) will rely how well the team is working together.

H4. In virtual teams, team performance during one time period positively influences decision scheme satisfaction at a later time period.

2.3. Unique issues for virtual teams

The social information processing model (SIP) proposes that members of virtual teams will adapt their relational messages to fit the media that they use (e.g., text-based chat). This means that virtual teams should develop in much the same way as face-to-face teams with "the passage of sufficient time and message exchanges" (Walther, 1992, p. 67). Thus, the overall framing of this paper is to apply the group development model to virtual teams. However, some IS research suggests that development processes in virtual teams may be different than in face-to-face teams. For example, media richness theory suggests that virtual team members will feel that CMC (especially textual) is a less appropriate means of communication than face-to-face for almost every communication task (Rice, 1993). More germane to the group development process is the consistent finding that conformity to group norms is increased when newly formed groups communicate via CMC (Haines & Mann, 2011; Postmes, Spears, & Lea, 1998; Spears & Lea, 1992). The group development process hinges to a degree on whether group members conform or do not conform to group norms: (1) during the dependency and inclusion stage, member conformity to group norms helps build cohesion, while (2) during the counterdependency and fight stage, members must fight against norms that they disagree with in order to build an atmosphere of trust where dissent is tolerated (Wheelan, 1994).

Over time, group development is an iterative process as group members deal with issues of each of the stages in turn, eventually resolving the issues as they become a mature group. In virtual teams, however, increased conformity due to the use of CMC could delay the process. As Wheelan notes, increased conformity aids in the dependency and inclusion stage, so members of virtual teams should initially have higher belonging. However, heightened conformity would inhibit the group's overall development by delaying their movement into and through the counterdependency and fight stage (Wheelan, 1994; cf., Saunders & Ahuja, 2006).

When completing this exercise (described in detail later), four of the five virtual team members had to indicate that they felt that their team was ready before the team could begin working on a second task. If there were a conformity issue with CMC, members of newly formed virtual teams would tend to indicate that their team was ready in spite of feeling that their team was really not ready (i.e., conforming to a team norm of "indicating readiness" Haines & Mann, 2011). As the team continued to work together, they would be expected to adapt to their task and the CMC environment. Once they felt comfortable with the technology and their team, members would feel freer to express disagreement within the team and not simply conform (i.e., they would wait until their team was actually ready before indicating readiness). Thus, I expect that early on, virtual teams will determine their level of trust based primarily on the degree to which they feel that their team is completing the task in an appropriate way (cf., Fransen et al., 2011). As the teams mature, their trust will be founded more on group development variables (i.e., their commitment to the group).

H5. In virtual teams that are early in the group development process, feelings that the group is accomplishing their task in an appropriate way will have a stronger impact on trust in peers than goal commitment.

3. Research method

I used a laboratory study to test the hypothesized relationships among the group development variables. All participants were recruited from intermediate level information systems courses required of all business majors at two southwestern universities. Two incentives were provided for participating: $2 was given to each participant, with an additional $20 to each member of the best performing teams at each university.

3.1. Team exercise

The exercise involved the use of a microcomputer application designed specifically for this study. There were two distinct modules to the application: a chat mode, where all members of a team could exchange messages with all team members at once, and an e-mail mode, where members could send messages to one team member at a time. The chat mode was used during the organization periods, while the e-mail mode was used to complete the task each round. To discourage organization messages during the task completion period, the performance objective for the teams was to complete the task using as few e-mail messages as possible. The participants were assigned to five person teams, and randomly assigned an alias: Apple, Grape, Orange, Pear, or Plum.

The exercise was a version of Leavitt's (1951) information sharing task, which has been characterized as being both simple and elegant in its ability to examine group processes without removing the essence of group interaction (Freeman, Roeder, & Mulholland, 1979). At the beginning of each round, each member was given a list of five out of six possible colors. The members would then share their colors with others via e-mail until at least one could determine which one colors was common to all of the lists. The round ended when all five team members had indicated the correct color. A similar task has been used in prior studies that had one-shot virtual teams (Cooper & Haines, 2008; Haines & Mann, 2011). In this study, teams completed the task together for ten rounds.

As teams performed the task of determining the common color and reorganizing themselves over a series of rounds, they simplified their communication network to improve their efficiency (Katz & Kahn, 1978). The least effective technique, requiring a minimum of 20 messages, was one where all members sent their colors to all other members and each member determined the common color him/herself. This technique was used most often the first time the teams attempted to complete the task. A two-tier hierarchy was one of the most effective techniques for completing the task, requiring a minimum of eight messages, in which one member received color lists from the other four members, determined the common color, and distributed the answer to the other team members. This technique was used by all of the teams after they had completed the task together several times.

Prior to the actual study, several pilot studies were run in which team members communicated exclusively via e-mail. Based on feedback from these participants, the chat mode was added to facilitate team organization as a separate task from finding the common color. This was done because some teams were reticent to communicate at all because of the incentive to minimize e-mail messages. The instructions were also modified to include a suggestion about how to complete the task because many pilot study teams were unable to get organized quickly enough to complete the exercise within the overall time allotted (1.5 h). The pilot test participants reported that they were motivated to complete the task and expressed frustration in their electronic messages and/or verbally when their team performed poorly. This suggested that the task was sufficiently involving to the participants (Greenberg & Eskew, 1993).

3.2. Variables

The computer system administered questionnaires after the teams had completed the first, third, sixth, and tenth task rounds. *Sense of belonging* (Chin, Salisbury, Pearson, & Stollak, 1999) measures the degree to which a team member feels like they belong in the team (e.g., I feel that I belong to this group.). *Goal commitment* (derived from Hollenbeck, O'Leary, Klein, & Wright, 1989) measures a team member's level of commitment to the goal of being the best performing team (e.g., I believe it's unrealistic for the group to expect to reach the goal.). *Trust in peers* (derived from Cook & Wall, 1980) measures a team member's perceptions that he/she can trust other members of their team to properly perform their portion of the task (e.g., I can rely on my other group members to accomplish what is expected of them.). *Team performance* is the number of e-mail messages that the team sent in determining the common color. *Decision scheme satisfaction* (Green & Taber, 1980) measures a team member's satisfaction with the team's problem solving process. *Task faithfulness* (derived from Chin, Gopal, & Salisbury, 1997) measures a team member's perception of whether the team is accomplishing the task in an appropriate way (e.g., We did not accomplish the task in the most appropriate fashion.). For all scales, values were coded such that higher values of the scale represent higher values of the underlying construct. The complete scales and the range of loadings of each item are shown in the Appendix A. All scales had average variance extracted above .50 and composite reliability above .60, indicating adequate scale reliability and validity (Bagozzi & Yi, 1988).

3.3. Procedures

Each session involved between one and six five-member, mixed gender teams completing the exercise together in a computer laboratory. Alias assignments (i.e., Apple, Grape, etc.) were made randomly, and when more than one team was present, team assignments were also made randomly. Geographic dispersal of each team was assured by physically separating team members when relatively few teams were present and by the random assignment of people to teams when the laboratory was relatively full.

First, participants were given instructions about the task and the application. Next, the participants each completed an example round alone, which involved reading a set of pre-sent e-mail messages that was sufficient to find the common color. The warm-up exercise ensured that team members knew which roles needed to be performed in order to complete the task, a necessary precedent to "swift trust" (Meyerson et al., 1996).

The first round began in the chat room. Participants were verbally reminded when the chat room came up that they should discuss how to find the common color for the first round. Once their team had decided how to find the color, the members indicated that their group was ready to begin the task round by checking a box. When four of the five team members had checked the box, the task round began. During the task round, team members shared their color list with others until at least one person could determine the common color. Once all team members had indicated the correct common color, the team was returned to the chat room and could discuss how to accomplish the task for the next round.

4. Results

The behavior of other team members has a strong influence on the perceptions of individual team members, and performance can only practically be measured at the team level. Thus, my analysis is of the average of the responses to the questionnaires within each team, and the sample size for the analysis is 31 (five-person teams).

Partial least squares (PLS) was used to analyze the collected data (Chin, 1998). Two separate PLS models were run, one that examined group development over time (testing hypotheses one through four), and a second that examined the predictors of trust at each measurement period (testing hypothesis five). In Figs. 2 and 3, the numbers above the lines connecting each latent variable are the path coefficients, and the number below a dependent latent variable is the variance explained by its preceding variables (r-squared). Significant path coefficients ($p < .05$) are indicated with an asterisk (*). The bootstrap resampling technique (Chin, 1998) was used to determine the significance of paths (500 subsamples, 31 cases per sample).

4.1. Model one: development over time

The first PLS model is summarized graphically in Fig. 2. Table 1 summarizes the composite reliability, average variance extracted (AVE), and the correlations among the latent variables for each scale used in model one. Hypotheses one through four suggest that the group development variables are linked. Consistent with these hypotheses: (1) sense of belonging after completing the task once was significantly linked with goal commitment after completing the task the third time ($b = .357$, $t = 3.14$, $p < .01$), (2) goal commitment after completing the task the third time was significantly linked with trust in peers after completing the task the sixth time ($b = .565$, $t = 4.55$, $p < .001$), (3) trust in peers after completing the task the sixth time was significantly linked with performance after completing the task the seventh time ($b = .395$, $t = 1.97$, $p < .05$), and (4) team performance the tenth time completing the task was significantly linked with decision scheme satisfaction ($b = .594$, $t = 2.92$, $p < .01$).

4.2. Model two: antecedents of trust

Fig. 3 graphically summarizes the results of the second PLS model, which was used to test hypothesis five. Table 2 summarizes the composite reliability, average variance extracted (AVE), and the correlations among the latent variables for each scale used in model two. Hypothesis five suggested that the link between task faithfulness and trust in peers would be the strongest early in development, but that as the team continued to develop, goal commitment would the most important indicator of trust in peers. Consistent with hypothesis five, task faithfulness had a strong significant relationship with trust in peers after the teams had completed the task once ($b = .582$, $t = 4.14$, $p < .001$) and after the teams had completed the task three times ($b = .963$, $t = 6.75$, $p < .001$). However, goal commitment's relationship with trust in peers was not significant ($b = .211$, $t = 1.27$, $p = .20$ and $b = -.133$, $t = 0.83$, $p = .41$). After the teams had completed the task six times together, the strengths were reversed, with goal commitment having a strong, significant relationship with trust in peers ($b = .547$,

$t = 2.85$, $p < .01$) while task faithfulness' relationship was insignificant ($b = .337$, $t = 1.79$, $p = .07$). This supports my contention that traditional development factors are more important to trust later in development. However, the relationships again reverse after the teams had completed the task together ten times, with task faithfulness again having a strong, significant relationship ($b = .538$, $t = 2.69$, $p < .01$) while goal commitment's relationship was insignificant ($b = .259$, $t = 1.10$, $p = .27$).

5. Discussion

The results bring to light some interesting factors for group development and trust in virtual teams. Contrary to prior virtual teams research, I found that the traditional group development model applies to virtual teams. Thus, like face-to-face teams, virtual teams evolve over time. A sense of belonging is important early in the formation of a virtual team, which in turn builds commitment to the team's goals. This in turn is linked with trust in peers, which in turn is linked with performance, and finally overall satisfaction with the team. As shown in Table 1, sense of belonging, goal commitment, trust in peers, and decision scheme satisfaction were also significantly correlated across the four different time periods. This suggests that there is a cascading relationship among group development issues – meaning that a high level of sense of belonging early in development may carry through the life of a team.

Antecedents of trust varied at different points in the life of these teams. Specifically, perceptions that the team was performing the task appropriately was a significant influence on trust in peers after the teams had completed the task once and three times, while goal commitment was not. After the teams had completed the task six times, the influences had reversed: goal commitment was significant while task faithfulness was not. This was consistent with hypothesis five, which suggested that increased conformity to the "indicating readiness" norm in these virtual teams would lead members to agree to begin the task during the first chat period even when they felt that their team was not ready to accomplish the task appropriately.

5.1. Qualitative analysis

Group development is a relatively mature theory in the social psychology literature, and conformity has been consistently found in ad hoc teams using CMC. The quantitative results presented earlier are consistent with my integrated model that proposes: (1) that virtual teams can develop when given enough time and message exchanges, and (2) that early conformity to perceived team norms would impede group development in virtual teams. However, I wished to further validate the impact of these theories and my model, so I qualitatively analyzed the chat messages among the teams that participated in the experiment. My aim was to classify and evaluate different approaches among the teams to reaching the objective of group development: getting the team ready to effectively work together.

First, using protocol analysis, I analyzed the chat messages overall to see how the teams evolved over time. My analysis of the first two rounds showed striking differences among the teams in terms of their discussion and performance, and confirmed that team members had a tendency to conform to a norm of indicating
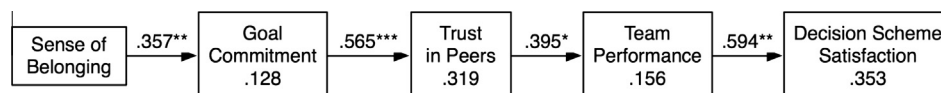

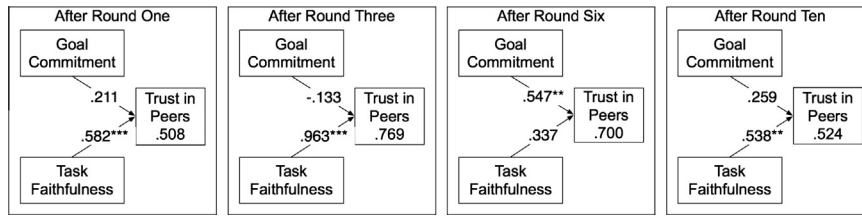**Fig. 2.** Summary of PLS results for model one. *$^*p < .05$, $^{**}p < .01$, $^{***}p < .001$.*

Fig. 3. Summary of PLS results for model two. $^*p < .05$, $^{**}p < .01$, $^{***}p < .001$.

Table 1
Composite reliability, AVE, and correlations of latent variables for model one.

	Composite reliability	AVE	1	2	3	4	5
1. Round 1 sense of belonging	.943	.847					
2. Round 3 goal commitment	.949	.860	.357				
3. Round 6 trust in peers	.991	.957	.512	.565			
4. Round 10 decision scheme satisfaction	.937	.753	.472	.549	.654		
5. Round 7 performance	n/a	n/a	.290	.127	.395	.176	
6. Round 10 performance	n/a	n/a	.482	.250	.391	.594	−.054

For correlations greater than .344, .444, and .548; $p < .05$, $p < .01$, and $p < .001$, respectively.

Table 2
Composite reliability, AVE, and correlations of latent variables for model two.

	Composite reliability	AVE	1	2	3	4	5	6	7	8	9	10	11
1. Rnd 1 GC	.891	.732											
2. Rnd 1 TF	.966	.904	.509										
3. Rnd 1 TP	.983	.920	.507	.689									
4. Rnd 3 GC	.948	.777	.416	.435									
5. Rnd 3 TF	.974	.926	.421	.395	.270	.684							
6. Rnd 3 TP	.992	.960	.337	.166	.210	.525	.872						
7. Rnd 6 GC	.953	.872	.657	.258	.434	.734	.600	.602					
8. Rnd 6 TF	.971	.917	.417	.415	.465	.597	.782	.760	.779				
9. Rnd 6 TP	.991	.957	.554	.218	.459	.569	.496	.551	.809	.763			
10. Rnd 10 GC	.969	.913	.767	.311	.425	.776	.527	.488	.912	.715	.791		
11. Rnd 10 TF	.956	.880	.363	.314	.258	.523	.793	.791	.625	.804	.548	.603	
12. Rnd 10 TP	.994	.970	.384	.081	.372	.389	.478	.617	.630	.614	.724	.583	.694

For correlations greater than .344, .444, and .548; $p < .05$, $p < .01$, and $p < .001$, respectively.

readiness in the first round. Generally speaking, the later rounds in all of the teams had similar discussions in them, and consisted almost exclusively of messages that implied no discussion was necessary (e.g., "let's go"), messages of encouragement (e.g., "rah rah rah"), and/or status messages (e.g., "2 more"). This showed that the sequential development process was followed in all groups.

Based on their performance and chat discussions in the first two rounds, I divided the teams into five categories. Each category reflects a different pattern of early development. The first category I call *Task Superstar*. These teams agreed to use a two-tier hierarchy to accomplish the task in the first round and successfully executed it for the first and all other rounds. For the first two rounds, their performance was in the top 50% of the teams. Ten teams that completed the experimental task were in this category.

The second category I named *Fast Learner*. These teams that did poorly on first round because they did not discuss how to do the task before ending the first chat session. However, they recovered during the second round by changing their technique to a two-tier hierarchy and then successfully executing it. For the first round, their performance was in the bottom 50% of the teams, but for the second round their performance was in the top 50% of teams. One team was in this category.

Weak Link indicates teams that agreed during the first chat to use a two-tier hierarchy. However, one or two of the team members did not understand their role, which caused the team to have

to adjust their structure while they were completing the task. After completing the first task poorly, they recovered during the second chat by ensuring that all team members understood how to perform their role. For the first round, their performance was in the bottom 50% of the teams, but for the second round their performance was in the top 50% of teams. Eight teams were in this category.

Rollercoaster indicates teams that did well on the first chat and task, choosing a two-tier hierarchy. However, for the second round, the teams chose to change their structure, either changing the central person or trying a novel strategy that they did not execute well. For the first round, the performance of these teams was in the top 50%, but for the second round their performance was in the bottom 50%. Four teams were in this category.

Slow Learners struggled on the first task because they did not agree on a technique for completing the task during the first chat session. Even after the second chat session, one or more of the members did not understand how to perform their role, meaning the team did poorly again. In these teams, performance for both the first and seconds rounds was in the bottom 50%. Eight teams were in this category. Table 3 summarizes the levels of goal commitment, task faithfulness, and trust in peers over time by category of team).

When the quantitative data is broken out by the qualitatively derived team categories, the underlying drivers of the relationship

Table 3
Average goal commitment, task faithfulness, and trust in peers by category of team.

		After Round1	After Round3	After Round 6	After Round 10
Task superstar	Goal commitment	6.00	6.28	6.18	6.12
	Task faithfulness	5.94	6.19	6.07	5.97
	Trust in peers	5.72	5.95	5.92	5.87
Fast learner	Goal commitment	6.33	6.53	6.33	6.93
	Task faithfulness	5.60	6.20	6.60	6.10
	Trust in peers	5.68	6.32	6.32	6.80
Weak link	Goal commitment	5.59	6.07	6.41	6.25
	Task faithfulness	4.35	5.78	6.13	6.12
	Trust in peers	5.13	6.10	6.50	6.57
Roller coaster	Goal commitment	5.47	5.76	5.31	5.64
	Task faithfulness	4.87	4.69	5.35	5.53
	Trust in peers	4.85	5.13	5.43	5.43
Slow learner	Goal commitment	5.57	5.87	5.95	6.05
	Task faithfulness	4.06	5.37	5.27	5.51
	Trust in peers	5.09	5.55	5.79	6.09
Overall	Goal commitment	5.66	5.99	6.06	6.05
	Task faithfulness	4.91	5.56	5.79	5.78
	Trust in peers	5.36	5.69	5.95	6.08

among the group development variables becomes more apparent. The task faithfulness scores for the task superstar and fast learner teams start out high and remain high for the entire course of the experiment in contrast with the other teams. Thus, it is the contrast between these higher task faithfulness and the weak link, roller coaster, and slow learner teams that is most responsible for my finding that trust and task faithfulness are most strongly linked early in team development. The link between goal commitment and trust in the sixth round appears to have come from a faster rise in trust versus a relatively slower rise in task faithfulness in the roller coaster and slow learner teams.

A deeper analysis of the early chat messages also revealed patterns between the categories of teams. All of the members of the task superstar teams participated in the first chat session, by either offering a suggestion or by indicating agreement with the proposed communication structure. After this point, however, there was relatively little communication – the team members simply accomplished the task and did not discuss their structure anymore. This is in contrast with the roller coaster teams that had lots of participation and discussion in the first round, then similar discussions in the later rounds about new techniques and/or role performance in those techniques.

In the fast learner team, the first chat was relatively short (i.e., no suggestions about structure were given), but all of the members participated by indicating agreement that they should start on the task. This contrasts with the weak link teams, who had relatively long first discussions about what the best structure would be, but one or two members did not actively participate. Both of these categories performed poorly on the task the first time, so their second discussion had broad participation and an active discussion about the best way to accomplish the task.

The slow learner teams had relatively little discussion in the first round, similar to the fast learner teams. However, not all of the team members participated at that point. In later chat sessions, the amount of discussion increased, but the participation of some team members still lagged.

Thus, I suggest that highly task-oriented teams, like the task superstars, may simply "coast" after their initial success and remain relatively distant from each other rather than increasing cohesion or trust over time. Managers that see their teams moving in this direction should be careful to offer contrasting opinions about how the team could work together, encourage them to take risks, and/or attempt to perform better. Teams that have faced and overcome problems seem to have higher levels of trust and commitment, like the fast learner and weak link teams. These teams would probably benefit from managerial encouragement when their early attempts at work come up short. Teams that are overreaching, like the roller coaster teams, are likely to have low trust and commitment over time, so managers should encourage them to step back and consider their pace relative to the capabilities of the team members. Finally, teams that struggle to get organized and work effectively, like the slow learners, would benefit from early guidance about how to organize themselves. Once they are able to work effectively, they can be encouraged to take risks if they begin to "coast."

5.2. Limitations

This study involved student participants, which have been shown in some cases to behave differently than individuals with work experience. However, the nature of this task was such that they were involved in it and their previous socialization provided them with enough experience to work as a team on it, making it sufficient to test my hypotheses (Greenberg & Eskew, 1993). The simplicity of the task inhibits its generalizability because virtual teams can work on less structured and more equivocal tasks. However, when comparing the trade-off between having teams work on a single, more complicated task over the course of an exercise (cf., Saunders & Ahuja, 2006) versus the simplicity of this task makes it appropriate for observing the development of virtual teams in a controlled setting.

6. Conclusions

The growing use of virtual teams for projects in organizations suggests that this organizational form will become even more pervasive. Because traditional methods of social control that rely on organizational culture and face-to-face contact are not as capable of inducing trust in organizations using virtual teams, leaders need other means for inducing trust (Nandhakumar & Baskerville, 2006). Swift trust has been proposed and studied as a means for quickly inducing trust in virtual teams, however, its fragility has been noted (Coppola, Hiltz, & Rotter, 2004; Jarvenpaa & Leidner, 1999; Nandhakumar & Baskerville, 2006). This study found that task faithfulness was important in

developing trust early in the life of a virtual team, goal commitment was important to the maturing period, and that task faithfulness was again important as the teams continued to work together. Thus, I suggest that in order to make trust resilient, virtual teams should focus on accomplishing the task in a way that the members agree is appropriate, then encourage innovation and experimentation as the team develops further.

The major contribution of this study is to show that the issues of prior stages in group development are important to the formation of trust in virtual teams; specifically, cultivating a sense of belonging when the team is first formed, and a sense of commitment to the group after the members feel that they belong and are accepted by the group. Ultimately, increases in trust precede increased performance and satisfaction with the process. I was able to show this because my experimental task enabled the participants to work together and get to know each other over time; conditions that are typical of most groups in real world organizations (Erez & Somech, 1996). Thus, I propose that the fundamental development processes of virtual teams ought to be experienced in much the same way as in face-to-face teams as long as the virtual team members freely communicate with each other in the shared workspace (cf., Riemer, Klein, & Frößler, 2007).

I noted in the rationale for hypothesis five that the group development process may differ in virtual teams because conformity to norms is heightened via CMC; specifically, that heightened feelings of conformity might accelerate the dependency and inclusion stage, while feelings of conformity would impede moving beyond the counterdependency and fight stage. This was offered as a potential explanation for why many experimental virtual teams do not move past the counterdependency and fight stage (Sarker & Sahay, 2003), and/or exhibit "suspicion and anxiety" (Nandhakumar & Baskerville, 2006, p. 383). All of the teams managed to move past this stage and were able to work together effectively. Furthermore, I was able to identify differences in development among the teams by classifying them according to how quickly and well they were able to get organized. Teams that were able to get organized quickly ran the risk of becoming complacent, leaving them with relatively lower trust than teams that had to overcome some difficulties. Teams that had initial success, but then attempted risky techniques, had the most difficulty and lowest trust overall, even when compared with teams that had difficulty getting organized at all.

Broadly speaking, the most striking differences between this experimental context and those of prior experimental studies were: (1) team members were able to determine and allocate clearly defined roles due to the highly structured nature of the task, (2) team members were all members of the same organization and would thus feel that they might work with the same people again, (3) team members felt the "presence" of the other team members because even though they did not know who was on their team, they knew they were in the same classroom, and (4) team members were cued about what to communicate by the alternating organization and work periods. Because all of these explanations serve to make these teams more like real world virtual teams, it is safe to suggest that leaders of virtual teams need to be aware that group development, particularly passing through the counterdependency and fight stage, relies on cultivating a virtual workspace that is similar to real world team environments. Team members (1) should have clear, specific goals, (2) should be encouraged or even required to communicate with each other, and (3) feel that they might work with the other team members again. These "real world" working conditions can enable virtual teams to express and consider conflicting ideas, meaning the team can then move on to more mature discussions about how it will accomplish its task (i.e., the trust and structure stage).

Another contribution of this study is that is provides advice to leaders of virtual teams on how to foster trust (cf., Powell, Piccoli, & Ives, 2004). To induce trust when a team is formed or must reorganize, team leaders should ensure that members feel like they belong to the team and that they feel that the task is being accomplished in an appropriate way. To maintain trust, commitment to the team's goals must be ensured, then, later in development, the team itself can be relied on to perform the task in an appropriate manner (cf., Saunders & Ahuja, 2006), and even be encouraged to innovate. Thus, I suggest that the concept of "swift" trust built through categorization processes (Meyerson et al., 1996) is not important in long-term virtual teams, and that high levels of swift trust may reflect and/or interact with increased conformity via CMC in retarding the development of virtual teams.

6.1. Implications

Teams accomplishing this simple task did not consistently arrive at a structure that could be called mature until they had accomplished the task three times. Even after arriving at a mature structure, the relationship among variables in the research model changed. It is clear that some teams were not completely developed after the sixth time they had accomplished the task together. This suggests that researchers that study group development in virtual settings must observe teams accomplishing complex tasks over several months and many meetings before suggesting factors that drive group development or making definitive comments about the amount of time necessary to achieve a particular stage of development (cf., Saunders & Ahuja, 2006; Wheelan, Davidson, & Tilin, 2003; Wheelan et al., 2003).

In summary, this study has shown that belonging, commitment, trust, performance, and satisfaction are linked to each other over time in virtual teams. Furthermore, when newly formed virtual teams work together, their trust is first linked with whether they feel that they are performing the task in an appropriate manner, then with whether they are committed to the team, and finally, I speculate that they only rely on the team's actual performance when they are working together effectively. Thus, leaders should understand that virtual teams, like face-to-face teams, must deal with development issues in order to work together most effectively. Technology designers should also recognize that user perceptions and use of the features of a collaboration system change over the process of group development, with communication features most important early in development, and status/monitoring features more important later (cf., Oemig & Gross, 2007; Saeed, 2012).

Acknowledgements

Appendix A. Questionnaires

As shown earlier Tables 1 and 2, the scales all exhibited adequate composite reliability and discriminant validity (Chin, 1998) because they shared more variance with their own items than with other latent variables (i.e., average variance extracted of each scale is greater than the square of its correlations with other latent variables). Table 4 lists each scale item and its range of loadings computed by PLS, which all exceed the .6 minimum (Bagozzi & Yi, 1988).

Table 4
Scale items and range of loadings.

	Loading[*]
Sense of belonging (from Chin et al., 1999)	
1. I feel that I belong to this group	.9465
2. I feel that I am a member of this group	.8760
3. I see myself as part of this group	.9367
Goal commitment (derived from Hollenbeck, O'Leary, Klein, & Wright, 1989)	
1. It's hard for me to take the group's goal seriously. (rev.)	.8044–.9442
2. I believe it's unrealistic for the group to expect to reach the goal. (rev.)	.8567–.9733
3. Quite frankly, I don't care if the group achieves the goal or not. (rev.)	.9026–.9567
Trust in peers (derived from Cook & Wall, 1980)	
1. I can trust the people in my group to complete their assigned duties	.9598–.9842
2. The other members of my group can be relied upon to fulfill their particular tasks	.9695–.9887
3. I have full confidence in the abilities of my other group members to carry out their duties	.9625–.9876
4. I can rely on my other group members to accomplish what is expected of them	.9468–.9867
5. I can depend on my other group members to perform their job well	.9574–.9905
Task faithfulness (derived from Chin et al., 1997)	
1. Our group probably accomplished the task improperly. (rev.)	.8961–.9709
2. Our group failed to accomplish the task as it should have been accomplished. (rev.)	.9570–.9647
3. We did not accomplish the task in the most appropriate fashion. (rev.)	.9508–.9753
Decision scheme satisfaction (Green & Taber, 1980)	
How would you describe your group's problem solving process?	
1. efficient…inefficient (rev.)	.9307
2. coordinated…uncoordinated (rev.)	.9435
3. fair…unfair (rev.)	.8882
4. confusing…understandable	.6024
5. satisfying…dissatisfying (rev.)	.9244

[*] Ranges are shown for scales used at multiple measurement points.

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