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Dynamic Nature of Trust in Virtual Teams

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Abstract
Building on the theory of swift trust, we empirically examine the dynamic nature of trust and its changing patterns in both cognitive and affective elements between high- and low-performing teams over time (early, middle, and late stages of project). Using data from 38, four-person student teams from six universities competing in a web-based business simulation game over eight-week periods, we found that both high- and low-performing teams started with similar levels of trust in both cognitive and affective dimensions. However, high-performing teams were better at developing and maintaining the trust level throughout the project life. Moreover, virtual teams relied more on a cognitive than an affective element of trust. These findings provide a preliminary step toward understanding the dynamic nature and relative importance of cognition- and affect-based trust over time.

Keywords: Trust, Virtual Team, Computer-Mediated Communication

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Dynamic Nature of Trust in Virtual Teams

Introduction

Today's organizations are experimenting with various forms in order to organize and leverage their human assets. With the growing popularity of virtual teams being enabled by the computer and communication technologies, a new method of organizing workforces have already begun to emerge (DeSanctis & Monge, 1999).

Virtual teams provide many advantages over traditional teams, including the ability to bridge time and space, and better utilization of distributed human resources without physical relocation of employees (Lipnack & Stamps, 2000). However, its flexibility also comes with many challenges due to its own inherent characteristics. Given the separation in time and space, possibly no history of working together, and limited options of communication channels, virtual teams could lead to catastrophic results. This observation was echoed by the prediction of the Gartner group that, by 2004, more than 60% of professional workforces in the Global 2000 Company would work in virtual teams. At the same time, Gartner group also predicted that "by 2003, 50 percent of virtual teams will fail to meet either strategic or operational objectives due to the inability to manage distributed workforce" (cited in Biggs, September 22, 2000). If this prediction about failure rate of virtual teams were true, what factors would lead to a better performance of virtual teams?

We now just begin to understand what fundamental factors drive the success and failure of virtual teams. One of the fundamental factors which is believed to be important in determining the success and failure of virtual teams is *trust*. The literature on trust in face-to-face teams suggests that the establishment of trust is of importance in the working relationship (e.g., Bhattacharya, Devinney, & Pillutla, 1998; Golembiewski & McConkie, 1975; Mayer, Davis, & Schoorman, 1995). Trust also leads to more open communication (Holden, 1990; Smith & Barclay, 1997), cooperation (Parks, Henager, & Scamahorn, 1996; Schlenker, Helm, & Tedeschi, 1973), a higher quality of decision-making (Zand, 1972), risk-taking (McKnight & Chervany, 2000) and satisfaction in the decision-making process (Driscoll, 1978). In all, this suggested that the presence of a high trust level is associated with a high performance.

Lipnack and Stamps (2000) argue that the success and failure of virtual teams begin with trust since trust functions like the glue that holds and links virtual teams together. Building on the theory of swift trust, IS researchers who have studied virtual teams (e.g., Iacono & Weisband, 1997; Jarvenpaa & Leidner, 1999) found that virtual teams require trust be built swiftly at the outset. However, this trust could be fragile for many reasons. A lack of a prior history of working together as well as no face-to-face communication which could create a sense of both physical and psychological distance among team members (O'Hara-Devereaux & Johansen, 1994).

The traditional trust literature has recognized that trust is a multidimensional construct with both *cognitive* (e.g., competence, reliability, professionalism) and *affective* elements (e.g., caring, emotional connection to each other) (Lewis & Weigert, 1985). The relative importance of these two elements varies depending on the context and the type of relationship among people. According to Meyerson, Weick and Kramer (1996), the formation and maintenance of trust in highly fragile environments such as virtual teams rely more on the *cognitive* than the *affective* element. To date, however, the differences between the cognitive and affective aspects of trust in virtual teams are not very well understood in the literature. The goal of this study is therefore to

fill this gap by examining the relative importance of cognition-based trust (CBT) and affect-based trust (ABT) on virtual team performance.

In addition to contributing to the virtual team literature by looking at both CBT and ABT, our research also contributes to the trust literature by looking at the temporal dynamic nature of trust in virtual teams. Though the role of trust has been widely studied, few researchers have looked at the dynamic nature of trust. Undoubtedly, however, the temporal factor plays a critical role in the study of the group and the organization (McGrath, 1984). Although we know that virtual teams must form trust quickly (Meyerson et al., 1996), few studies have looked at the dynamic nature of trust at different stages over the course of a project's life. We believe that it is necessary to examine and empirically test the dynamic nature of trust and its pattern of changes in both cognitive and affective elements between high- and low-performing teams over time.

The paper begins by reviewing the literature on trust. Our theory and hypotheses are then presented, followed by the research methods. Finally, the discussions and expected contributions of the study are presented.

Theoretical Foundation and Hypotheses

Although the concept of trust has been viewed at different levels (group, organization, society) (Zimmer, 1972), we focus on interpersonal trust among team members, which is defined as "the extent to which a person is confident in, and willing to act on the basis of, the words, actions, and decisions of another" (McAllister, 1995, p. 25). Interpersonal trust is a multi-dimensional construct with both cognitive and affective foundations (Lewis & Weigert, 1985). CBT refers to the calculative and rational characteristics of trustees such as reliability (e.g., McAllister, 1995; Rempel, Holmes, & Zanna, 1985), integrity, and competence (Mayer et al., 1995). On the other hand, ABT involves the emotional aspects and social skill of trustees. Care and concern for the welfare of partners form the basis for affect-based trust (McAllister, 1995; Rempel et al., 1985). Unlike CBT, which was studied mainly in the context of working groups, ABT has typically been studied in the context of close social relationships such as couples, family members and friends (Boon & Holmes, 1991).

Only few studies have empirically tested the relative importance of cognition-based and affective-based trust in working relationships. Past research in face-to-face environments shows that the relative importance of the cognitive versus affective elements of trust depended on the type of social relationship, situation, and system under consideration (Lewis & Weigert, 1985 p. 972-973). For example, while in a close social relationship such as couples, and family members, affect-based trust is higher than cognition-based trust. Conversely, cognition-based trust would be of greater importance in a less acquainted group such as a work group. For example, Gabarro (1978) found that a cognitive aspect, especially competence, is key to establishing and sustaining trust in working relationships. In the context of virtual team environments, Meyerson et al (1996), posit that people working in a temporary system dealt with each other primarily in terms of the professional roles each individual performs, not in terms of developing social relationships. In this circumstance, they argue that trust must be built swiftly at the outset. In a temporary team, "people have to wade in on trust rather than wait while experience gradually shows who can be trusted and with what: Trust must be conferred presumptively or *ex ante*" (Meyerson et al., 1996, p. 170). This form of trust is normally known as *swift trust*. Typically, most of the virtual teams are temporary and the nature of the tasks is highly interdependent.

These multitalented teams of professionals share some risk due to the mutually dependent nature of the task that they perform. Hence, Meyerson et al. (1996) argue that the formation and maintenance of swift trust relies more on a cognitive and action orientation than an interpersonal relationship. Thus, one can hypothesize that, in virtual environments, teams will have a higher degree of CBT than ABT.

Furthermore, we argue that the communications media of virtual teams would also influence the formation of trust in virtual teams. That is, typically, virtual teams rely on computer-mediated communication tools as their primary means of communication (Majchrzak, Rice, Malhotra, & King, 2000). Although past research has shown that individuals can develop social relationships in computer-mediated communication environments when they are given enough time (Walther, 1995), there is an overwhelming body of literature that shows that, other things being equal, it is more difficult to develop social relationships through computer-mediated communications due to the depersonalization effect (Kiesler, Siegel, & McGuire, 1984; Sproull & Kiesler, 1986). Therefore, one can expect that the communications in virtual teams are more task-oriented (Hiltz, Johnson, & Turoff, 1986). Taken together, we expect that virtual teams will show a higher degree of CBT than ABT. Thus, we hypothesize that:

H1. In virtual team environments, the level of CBT will be higher than that of ABT throughout the course of the project, regardless of the team performance.

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Past studies have shown that trust in a traditional working relationship develops and changes over time (Rempel et al., 1985; Rotter, 1980; Zand, 1972) based on on-going interaction, and the experience of working together. This is because these interactions and experiences allow team members to learn and assess one another (Gabarro, 1978).

In a virtual team where members normally work in a short-lived project, they might not have enough time to gather sufficient information about their co-workers in order to determine whether that person is trustworthy. Moreover, the physical separation of team members may imply that the levels of trust among virtual team members must be higher than in traditional work relationships in order to achieve the goal (Hartman, 1999). The lack of engagement in a typical social greeting, such as a handshake and face-to-face interaction, make it harder for team members to establish trust in a new working relationship. For a team to perform well, CBT among team members must be built swiftly at the beginning stages of the project (Meyerson et al., 1996). When a role and a task were equivocal and highly interdependent, there is a relatively high risk of making mistakes. Without CBT, therefore, team members would not be able to take risks for fear of losing their jobs (Kristof, Brown, Sims, & Smith, 1995). Although ABT is typically found to be important in the context of close social relationships, McAllister (1995) found that even in the working group environments, ABT influences the performance and well-being of the teams.

In an early study of trust in virtual teams, Iacono and Weisband (1997) noted that teams with a high level of trust tended to engage in continuous and frequent communications, to focus on work content, and to adequately socialize during the early stage of the project. They found that both theaffective and cognitive elements of trust were prominent in the high-trust high-performance virtual teams. Jarvenpaa and Leidner (1999) found that trust can be swiftly developed in the virtual teams that they studied. Analyses of teams' e-mail messages revealed that high-performing teams exchanged background, personal information and were more

socialized with other members at the very beginning of the project. In another study, Kristof et al (1995) found that having trust in a company and fellow co-workers was considered to be a key element of success virtual teams. Taken together, these studies suggest that high-performing teams quickly develop both CBT and ABT early in the project. Thus, we hypothesize that:

H2. In virtual teams, high-performing teams will show higher levels of CBT than low-performing teams at the *beginning* of the project.
H3. In virtual teams, high-performing teams will show higher levels of ABT than low-performing teams at the *beginning* of the project.

Finally, although trust may not be easy to build, it is easy to destroy among team members, particularly in virtual teams. With one fault action, mutual trust can be destroyed (Deutsch, 1958). When the other party feels that trust is violated, cognitively, he or she assesses the degree of violation. Affectively, he or she may get angry, experience stress, and become disappointed (Lewicki & Bunker, 1995, p. 162). For example, Crisp and Jarvenpaa (2000) found that trust in virtual teams decreases over time. However, they did not examine whether high- and low-performing teams would experience the same decreasing pattern of trust over time. Jarvenpaa and Leidner (1999) also found that the trust in virtual teams was fragile; some teams that started with high trust levels ended up with low trust levels at the end of a six-week long group project. Thus, these studies suggest that high-performing virtual teams are not only able to quickly develop high degrees of CBT and ABT early on in the project, but also maintain them at high levels. Thus, we hypothesize that:

H4. In virtual teams, the level of CBT of high-performing teams will increase while that of low-performing teams will deteriorate over time.
H5. In virtual teams, the level of ABT of high-performing teams will increase while that of low-performing teams will deteriorate over time.

Method

Participants

Participants were recruited through an e-mail announcement that was broadcasted by an Internet list-serve popular among faculty members in the information systems area. Six different MBA courses that were taught by five professors in four different countries were recruited for the study[1].

A total of 146 MBA students (100 males; 46 females) of ten nationalities participated in the study. The average age and length of work experience of the participants were 28 and 5 years, respectively. Students took part in the project as part of their course and were randomly assigned to 40, four-member teams. Team members were students from four different universities; two teams had two members from the same university. During the course of the project, two teams were removed due to member inactivity. This left 38 teams for the data analysis.

[1] The second author taught two of them.

Task

A web-based, complex and realistic business simulation game, Inc 2000®, was used for the study. The engine of the game was developed by the first author and has been used regularly in both academic institutions and corporations in more than 100 sessions over the last three years. Inc 2000® is a strategic business simulation game built on generic business concepts. It equally emphasizes all four major functional areas of business—marketing, finance, production & operations, and human resources. The game is framed around the assumption that every team has been in business for 2 years.

All teams started with the same position in terms of market shares, financial resources, human resources, inventory, etc. Each team managed a $356 million company, producing and selling high-end server computers and competing against the other teams. The goal was to maximize the stock price of the company, which is influenced by several firm performance indicators that include market share, profit, unit cost, stock price, ROA, and ROE.

The game was conducted over an eight-week period. Each member was randomly assigned to one of the four business roles: VP of marketing; VP of productions and operations; VP of finance; and VP of human resources. Apart from the first week of the project, during which participants spent time getting to know other team members, reading the game manual and collectively setting the vision and objectives for their fictitious companies, teams were required to make a decision on 25 variables in the four functional areas on a weekly basis. Team members discussed how they should run their company for each week (from weeks 2–8), primarily through text-based, computer-mediated communication. At the end of each week (after all weekly decisions were submitted), the game administrator processed the decisions. Each team's weekly performance results were then distributed. The outcomes from prior weeks were taken into account in the subsequent week.

A web-based interface was designed to support and facilitate communication and knowledge coordination among team members in different places (see Figures 1 and 2). The interface design allowed the participants to (1) enter/edit/view their decisions and to see their team's performance, and (2) to communicate and exchange ideas/information from anywhere at anytime through a web-based discussion database that was tightly integrated into the game. In addition to this discussion database, members were provided an electronic mailing list for e-mail communications. All e-mail messages sent via the mailing lists were archived.

The web interface is purposely designed to allow only the member who is assigned to a particular functional area to input decision variables in that area, while other members can only view these variables once they are entered. The purpose of this split interface design, along with the interdependence among four functional areas in the game's logic, was not only to make the business game more realistic, but also to make each individual's decision part of a larger system. Individual members' effective interrelating actions through communication therefore became critical to the team's performance.

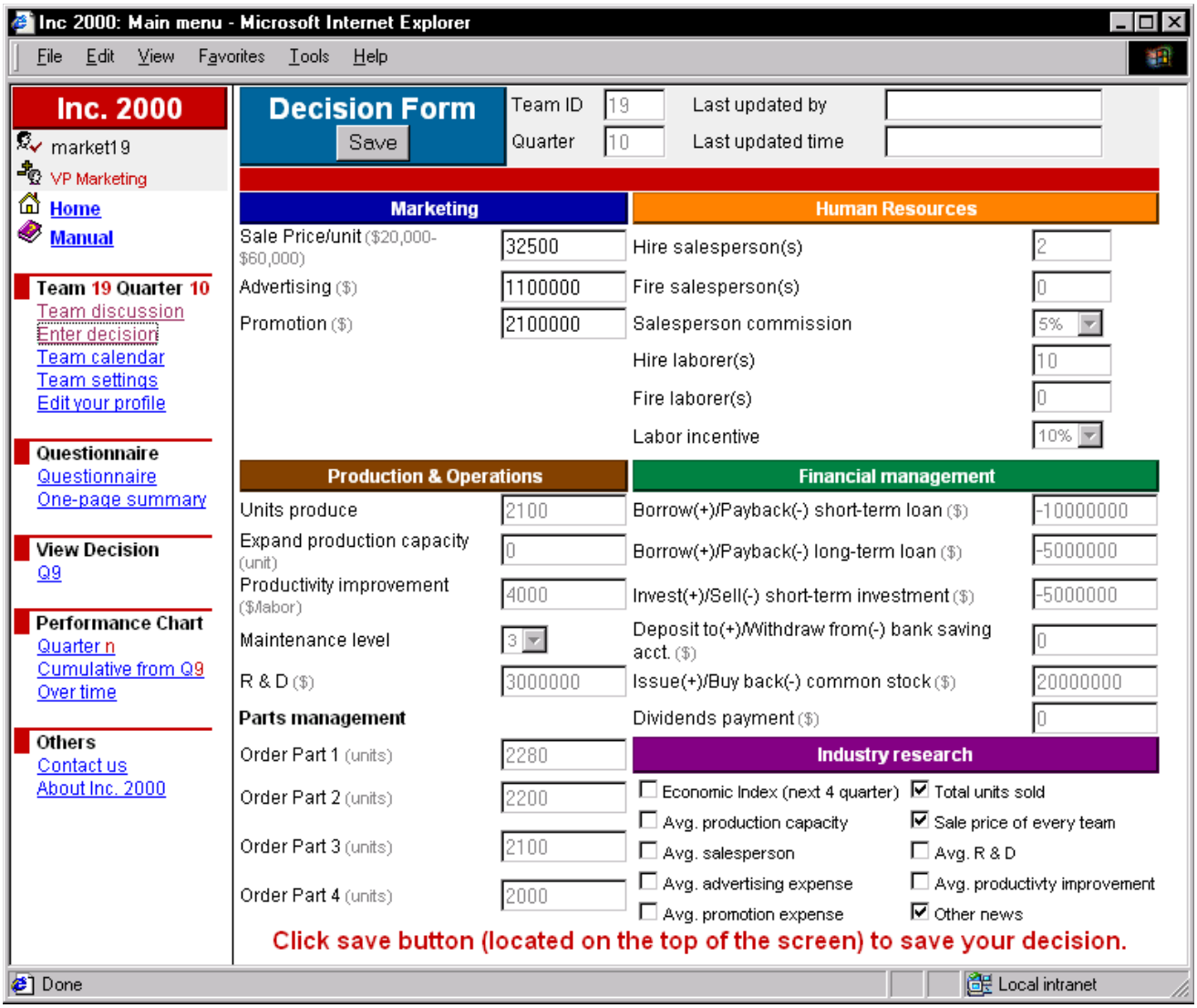

Figure 1. Decision form of a member in charge of marketing area

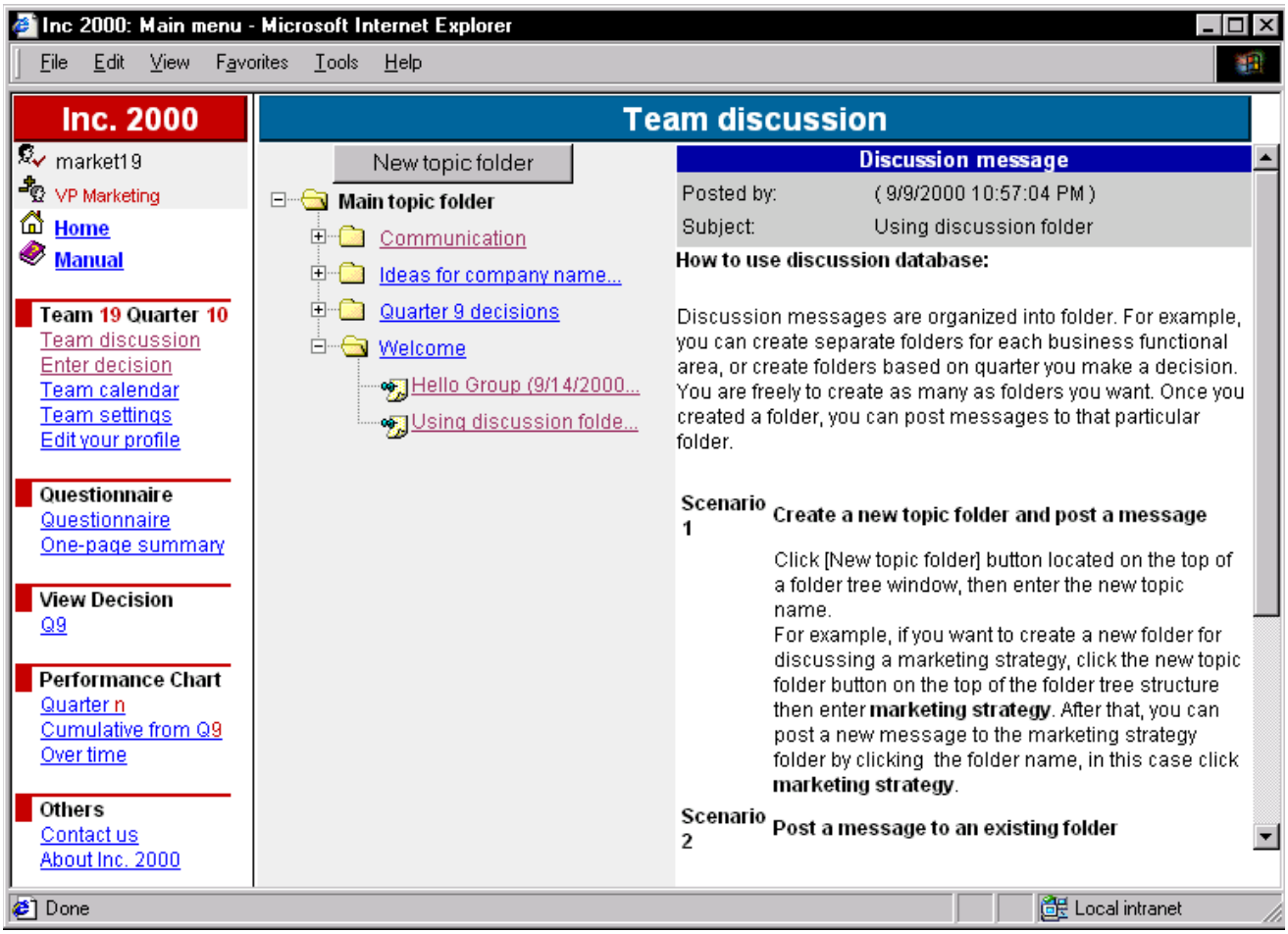

Figure 2. Team discussion database screen

Measures

The survey was administered three times at the end of weeks 2 (T1), 5 (T2), and 8 (T3). The timing of the survey administration was chosen based on Gersick's (1990, 1991) finding that teams with a definitive deadline tend to experience dramatic change at the midpoint. Thus, we hoped to capture the level of trust at the beginning of the project[2], at the midpoint, and at the end of the project.

A questionnaire was administered via a web page once all the decisions were submitted. A reminder e-mail was automatically sent out one day before the deadline to participants who had not yet completed the questionnaire in that respective quarter. Except for team performance, all measures were assessed using 5-point Likert scales. All items were listed in Table 1.

[2] Since the teams didn't start the real decision-making task until week 2, the trust level measured at the end of week 2 is considered as initial trust level.

Team performance (PERF). Weekly team performance was assessed using six criteria – profit, return on asset (ROA), return on equity (ROE), stock price, unit sold (market share), and unit cost – all generated from Inc. 2000. Each performance criterion value was separately ranked relative to other teams. The six rankings were then compiled as a composite performance score ranging from 6 to 240 (6 criteria × 40 teams). For example, the team holding the 1^{st}, 4^{th}, 10^{th}, 8^{th}, 23^{rd}, and 5^{th} rankings in profit, ROA, ROE, stock price, market share, and unit cost, respectively will have a composite score of 51 (1 + 4 + 10 + 8 + 23 + 5). These composite scores were then reversed and normalized to arrive at a performance score that ranged from 1 (low) to 100 (high).

Disposition to trust (DT). Since individuals' trust can be influenced by their disposition to trust (McKnight, Cummings, & Chervany, 1998), we measured individual disposition to trust using a four-item scale developed by Pearce (1992). Respondents assessed items by rating them on a scale ranging from 1 (Strongly disagree) to 5 (Strongly agree). This scale was measure at T1 and T2.

Trust. We measured CBT and ABT using the adapted scale developed by McAllister (1995). Wordings in items were modified to suit the group level measurement. Each dimension is measured by 4 items. Respondents assessed items by rating them on a scale ranging from 1 (Strongly disagree) to 5 (Strongly agree). Both CBT and ABT were measured at T1, T2 and T3.

Analyses

Levels of Analysis

The data were analyzed at the team level. In order to check the appropriateness of aggregating individuals' scores into a group-level score, we conducted two statistical tests: 1) James' index (r_{wg}), commonly known as the interrater agreement index (James, Demaree, & Wolf, 1984), and 2) Intraclass correlation (ICC) (Kenny & la Voie, 1985). James' index measures the homogeneity of members' perceptions. Generally, an aggregation is considered appropriate if the r_{wg} median of the scale is greater than 0.70 (George, 1990). The calculation of the intraclass correlation (Kenny & la Voie, 1985) is based on the computation that compares within-group and between-group variance. To justify aggregation, the ICC values of scale should be higher than 0.12 (James, 1982).

The results show that all r_{wg} medians of CBT and ABT were .87 and .72, respectively, scores that are well above .70. Intraclass correlations of CBT and ABT were .15, and .13, respectively, indicating that an aggregation of individuals' scores into the group-level score is warranted.

Test of Measurement Model

We first demonstrated that items would be loaded on their targeted factors. We conducted three separate confirmatory factor analyses using the EQS 5.7b package for T1, T2, and T3. The results showed that all items were loaded in the target factors at all three phases. All loadings were greater than .70 and stable across all periods (see Table 1). Also, as shown in Table 1, all goodness of fit indexes for all periods clearly indicated that the model fit well with the data, thus providing strong evidence for the convergent and discriminant validity of the measures used in the study.

Then, to demonstrate the multidimensionality of the trust scale, we examined the differences in chi-square between one- ($\chi^2 = 90.29$, $df = 20$, $p < .001$) and two-factor ($\chi^2 = 29.88$,

df = 19, $p < .05$) trust models. The results revealed that the two-factor model is superior to the one-factor model, as suggested by a significant change in chi-square ($\Delta\chi^2 = 60.41$, *df* = 1, $p < .0001$) as well as a moderate increase in the GFI index value of .13. Based on this evidence, a two-factor model appears to be warranted.

We further examined the discriminant validity using the square root of the average variance extracted. As shown in Table 2, all square roots of the average variance extracted displayed in a diagonal of a correlation matrix are greater than the off-diagonal construct correlation in the corresponding rows and columns for each separate time period. This indicated that each construct shared more variance with its items than it shared with other constructs (Fornell & Larcker, 1981), thereby confirming the discriminant validity.

	Time		
	T1	T2	T3
Cognition-based Trust (CBT) (Construct reliability = 0.89)			
Most of my teammates approach his/her job with professionalism and dedication.	.873	.861	.893
I see no reason to doubt my teammates' competence and preparation for the job.	.810	.881	.874
I can rely on other teammates not to make my job more difficult by careless work.	.778	.815	.896
Most of my teammates can be relied upon to do as they say they will do.	.820	.903	.871
Affect-based Trust (ABT) (Construct reliability = 0.86)			
I can talk freely to my team about difficulties I am having at work and know that my team will want to listen.	.708	.783	.882
I would feel a sense of loss if one of us was transferred and we could no longer work together.	.771	.832	.890
If I shared my problems with my team. I know (s)he would respond constructively and caringly.	.789	.841	.876
I would have to say that we (my team) have made considerable emotional investments in our working relationship.	.853	.866	.853
Disposition to Trust (DT) (Construct reliability = 0.72)			
Most people tell the truth about the limits of their knowledge.	.552	.763	
Most people can be counted on to do what they say they will do.	.487	.745	
Most people are honest in describing their experience and abilities.	.717	.895	
Most people answer personal questions honestly.	.743	.726	
Goodness of fit index			
Chi-square	81.900	100.684	28.825
df	54	53	19
p	.008	.001	.068
NFI	.932	.941	.973
CFI	.975	.971	.991
RMSEA	.064	.085	.068
RMSEA (90% confidence interval)	(.03, .09)	(.06, .11)	(.00, .11)

Note: All loadings were significant; *t*-values ranged from 4.60 to 11.21. Construct reliability using Fornell and Larcker's formula (1981) reported here was based on the CFA result of T1.

Table 1. Results of confirmatory factor analysis (using EQS 5.7b) of constructs for each time period

Finally, we estimated the reliability of the measures using Fornell and Larcker's construct reliability (1981). All factors achieved high reliability. Table 2 shows the descriptive statistics and the correlation matrix of all measures for all three phases of measurement.

				Correlation of constructs[a]								
		Mean	SD	ABT_1	CBT_1	$PERF_1$	ABT_2	CBT_2	$PERF_2$	ABT_3	CBT_3	$PERF_3$
Time 1	ABT_1	2.77	0.59	**.78**								
	CBT_1	3.22	0.52	0.74**	**.82**							
	$PERF_1$	55.55	22.41	-0.16	-0.05	**na**						
Time 2	ABT_2	2.95	0.52	0.45**	0.33*	0.11	**.83**					
	CBT_2	3.41	0.59	0.20	0.30	0.24	0.56**	**.87**				
	$PERF_2$	51.50	23.57	0.00	0.15	0.15	0.34*	0.35*	**na**			
Time 3	ABT_3	2.79	0.67	0.40*	0.17	0.11	0.75**	0.47**	0.26	**.88**		
	CBT_3	3.18	0.71	0.21	0.29	0.06	0.54**	0.59**	0.44**	0.66**	**.88**	
	$PERF_3$	52.32	19.23	-0.01	0.09	0.26	0.21	0.23	0.54**	0.29	0.39*	**na**
	FPERF[b]	51.66	25.44	-0.02	0.11	0.27	0.27	0.39*	0.86**	0.27	0.46**	0.68**

Note: * Correlation is significant at the 0.05 level (2-tailed).

** Correlation is significant at the 0.01 level (2-tailed).

[a] Diagonal boldface elements were the square root of the average variance extracted.

[b] Overall Performance.

Table 2. Means, Standard Deviations and Correlation of constructs at the group-level (n = 38)

Results

We first split 38 teams into 19 high- and 19 low-performing teams based on the overall performance score. Then, to make sure that individuals' disposition to trust did not influence the study results, we first examined whether their levels of disposition to trust vary across time and team performance. An analysis of variance (ANOVA) revealed no differences in the levels of disposition to trust ($F(1, 253) = 1.27$, $p = .26$) between a high-performing team (mean = 3.34, s.d. = .75) and a low-performing team (mean = 3.24, s.d. = .71). The ANOVA results also revealed no changes of disposition to trust between time 1 and time 2 ($F(1, 253) = .63$, $p = .43$). These results indicated that individuals working in both high- and low-performing teams have no difference in a level of their disposition to trust at the beginning and the middle stages of the project.

We expect that, in virtual environments, teams will develop a higher level of CBT than ABT (H1). To test our hypothesis, we conducted a paired t-test comparing the levels of CBT and ABT at all three periods using the full sample. The results strongly support H1. The level of CBT is higher than that of ABT at all three periods ($t(37) = 6.70$, 5.33, and 4.15, for T1, T2, and T3 at $p < .0001$).

H2 and H3 aim at identifying the differences between high- and low-performing virtual teams in terms of CBT and ABT at the outset of the project. We hypothesized that high-performing teams will show higher initial CBT and ABT than low-performing teams. We

conducted two t-tests contrasting high- and low-performing teams in terms of CBT and ABT in T1. As shown in Table 3, the results show that there is no significant difference between high- and low-performing teams in terms of initial CBT ($F(1, 36) = 0.08$, $p = 0.78$) and ABT ($F(1, 36) = 0.17$, $p = 0.68$).

Trust	High		Low		*Sig.*
	mean	SD	mean	SD	
CBT	3.24	(054)	3.19	(0.51)	0.78
ABT	2.73	(0.58)	2.81	(0.62)	0.68

Table 3. *t*-test of CBT and ABT at T1

Finally, we hypothesized that the CBT and ABT of high-performing teams would increase over time while those of low-performing teams would deteriorate (H4 and H5). To test our hypotheses, we conducted four repeated measure ANOVA tests that examine the changing patterns of CBT and ABT in high- and low-performing teams. The repeated measure ANOVA allows us to see whether the changing patterns of CBT and ABT over time follow linear or quadratic patterns (Bray & Maxwell, 1985). If the repeated measure ANOVA detected either linear or quadratic patterns, we performed post-hoc pairwise comparisons among T1, T2, and T3 using the Scheffe test to understand the nature of the changing patterns of trust more clearly. The results of these tests are shown in Table 4. The repeated measure ANOVA for CBT of high-performing teams revealed a significant quadratic trend ($F(1, 18) = 5.941$, $p = 0.025$). To better understand the nature of this trend, we conducted post-hoc pairwise comparisons between T1 vs. T2 and T2 vs. T3. The results of the post-hoc test showed that there was a significant increase of CBT in high-performing teams from T1 (mean = 3.24, S.D. = 0.54) to T2 (mean = 3.60, S.D. = 0.55) ($F(1, 18) = 5.27$, $p = 0.034$). However, there was no significant difference between T2 and T3 (mean = 3.35, S.D. = 0.78) ($F(1, 18) = 3.09$, $p = 0.096$). This suggests that high-performing teams in our sample were able to develop high-levels of CBT during the first half of the project and maintained these levels during the second half. On the contrary, the repeated measure ANOVA of CBT of low-performing teams did not show any significant results. This implies that the level of CBT of low-performing teams did not change throughout the project life cycle.

We found an almost identical pattern for ABT. Again, the repeated measure ANOVA for ABT of the high-performing teams showed a significant quadratic trend ($F(1, 18) = 5.297$, $p = 0.034$). The post-hoc test revealed a significant increase in ABT from T1 (mean = 2.73, S.D. = 0.58) to T2 (mean = 3.06, S.D. = 0.45) ($F(1, 18) = 5.29$, $p = 0.034$), while showing no statistically significant changes from T2 to T3 (mean = 2.91, S.D. = 0.79) ($F(1, 18) = 1.47$, $p = 0.241$). On the other hand, the repeated measure ANOVA of ABT of the low-performing teams did not show any significant results. Thus, we concluded that the level of ABT of low-performing teams did not change over time.

Source		*SS*	*df*	*MS*	*F*	*Sig.*
CBT-High-performing teams						
TIME	Linear	.105	1	.105	.403	.533
	Quadratic	1.194	1	1.194	5.941*	.025
Error	Linear	4.703	18	.261		
	Quadratic	3.617	18	.201		
CBT-Low-performing teams						
TIME	Linear	.334	1	.334	1.168	.294
	Quadratic	.196	1	.196	1.405	.251
Error	Linear	5.148	18	.286		
	Quadratic	2.516	18	.140		
ABT-High-performing teams						
TIME	Linear	.307	1	.307	1.167	.294
	Quadratic	.716	1	.716	5.297*	.034
Error	Linear	4.740	18	.263		
	Quadratic	2.433	18	.135		
ABT-Low-performing teams						
TIME	Linear	.184	1	.184	.881	.360
	Quadratic	.148	1	.148	2.122	.162
Error	Linear	3.762	18	.209		
	Quadratic	1.254	18	.069		

Note: * significant at $p < .05$

Table 4. Results of pairwise comparisons.

Discussion

Our main focus of this study was to examine the dynamic nature of trust in virtual teams and the pattern of changes of both CBT and ABT between high- and low- performing teams over time. We found that virtual teams in our sample developed a higher-degree of CBT than that of ABT. Our results strongly support the swift trust proposition made by Meyerson et al (1996) that, in a temporary work team, the cognitive element is more important than the affective element. While we do not downplay the importance of ABT, we emphasize that virtual teams should explicitly attempt to develop CBT early in the process. Complementing previous studies in virtual teams that were mostly based on the case study method, our study empirically tested the dynamic patterns of both CBT and ABT over a period of time. We found that, as teams moved along, their levels of CBT and ABT changed. Additionally, their patterns of change were different depending on how well teams performed.

Specifically, both high- and low-performing teams started with comparable levels of CBT and ABT. However, high-performing teams were able to develop both CBT and ABT during the first half of the project and maintain the trust level in the second half. Therefore, one could argue that high-performing teams were able to perform at a high level since trust among team members facilitated the flow of knowledge and cooperation (Deutsch, 1958; Huemer, von Krogh, & Roos, 1998) while reducing the level of uncertainty (Sorrentino, Holmes, Hanna, & Sharp, 1995).

On the contrary, low-performing teams experienced no change in the level of CBT and ABT. In fact, our post-hoc analysis showed that there was a significant drop in ABT of low-performing teams from T2 (mean = 2.85, S.D. = 0.58) and T3 (mean = 2.67, S.D. = 0.52) ($F(1, 18) = 5.09$, $p=0.037$), although it did not influence the overall pattern as examined by the repeated measure ANOVA. One can argue that the low performance level of these teams can be attributed to their inability to develop an adequate level of trust among team members in virtual team environments, this in turn hindered the cooperation among and withdrawal of members (Luhmann, 1979).

Limitations

Our study has several limitations. First, we arbitrarily assigned roles to participating students. We felt that this might have suppressed the influence of individual team members' real abilities and expertise, which consequently might have suppressed the level of CBT. Future research should attempt to align participants' expertise to their assigned role. Alternatively, future research may also examine the dynamic of trust in real organizational settings. These alternative designs will allow us to see the real impact of CBT in virtual teams. Second, we measured trust through perceptual measures. Although these measures were taken from the literature and showed excellent measurement properties, we felt that a better understanding can be gained by analyzing team members' communicative actions. In the context of virtual teams where members are geographically separated, this means one needs to examine the contents of their communication interactions. A micro-level content analysis of team communication interactions would undoubtedly improve our understanding in this area.

Implications for Virtual Team Management and Future Research

Despite these limitations, our study provides a few important implications for virtual team management practice. First, we suggest that managers of virtual teams need to pay conscious attention to the development and maintenance of trust among team members in order to achieve high performance. Despite the challenges of developing a high-level of social relationships, numerous research studies, including our own, have demonstrated the importance of trust in virtual teams.

Second, we suggest that the managers of virtual teams should focus on both CBT and ABT. While the typical socialization strategies suggested by previous virtual team studies might help teams develop ABT, they may not be enough to develop and maintain CBT. Given that CBT is based on a calculative, rational process, managers need to provide task-relevant background information on virtual teams members so that team members can quickly develop CBT as well as ABT.

Third, we suggest that the managers of virtual teams should focus on the maintenance as well as the development of trust in virtual teams. Our results clearly showed that high-performing teams were able to maintain high levels of CBT and ABT until the end of the project. Again, typical socialization strategies may help managers develop trust, they may not be enough

to maintain it once conflicts among team members emerge. Thus, managers need to be equipped with various conflict resolution strategies in order to alleviate conflict before it leads to degradation of trust among members.

Our study also provides several directions for future research. First, as indicated earlier, future research can examine the micro-level communication processes by which teams develop different levels of CBT and ABT over time. Such studies can provide invaluable insights to managers and researchers alike about how to "read" the health of the team in terms of CBT and ABT. Second, recent studies suggest that socio-cognitive constructs such as transactive memory and collective mind have a direct and important influence on team performance above and beyond typical socio-psychological constructs such as trust. Future studies can examine how those socio-cognitive constructs and socio-psychological constructs are interrelated in virtual teams. Third, we studied the trust among team members. However, past research in face-to-face environments shows that trust in leaders is also important for team performance. Future studies can examine the influence of leader-subordinate trust on team performance.

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