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The Impacts of Computer-Mediated versus Face-to-Face Communication on Transactive Memory System

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ABSTRACT

The goal of this research is to reconcile inconsistent findings on transactive memory system development in computer-mediated versus face-to-face settings. A quasi-experiment with repeated measures was conducted. Results showed that computer-mediated communication had the same impact on transactive memory system development as face-to-face communication and the impact of computer-mediated and face-to-face communication both dissipated over time.

KEYWORDS: Transactive memory system, Computer-mediated communication, Face-to-face communication, Compensatory adaptation theory, and Quasi-experiment

INTRODUCTION

Transactive memory system (TMS), a shared cognitive system that team members develop to encode, store, and retrieve knowledge of different substantive domains (Moreland, 1999; Wegner, Giuliano, & Hertel, 1985), is one of most researched topics in the field of team cognition over the past two decades (Ren & Argote, 2011). Early research was focused on traditional, face-to-face (FtF) team settings and has consistently reported that developed TMS leads to positive results for team performance (Akgun, Byrne, Keskin, & Lynn, 2006; Choi, Lee, & Yoo, 2010).

With the advancements in information communication technologies (ICTs), contemporary organizational teams begin to commonly rely on computer-mediated communication (CMC) and thus become increasingly virtual (Maynard, Mathieu, Rapp, & Gilson, 2012). In fact, it is rare to find teams that do not employ some forms of CMC nowadays (Kirkman & Mathieu, 2005). Consequently, recent research on TMS has shifted attention from FtF to CMC settings (Ren & Argote, 2011). Empirical studies have reported that effective TMS remains influential to virtual team performance (Kanawattanachai & Yoo, 2007; Maynard et al., 2012).

However, research has been inconclusive on the mechanism of TMS development in CMC settings. On one hand, empirical findings show non-FtF communication (e.g., emails) has no impact on TMS's initial formation and negative impacts on TMS's maturation (Lewis, 2004).

Hence, some researchers suggest that nonverbal, paralinguistic cues have significant bearing on TMS development (Hollingshead, 1998) and it may be difficult, if not impossible, for virtual teams to develop effective TMS due to lack of such cues (Lewis, 2004; O'Leary & Mortensen, 2010). On the other hand, other researchers argue that, by improving elaborateness, thoughtfulness, and usefulness of communication, people may adapt non-FtF communication to compensate the loss of nonverbal cues (Kock, 2004). They, thus, suggest that virtual teams would be able to develop matured TMS (Maynard et al., 2012). This proposition is also supported by empirical findings, which show non-FtF communication, taking place solely via mailing lists, leads to TMS development (Kanawattanachai & Yoo, 2007). Therefore, regarding TMS development in CMC versus FtF settings, we are lack of conclusive answers for two important questions: First, what impact does non-FtF communication have on TMS development? Second, how different is the impact of non-FtF from that of FtF communication on TMS development? This research attempts to provide answers for these questions.

There are many forms of CMC settings, such as video-based and text-based (Nowak, Watt, & Walther, 2005). This study chooses to focus on a text-based CMC setting (i.e., text conferencing). Although video-based CMC tools have been around for quite some time, “blogs, twitter, and mobile texting continue to make text-based messaging a primary communication modality” in CMC settings (Walther, 2015, p. 426). This might be mainly due to the fact that most people have developed the habit of using text-based communication when coming to CMC. The rest of the paper is organized as follows. First, theoretical foundation and hypotheses will be discussed. Then, research methodology and results will be presented. Finally, theoretical implications of the findings, limitations of the research, and future research directions will be discussed, and practical implications of the findings will also be suggested.

THEORETICAL FOUNDATION

TMS

Team cognition literature suggests that as team members interact with each other and jointly perform team tasks, they may develop knowledge about the team (Cannon-Bowers, Salas, & Converse, 1993; Klimoski & Mohammed, 1994). Such knowledge is concerned with knowledge relevant to team members’ roles, responsibilities, skills, abilities, preferences, and styles (Cooke, Salas, Cannon-Bowers, & Stout, 2000). TMS is a type of knowledge about the team, which particularly describes “individuals’ memories of group members as associating hierarchically organized domains of knowledge, in the form of higher-order and lower-order labelled categories of information, with location information that describes where the labelled information is stored, such as in another person” (Brandon & Hollingshead, 2004, p. 635). For example, programming language is a higher-order category, Java is a lower-order category, and Donald is a location. The essence of TMS is associating programming language-Java with Donald; that is, who knows what in the team.

A developed TMS manifests itself in three aspects of team behaviors: First, team members can quickly figure out whom they need to interact with in order to obtain needed information (Kanawattanachai & Yoo, 2007). Second, team members with highly developed TMS show sufficient trust in each other’s expertise. This trust allows them to carry out tasks of their specialties without explicitly justifying courses of actions, and avoids criticizing each other’s work too often (Moreland, 1999). Third, team members can anticipate what others may need to know. Thus, they dynamically adjust their own coordinative behaviors in order to meet the need of others (Choi et al., 2010; Rico, Sánchez-Manzanares, Gil, & Gibson, 2008).

Media Richness Theory

According to media richness theory (MRT) (Daft & Lengel, 1987; Daft & Lengel, 1986; Daft, Lengel, & Trevino, 1987; Trevino, Lengel, & Daft, 1987), media differ in aspect of the bandwidth or number of cue systems available within them. FtF channel is regarded the “richest” medium because immediate feedback is available and various nonverbal cues can be utilized. Though, a computer-mediated channel, such as text conferencing, is considered as a typical “lean” medium mainly because traditional nonverbal cues, such as voice tone, facial expression, and body movement, are missing. MRT posits the richness, as the structural characteristics of media, to be a key factor determining the way communicators interact with each other and thus the amount of information exchanged. This, in turn, leads to differences in relational development (e.g., TMS) between CMC and FtF settings. The lower level of richness is associated with less developed relationships.

Compensatory Adaption Theory

MRT suggests that CMC suffers the loss in richness, frequency, social presence, and spontaneity (Daft & Lengel, 1987; Short, Williams, & Christie, 1976). However, several researchers (e.g., Fulk, Schmitz, & Steinfield, 1990; Kock, 2004; Ngwenyama & Lee, 1997) contend that participants in CMC are able to compensate the loss by improving other aspects of communication. For instance, the message content of the text-based CMC tends to be more elaborated and well-thought (Kock, 2001). As Kock (2004) argues, ample evidence of biological anthropology indicate that human beings’ communication apparatus, which includes the elements of brain and body used for communication, has naturally evolved to serve primarily for FtF communication. Therefore, CMC presents a less than natural medium for our communication apparatus. The decrease in naturalness forces individuals to put more cognitive effort in communication activities, which in turn induces individuals to adapt their communication behaviors in a compensatory way. Kock named this phenomenon compensatory adaption.
In the context of the email medium, Kock (1998, 2001) found that compensatory adaption manifested itself as discussants spent more time preparing email postings and the postings tended to be focused, well-articulated, and carefully thought-out. Therefore, individuals may adapt to the email medium by improving their communication quality. This adaptive behavior is constraint-induced: The text-based, asynchronous feature compels and also facilitates individuals to think and reflect carefully on what they are going to communicate. Hemetsberger and Reinhardt (2006) had similar findings: A software team relied on the mailing list to coordinate work between developers. In order to compensate the abstractness of the text-based communication, the developers employed various forms of figurative language, such as metaphors and analogies, and used simple examples of everyday experience and usage scenarios. In addition, the text-based nature instigated the developers to think more thoroughly and carefully about what others said and what they were going to post.

HYPOTHESES

Communication plays an essential role in the process of TMS development (Peltokorpi, 2014). It is through communication that team members acquire information about each other. Such information tell them about the content and depth of other members’ knowledge and help them construct and refine perceptions of member-expertise association (Lewis, 2004).
Communication occurred in small groups can be largely classified into two categories: social-emotional and task-related communication (Ghosh & Dickerson, 2015; Löfstrand & Zakrisson,

2014). While the former shows emotions, such as solidarity and antagonism, the latter focuses on intellectual interactions, such as giving suggestion and analysis (Bales, 1950).

The essence of TMS development is to establish expertise-member association. Because a member's expertise can only be demonstrated through his task-related behaviors, task-oriented communication, such as, stating their qualifications or lack of expertise in certain domains, responding to questions, and soliciting information from others (Hollingshead, 1998), should have a positive impact on TMS development. Moreover, compensatory adaptation theory suggests that the message content of CMC tends to be more focused, well-articulated, and carefully thought-out to compensate the loss of traditional verbal cues, such as voice tones, body movements, and facial expression (Kock, 2004). Therefore, it is reasonable to expect that the impact of non-FtF communication on CMC teams' TMS would be as strong as the impact of FtF communication on FtF teams' TMS. Nevertheless, as TMS develops and gradually reaches its maturation, task-oriented communication provides nothing but redundant information about other members' expertise (Kanawattanachai & Yoo, 2007). Consequently, the impact of the communication on TMS development will attenuate over time and eventually disappear. This should be the same for both FtF and CMC teams.

> Hypothesis one. The impact of non-FtF task-related communication on CMC teams' TMS development is as strong as the impact of FtF task-related communication on FtF teams' TMS development.

> Hypothesis two. The impacts of both non-FtF and FtF task-related communication on TMS development attenuate over time.

METHOD

A quasi-experiment with repeated measures was conducted to test the hypotheses proposed above. Data were collected from three sources: (1) questionnaires; (2) audio records of FtF communication; (3) archives of text-based CMC.

Participants and Team Composition

Seventy two undergraduate students from a major university in southwest China were recruited to participate in this study. The age range was from 18 to 23 years. Participants were from three classes. Each class met on a different day of the week. Two of the classes were attending an introductory course for management information systems (MIS) and the other one was attending an introductory course for management. No participants were attending both courses. Participants were grouped into three-member teams to complete a project. Based on the quality of the work, they could earn up to 30 percent of the course credit. Initially, there were 24 teams in total.

Each member of a team was randomly chosen in a class and three members were from three different classes. The team was composed this way to eliminate the potential confounding effect of familiarity on TMS development (Lewis, 2004). In addition, team members were asked to rate to what extent they knew others in their teams before the experiment started on a four-point scale (1=do not know, 2=acquaintance, 3=know well, 4=know very well) (Gruenfeld, Mannix, Williams, & Neale, 1996). All the participants gave the rating of 1 or 2. Another purpose of the team composition was to create an imbalanced knowledge distribution within a team, which is an essential pre-condition for TMS development (Moreland, 1999). Specifically, members from

MIS classes were knowledgeable about relational database design, whereas members from the management class knew the details of business operations that were needed for completing the project.

Task, Procedures, and Media Manipulation

There were many bike rental shops on and around the university campus. The teams were asked to develop a relational database system for one rental shop of their choice using Microsoft Access. The task lasted for three weeks. Members of each team were required to meet once per week to discuss the task. Before the task was assigned, participants from MIS classes had been taught in their course sessions about rational database, focusing on entity-relationship diagram and functionalities of Access. They were subsequently assigned with the role of “programmer” in their teams and responsible to the technical details of database design. Participants from the management class, on the other hand, were assigned with the role of “customer representative.” Their job was to obtain any business information that their teams needed from rental shops.

At the beginning of the first week, members of a team were informed separately in their respective class sessions about time slots available for the first-week meeting and the communication medium to be employed. The meeting lasted for one hour and was conducted either FtF or via an online text conferencing tool (i.e., an electronic medium). Specifically, the tool employed was Tencent QQ, which allowed users to set up a discussion group to have real-time text communication. This tool was chosen because it was free to use and also it was very easy to use. FtF meetings were audio-taped and the audio records were transcribed to text for the content analysis. Computer-mediated meetings were electronically archived. After the meeting, each team completed an online survey measuring TMS. The same procedure was repeated at the second and third week, except that the meeting at the third week lasted for half an hour.

Two medium settings were created: (1) the meetings over the three-week period were all conducted FtF (i.e., FFF); (2) the meetings over the three-week period were all conducted electronically (i.e., EEE). Teams were randomly assigned to one of two settings and each setting had 12 teams. To ensure that all communication influencing TMS development were recorded and observed, participants were asked to do their best to avoid interactions with other team members outside of the context of the experimental sessions. If they had to, only could phone calls and emails be used, and they also needed to report such communication each week if it happened. If a phone call was made, they needed to report the time, duration, and content. If an email was sent, they needed to forward the email to the author. The reports indicated that few phone calls and emails took place outside the experimental sessions each week. They were all concerning convenient time slots for meeting. Therefore, it was concluded that such communication should not have practical impacts on TMS development and was not included in the analysis.

Measures

TMS was measured using six items developed by Lewis (2003). Because all the participants were Chinese, the items were translated to Chinese. The forward and backward translation technique was employed to ensure the translation accuracy. Each item was rated on a five-point Likert scale, from “strongly disagree” to “strongly agree”. The items are listed in Appendix.

Non-FtF and FtF task-related communication was measured by content-analyzing text records of CMC and audio records1 of FtF meetings. The Bales' interaction protocol analysis (IPA) was used (Bales, 1950). IPA is one of frequently used method to study communication behaviors of small groups and has been successfully applied to both FtF and CMC settings (Hiltz & Johnson, 1990; Kanawattanachai & Yoo, 2007; Weisband, 1992). IPA classifies communication behaviors occurred in small groups into 12 different sub-categories, including showing solidarity (1), tension release (2), and agreement (3); giving suggestion (4), opinion (5), and orientation (6); asking for orientation (7), opinion (8), suggestion (9); showing disagreement (10), tension (11), and antagonism (12). Sub-category (1)-(3) and (10)-(12) can be further clustered to a category of social-emotional communication, and sub-category (4)-(9) can be further clustered to a category of task-related communication. The unit to be coded in IPA is a simple sentence or its equivalent, representing a complete thought that permits the other person to make a reasonable interpretation (Bales, 1950). Task-related communication in this study was measured by counting the number of IPA units belonging to the category task-related communication.

The procedure developed by Kanawattanachai and Yoo (2007) was followed to conduct IPA. Two graduate students were hired as coders and given one week to study the Bales' IPA manual carefully. One week later, a session was held. The first author met with the coders. First, the author answered the questions which the coders had about the manual. Second, the author and coders worked by consensus to code one randomly chosen team meeting record using the manual. Last, three randomly chosen team meeting records from Week 3 were assigned to the coders. The coders were given three weeks to code the records separately. Three weeks later, the coders reported their coding results. The inter-rater reliability measured by kappa was 0.77. The coders met and resolved coding differences. The same coding practice was applied to three team meeting records from Week 1 and another three from Week 2. The inter-rater reliability was 0.84 and 0.87, respectively. Any coding differences were discussed and resolved between the coders. After completing the training session, the rest of meeting records was divided into two sets. Each coder was assigned with one set. It took about three months to complete the coding. Table 1 shows descriptive statistics of non-FtF and FtF task-related communication.

Table 1. Means and Standard Deviations for Non-FtF and FtF Communication

	WEEK1		WEEK2		WEEK3	
	Mean	S.D.	Mean	S.D.	Mean	S.D.
Non-FtF	115	35	95	35	62	30
FtF	535	230	497	167	310	154

Analysis Strategy

The analysis was conducted in four steps (Choi et al., 2010): First, the psychometric properties of the TMS measure were examined using individual-level data. Second, statistical tests were performed to examine whether it was appropriate to aggregate individual-level TMS measure into a team-level score. Third, hypotheses were tested by employing partial least squares (PLS).

RESULTS

Test of the Measurement Model

The individual-level data were first analyzed using a reliability analysis (i.e., Cronbach's α) and exploratory factor analysis (EFA) in SPSS. Since TMS was measured at three different times, three separated analyses were conducted. In EFA, a maximum likelihood method was used to extract the initial factors and the varimax was used in the rotation phase. The results are shown in Table 2. The TMS measure achieved an acceptable reliability score with Cronbach'sαgreater than 0.70 in all three weeks. The six measurement items, as expected, loaded on a single factor and all factor loadings were greater than 0.50 (Hair, Anderson, Tatham, & Black, 1995; Shih, 2004).

Table 2. Cronbach's α and Results of EFA

	WEEK1 Cronbach's α = 0.77	WEEK2 Cronbach's α = 0.82	WEEK3 Cronbach's α = 0.81
	Factor loadings	Factor loadings	Factor loadings
Item1	0.67	0.52	0.62
Item2	0.71	0.75	0.73
Item3	0.77	0.87	0.83
Item4	0.75	0.83	0.82
Item5	0.63	0.65	0.68
Item6	0.60	0.79	0.69

Next, three separated confirmatory factor analyses (CFA) were performed using AMOS. The CFA model contained a single factor and six measurement items loaded on this factor. The results showed that the factor loading of Item5 at week 1 was 0.46 and the factor loadings of Item1 at Week 2 and 3 were 0.36 and 0.45, respectively. Therefore, these two items were dropped and CFA were performed again. The results are shown in Table 3. All loadings were statistically significant at the $p<0.05$ level and greater than 0.50 for all three weeks. Chi-square, AGFI, and RMSEA clearly indicated that the one-factor model fit well with data for all three weeks. In addition, satisfactory composite reliability (CR) and average variance extracted (AVE) scores were also achieved for all three weeks.

Table 3. Results of CFA

	WEEK1	WEEK2	WEEK3
CR	0.86	0.91	0.90
AVE	0.63	0.72	0.70
Chi-square (df = 2)	0.62	1.32	1.11
P-value	0.43	0.25	0.29
AGFI	0.97	0.94	0.95
RMSEA	0.00	0.06	0.03
	Factor loadings	Factor loadings	Factor loadings
Item2	0.53	0.58	0.55
Item3	0.72	0.85	0.78
Item4	0.92	0.92	0.96
Item6	0.56	0.78	0.67

Aggregation Analysis

In order to verify the appropriateness of aggregating individual responses into a team-level score, the James's index (rwg) based on a uniform null distribution (James, Demaree, & Wolf, 1993) and average deviation index (ADM) (Burke, Finkelstein, & Dusig, 1999) were calculated. Both indexes measure the homogeneity of team members' perceptions. While rwg is heavily influenced by the choice of the null distribution, ADM does not have such a limitation (LeBreton & Senter, 2008). Therefore, ADM is considered as a useful complement to rwg. The cut-off values for rwg and ADM are (≥) 0.70 and (≤) 0.8, respectively (LeBreton & Senter, 2008). The analysis results showed that individual responses from Team 2 at Week 1 did not warrant aggregation since its rwg and ADM were 0.57 and 0.89; individual responses from Team 4 and 26 at Week 2 did not warrant aggregation since their rwg was 0 and 0.57 and their ADM was 1.50 and 0.89; individual responses from Team 6 and 16 at Week 3 did not warrant aggregation since their rwg was 0.51 and 0.57 and their ADM was 0.89 and 0.83. These teams were excluded from subsequent team-level analyses.

Test of the Hypotheses

PLS was employed to test Hypothesis one and two. For each time period (i.e., Week 1, 2, and 3), the analysis was performed separately for each communication setting, and the path coefficients from non-FtF and FtF task-oriented communication to TMS were then contrasted across communication settings and time periods. The small sample size (i.e., 30 teams) of this study prohibited the use of covariance-based structured equation modeling (SEM) techniques. The sample size requirement of PLS is consistent with that of multiple regression (Chin, 1998). The ratio between the number of observations and the number of predictors in the most complex portion of the PLS model needs to be within the range of 5 to 30 (Guadagnoli & Velicer, 1988). The research model concerning Hypothesis one and two has only one predictor (i.e., task-oriented communication) and the sample has 10-11 teams in each communication setting during each time period, and thus the ratio is within the acceptable range. The testing results are shown in Table 4, 5, and 6.

Table 4. PLS Results at Week 1

	COEFFICIENT	S.E.	t	P	R^2
EEE: non-FtF→TMS	0.71*	0.35	1.99	0.02	0.50
FFF: FtF→TMS	0.45*	0.27	1.66	0.05	0.20

Notes: * path coefficient is significant at the 0.05 level one-tailed.

Table 5. PLS Results at Week 2

	COEFFICIENT	S.E.	t	P	R^2
EEE: non-FtF→TMS	0.34*	0.20	1.66	0.05	0.11
FFF: FtF→TMS	0.63*	0.20	3.17	0.00	0.40

Table 6. PLS Results at Week 3

	COEFFICIENT	S.E.	t	P	R^2
EEE: non-FtF→TMS	0.30	0.26	1.17	0.12	0.09
FFF: FtF→TMS	0.07	0.26	0.28	0.39	0.01

Hypothesis one suggested that the impact of non-FtF task-oriented communication on CMC teams' TMS would be as strong as the impact of FtF task-oriented communication on FtF teams' TMS. At Week 1, the path coefficient for EEE teams was 0.71 (t=1.99, p=0.02) and statistically significant, and the path coefficient for FFF teams was 0.45 (t=1.66, p=0.05) and statistically significant. The difference between these two coefficients was 0.26. The t-test indicated that the difference was not statistically significant (t=1.10, p=0.14). At Week 2, it was similar. The path coefficient for EEE teams was 0.34 (t=1.66, p=0.05) and statistically significant, and the path coefficient for FFF teams was 0.63 (t=2.27, p=0.02) and statistically significant. The difference between these two coefficients was 0.29. The t-test indicated that the difference was not statistically significant (t=1.49, p=0.08). At Week 3, the path coefficient for EEE teams was 0.30 (t=1.17, p=0.12) and the path coefficient for FFF teams was 0.07 (t=0.28, p= 0.39). Neither of them was statistically significant. Therefore, Hypothesis one was supported. Hypothesis two suggested that impacts of both non-FtF and FtF task-oriented communication would dissipate over time. For EEE teams, from Week 1 to Week 2 the path coefficient changed from 0.71 (t=1.99, p=0.02) to 0.34 (t=1.66, p=0.05). Both coefficients were statistically significant. The t-test indicated that the decrease of 0.37 was very close to statistical significance (t=1.65, p=0.057). From Week 2 to Week 3, the path coefficient changed from 0.34 (t=1.66, p=0.05) and statistically significant to 0.30 (t=1.17, p=0.12) and not statistically significant. For FFF teams, from Week 1 to Week 2 the path coefficient changed from 0.45 (t=1.66, p=0.05) to 0.63 (t=3.17, p=0.00). Both coefficients were statistically significant. The t-test indicated that the decrease of 0.18 was not statistically significant (t=0.85, p=0.20). From Week 2 to Week 3, the path coefficient changed from 0.63 (t=3.17, p=0.00) and statistically significant to 0.07 (t=0.28, p=0.39) and not statistically significant. Therefore, Hypothesis two was largely supported.

DISCUSSION

Implications for Research

Previous studies had inconsistent findings about TMS development in CMC settings (e.g., Kanawattanachai & Yoo, 2007; Lewis, 2003; Maynard et al., 2012; O'Leary & Mortensen, 2010). The inconsistencies were mainly concerned with the impact of non-FtF versus FtF communication on TMS development. Because of varied research contexts, it is hard to derive reasonable explanations by directly comparing and contrasting the results from these studies. On the other hand, this study put teams in the same research context and controlled task complexity, team size and composition, and prior familiarity among team members. The only difference between teams was communication medium. By doing so, this study is able to isolate the impact of communication medium on TMS development from other influencing factors and provide answers for two questions listed in the introduction.

This study reported that non-FtF task-related communication had the same impact on TMS development as FtF task-related communication did at Week 1, 2 and 3. In addition, this study reported that the impact of non-FtF and FtF communication on TMS development both dissipated over time. Specifically, the impact of non-FtF communication stayed at the same level at Week 1 and 2 and then became none at Week 3. The impact of FtF communication also stayed at the same level at Week 1 and 2 and then became none at Week 3. These findings show no substantive difference between non-FtF and FtF communication in terms of their impacts on TMS development, and thus provide further support to the argument that TMS is able to develop in CMC settings. Although Lewis (2004) reported no and negative impact of non-FtF communication (i.e., email and phone calls) on TMS development, she did not differentiated task-related from social-emotional communication. This might explain why her findings are inconsistent with the findings of Kanawattanachai and Yoo (2007) and this study.

Limitations and Future Research

This study bears several limitations. First, participants of this study were all undergraduate students. Whether the findings here can be generalized to other populations needs empirical tests of future studies. Second, the complexity of the task used in this study should be fairly low, relative to most of software development tasks in practice. Whether the findings here can be generalized to more complex tasks needs empirical tests of future studies. Third, the teams used in this study were three-member teams. Previous studies report that team size has impacts on TMS development (Palazzolo, Serb, She, Su, & Contractor, 2006). Therefore, whether the findings here can be generalized to teams with more than three members needs empirical tests of future studies. Fourth, in practice, teams might employ FtF communication and CMC more flexibly than the way defined in this study. For example, a team may employ FtF communication at the first meeting, CMC at the second meeting, and then switch back to FtF communication at the third meeting. Or at the same meeting, a subset of members sit in a same room and communicate FtF, while another subset is at a different location and communicate electronically with the former. Future studies may examine whether and how TMS develops in such a setting. Fifth, CMC in this study is confined to text-based CMC. Whether the findings here can be generalized to other types of CMC needs empirical tests of future studies.

APPENDIX

Item1: Each team member has specialized knowledge of some aspect of our project.
Item2: I know which team members have expertise in specific areas.
Item3: I trusted that other members' knowledge about the project was credible.
Item4: I was confident relying on the information that other team members brought to the discussion.
Item5: Our team had very few misunderstandings about what to do.
Item6: We accomplished the task smoothly and efficiently.

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