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# "Is It Already 4 a.m. in Your Time Zone?"

## Focus Immersion and Temporal Dissociation in Virtual Teams

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Using a sample of students ($N = 118$) engaged in an 8-week project to build an e-book chapter, this study finds that cognitive absorption impacts interpersonal conflict and team performance. In particular, virtual teams with aggregated higher levels of focus immersion and temporal dissociation (dimensions of cognitive absorption) demonstrate higher levels of performance and interpersonal conflict. Furthermore, there is an interaction effect between focus immersion and temporal dissociation that moderates the impact on performance and interpersonal conflict. The teams with aggregated high levels of focus immersion and aggregated low levels of temporal dissociation demonstrated the best performance and lowest levels of interpersonal conflict. The authors also found that individuals with high levels of focus immersion preferred asynchronous communication media, whereas individuals with low levels of temporal dissociation preferred synchronous communication media. The implications are discussed.

**Keywords:** *virtual teams; focus immersion; temporal dissociation; ICT; subjective performance*

Considering that most visitors to a Web site stay only a fraction of a minute, marketers try to find ways to make their sites "stickier." Game designers strive to create games that encourage game players to become deeply involved—so involved that they lose track of time. For marketers

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and game developers, cognitive absorption, or the state of deep involvement with software (Agarwal & Karahanna, 2000) is highly desirable. Yet is cognitive absorption always a good thing?

In a world where more and more employees must go online to do their work, cognitive absorption may help them focus on a task. But if they need to interface with others, especially if those others are remote members of their virtual teams (VTs), cognitive absorption may cause them to miss important coordination signals.

VTs are "groups of geographically and/or organizationally dispersed co-workers that are assembled using a combination of telecommunications and information technologies to accomplish an organizational task" (Townsend, DeMarie, & Hendrickson, 1998, p. 18). Because VTs enable work across distances, time zones, and geographical and organizational boundaries, organizations around the globe are largely embracing them (Horvath & Tobin, 2001; Kanawattanachi & Yoo, 2002; Lu, Watson-Manheim, Chudoba, & Wynn, 2006; McDonough, Kahn, & Barczak, 2001).

The increasing popularity of VTs is fueled by the ease of access to webs of communication technologies (Lipnack & Stamps, 1997). New information and communication technologies (ICTs), as well as a larger Internet bandwidths, offer companies and educational institutions efficient and low-cost synchronous and asynchronous communication tools such as instant messaging, videoconferencing, voice-over Internet Protocol (IP), and e-mail, to only name a few. Unlike their more traditional face-to-face (FtF) counterparts, VTs must meet additional challenges such as networking, self-management, and interpersonal awareness that arise from using new and evolving communication technologies (Duarte & Snyder, 1999). VTs and team members have to learn and select the appropriate technologies to support their tasks (Saunders, 2000) from a wide portfolio of ICTs in constant evolution.

The literature on VT performance focuses primarily on effectiveness (Powell, Piccoli, & Ives, 2004) and shows little agreement about the relative effectiveness of networked communication compared to the FtF mode of communication. On one hand, the limited nature of technology, compared to FtF interaction, raises the specter of unresolvable clashes (Kiesler & Sproull, 1992) and task distractions (Davison & Vogel, 2001). On the other hand, computer-mediated teams outperform FtF teams in task of idea generation (Connolly, Jessup, & Valacich, 1990; Valacich, Dennis, & Connolly, 1994), and decision making (Schmidt, Montoya-Weiss, & Massey, 2001). Also, networked communication modes have been found to provide more time for reflection and task focus (Cho, Schunn, & Lesgold, 2002).

The effect of individual differences among group members on VT performance is often ignored (see Devine, 1999; Martins, Gilson, &

Maynard, 2004). However, a link between individual characteristics and team performance has been recognized in FtF contexts (Jackson, 1992). For example, Moreland and Levine (1992) have shown that interdependence among different individual characteristics is related to team performance. Team performance is also dependent on successfully combining the diversity of the team members' individual characteristics and cognitive abilities in relation to the task (Devine & Philips, 2001; McGrath, 1997).

To understand how individual characteristics can be combined to improve staffing and team performance, researchers in the industrial-organization field are increasingly studying group personality composition (see Halfhill, Sundstrom, Lahner, Calderone, & Nielsen [2005] for review). At the team level, research has demonstrated that the trust, technical expertise, and experience with technology of the individual team members are positively associated to the team's performance (Jarvenpaa & Leidner, 1999; Kayworth & Leidner, 2000; Walther & Bunz, 2005).

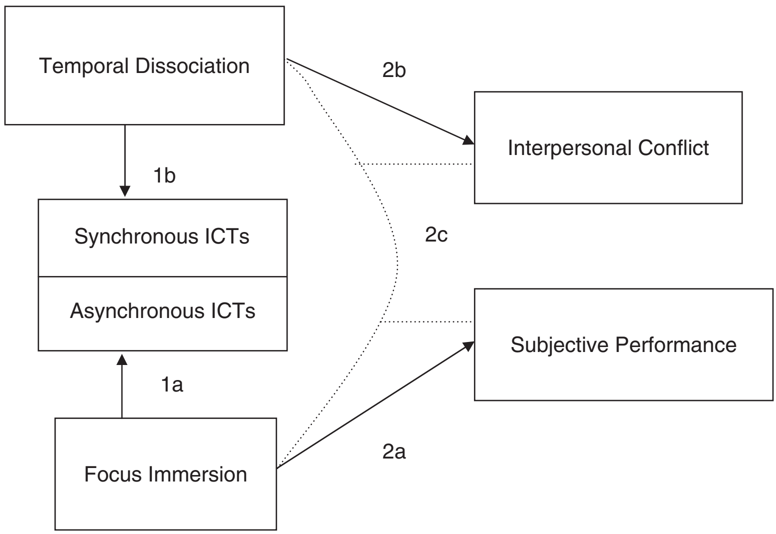
The construct of cognitive absorption has been used to create profiles of individual's receptiveness to new technology (Agarwal & Prasad, 1999). Unfortunately, little is known about the effects of individual cognitive characteristics on the actual preference of ICT channels (i.e., synchronous versus asynchronous) in the context of VTs. It is also unclear how, or if, cognitive individual characteristics, when aggregated at the team level, predict the VT's processes and outcomes. In particular, do different states of absorption with ICTs influence the individual preference for synchronous and asynchronous ICTs by the team members; and if so, when aggregated, do those map differently on interpersonal conflict and performance in VTs?

In this article, we explore the role that the cognitive absorption of individual team members plays on two VT processes (i.e., conflict and communications) as well as on team performance. Specifically, using a quasi-experimental design incorporating virtual student teams, we examine the effects of two dimensions of cognitive absorption (i.e., focus immersion and temporal dissociation) on individual ICT preferences. We also explore the effects of cognitive absorption dimensions on interpersonal conflict and performance in VTs when aggregated at the team level.

## Hypotheses

As noted in our research model in Figure 1, our focus is on cognitive absorption and its impact on the individual choice of ICT, team performance, and interpersonal conflict in VTs. Cognitive absorption has been found to influence both the use of and beliefs about information technology

**Figure 1**
**Research Model**




Note: ICT = information and communication technology.

(IT). Cognitive absorption is based on the original Tellegen Absorption Scale (TAS), the constructs of state flow (Csikszentmihalyi, 1990), and cognitive engagement (Webster & Ho, 1997). Cognitive absorption is defined as "a state of receptivity or openness to experiencing [*sic*] that may occur with the tendency to dwell on, rather than go beyond, the experiences themselves and the objects they represent" (Tellegen, 1982, p. 222). Cognitive absorption is an intrinsic dimension of personality that precedes deep involvement and attention focus (Roche & McConkey, 1990).

In their original work, Agarwal and Karahanna (2000) tested five cognitive absorption dimensions: temporal dissociation, focus immersion, heightened enjoyment, control, and curiosity. The present study focuses on two dimensions of the construct: temporal dissociation and focus immersion. The first dimension, focus immersion, is related to the constructs of flow (Trevino & Webster, 1992) and engagement (Webster & Ho, 1997), also called attention focus. The second dimension, temporal dissociation, is related to the constructs of flow such as transformation of time (Csikszentmihalyi, 1990), and of telepresence/time distortion (Novak, Hoffman, & Yung, 2000). We did not measure the dimensions of heightened enjoyment and curiosity in the context of the VT project because they are focused on the general experience of being a VT member rather than use of the technology. The dimension of control was also not researched in the study because the three items that composed the scales addressed control with the computer interface rather than cognitive characteristic (i.e., external versus internal locus of control).

If a person is highly focused on a single task, then that person may be said to have a high level of focus immersion. However, within a team, that person may experience the pressure to respond to teammates by doing two or more things at the same. That person experiences the need for time relocation, or having one or more of the conflicting events extracted from its context and rescheduled (McGrath & Rotchford, 1983). One time relocation technique is to use asynchronous communication media. In particular, the person using asynchronous media such as e-mail, forums, or bulletin boards can deal with messages from teammates at some later more convenient time. Using e-mails allows these team members to cut themselves off, at least temporarily (Nardi & Whittaker, 2002). Asynchronous ICT communication media are more efficient for interpretation and reflection at a later time (Warschauer, 1997) and provide structuring mechanisms to help users organize shared information (Leidner & Jarvenpaa, 1995). The use of asynchronous communication media has been linked to workers who prefer to work on one task in a linear, sequential manner and then move on to the next task (Saunders, van Slyke, & Vogel, 2004). Individuals who concentrate on a small range of stimuli and screen out other stimuli are more likely to be focus-immersed. Thus, an individual with a focused-immersed personality is more likely to prefer asynchronous communication media such as forum or e-mails when working on a VT. Asynchronous communication media allow them to complete the task on which they are working before dealing with unrelated communications.

*Hypothesis 1a:* Individuals with a higher mean score of focus immersion with the technologies “in-virtual-context” will prefer asynchronous technologies.

Individuals who focus on one task at a time tend to be less aware of others’ activities and tasks (Bluedorn, 2002). On the other hand, individuals who prefer performing multiple tasks at the same time may be more aware of the activities of the other team members. Conte (2000) found that the more individuals preferred multitasking, the greater likelihood they would be late. They could be late because they are temporally dissociated. In other terms, the multitaskers cognitively fail to allocate their time resources among the different activities required for the effective functioning of the VTs.

Conte (2000) also found that multitaskers tended to be less conscientious and more extraverted. Straus (1996) demonstrated that extraversion is an individual characteristic that consistently increases the willingness of the individuals to engage in VTs requiring multitasking abilities. That is, multitasking appears to be related to temporal dissociation to the extent that multitaskers divert their attention by keeping track of what others are doing, as well as juggling their own tasks. In the process, the multitaskers, like temporally dissociated individuals (Novak et al., 2000), tend to lose track of time.

An individual's ability to support multiple tasks at the same time and deal spontaneously with events as they arise has been linked to a preference for synchronous communication media (Lee, 1997; Saunders et al., 2004). One popular form of synchronous communication media, instant messaging, supports presence awareness and allows involvement in multiple discussions required to sustain interpersonal relationships (Li, Chau, & Lou, 2005). Instant messaging supports passive awareness of colleagues' availability, announces new information without demanding excess attention (Kraut, Fussell, Brennan, & Siegel, 2002), and creates a persistent connection to a partner by creating a virtual common space for conversation at any time (Nardi, Whittaker, & Bradner, 2000).

The link between multitasking and preference for synchronous communication has been empirically supported. However, little is known about the link between ICT preference and the correlates of multitasking, for example, temporal dissociation. The time distortion found in telepresence situations has been positively related to flow, for example, the intense involvement of individuals using the Web (Novak et al., 2000). We are suggesting that when preferred communication media is synchronous, it allows team members to maintain presence awareness of their team and execute multiple tasks, activities that are likely to draw their focus away from the time. Therefore, we propose,

*Hypothesis 1b:* Individuals with a higher mean score of temporal dissociation with the technologies "in-virtual-context" will prefer synchronous technologies.

At the group level, "difference and similarities in cognitive styles are likely to have a significant effect on the behavioral tendency of working teams" (Armstrong & Priola, 2001, p. 290). "At the core of any virtual team process is communication" (Powell et al., 2004, p. 11). The differences in cognitive styles require communicating and coordinating among members. They need to communicate in such a way that they can stay focused on their common goal. Based on Hypothesis 1a, a focus-immersed team (i.e., aggregation of the mean score of personality characteristic at the team level) should show a preference for asynchronous ICTs. Consequently, by using communication technologies that jointly allow team members to reserve more attention for the task, more focus-immersed teams should perform better than less focused-immersed VTs. In the next hypothesis, we focus on performance.

*Hypothesis 2a:* VTs with a higher mean score of focus immersion with the technologies "in-virtual-context" will perform better than VTs with a lower score of focus immersion.

Temporally dissociated teams (i.e., aggregation of the mean score of personality characteristic at the team level) should have a more difficult time coordinating the activities of team members. Temporal coordination requires synchronizing the activities of team members. If team members lose track of time, temporal coordination becomes more difficult, if not impossible. Greater temporal coordination has been associated with greater conflict (McGrath & Rotchford, 1983). For example, conflict may occur when a team member fails to respond to an e-mail within an agreed-upon time period, thus delaying the activities of other teammates (Sarker & Sahay, 2003). Furthermore, people who prefer to work on several tasks at the same time often dislike concentrating on a single task until it is completed by the stated deadline. These individuals who display "free-running behaviors" dislike being constrained by time. They tend to be frustrated with coworkers and supervisors who want to stick to one task until it is completed (Bluedorn, 2002). Consequently, they are likely to hamper their team's attempts at temporal coordination.

Eviatar Zerubavel (1979) concluded that "the maintenance of continuous coverage in the hospital would be impossible without temporal coordination among physicians and among nurses" (p. 60). Barley (1988), employing Zerubavel's concepts, found that the temporal symmetry between radiologists' and technicians' work increased after the installation of new computer-based equipment in hospital radiology departments. The enhanced temporal symmetry in terms of sequences, durations, and rates of recurring events contributed to less conflict between radiologists and technicians. Such symmetry is unlikely to be achieved if the team is temporally disassociated, since interpersonal conflict is likely to erupt.

*Hypothesis 2b*: VTs with a higher mean score of temporal dissociation with the technologies "in-virtual-context" will report more interpersonal conflict than VT with a lower mean score of temporal dissociation.

We see focus immersion and temporal dissociation as separate dimensions that differentially impact interpersonal conflict and performance. To our knowledge, neither their interaction nor any other interaction among the cognitive absorption dimensions has been explored. We anticipate that this interaction effect is important. We indicated an interaction effect through the dotted lines in Figure 1. Poole, Holmes, and DeSanctis (1991) demonstrated that conflict could be reduced when participants use technologies in adaptive ways to orient their focus on tasks and issues rather than on interpersonal differences. From a performance angle, we anticipate that greater focus (high focus immersion) and more awareness of time (low temporal dissociation) at the team level should increase the team's performance. Because the impact of the interaction of these two dimensions is so unknown, we test the following:

*Hypothesis 2c*: States of focus immersion and temporal dissociation with the technologies "in-virtual-context" in tandem will impact interpersonal conflict and performance in VTs differently.

# Method

## Participants and Sample

One hundred eighteen participants from universities in the Netherlands ($n = 53$), Hong Kong ($n = 50$) and the United States ($n = 15$) formed the basis of the individual level of analysis of the study. The age of the participants ranged from 22 to 35 years. Fifty-two percent of the participants were older than 25 years. The gender composition of the sample was 98 males (83.1%) and 20 female (16.9%).

Only the results of the VTs composed of more than 70% of participants who completed the pretest and the posttest questionnaires were included in the results. Ninety-eight students formed 13 VTs composed of students from universities in the Netherlands ($n$ = 44), Hong Kong ($n$ = 40) and the United-States ($n$ = 14) formed the basis of the team level of the study. Each team was composed of 7 to 10 members with 3 to 4 Dutch, 2 to 3 Hong Kong, and nominally 2 U.S. participants on each team. The local teams were free to self-select membership. In this sense, this is a quasi-experimental setting because the assignment was not totally random, but controls on the construct of cognitive absorption were incorporated through the use of a pretest and posttest. As noted by Trochim (2001), quasi-experiments approach the random distribution of controlled, randomized experiments, as long as they have high participation and no major environmental differences exist that can skew the conditions. Such was the case in this study. We used post hoc analysis to study the VTs in their natural context.

The age composition of the sample was 46% older than 25 years and 54% younger than 25 years. The gender composition of the sample was 79 males (80.6%) and 19 females (19.4%). Four academic staff managing the project determined the size and composition of the teams by assigning team members based on their location and choice of the VT research topic. An attempt was made to balance team members from the same location, though the teams had more members from Hong Kong and the Netherlands because there were more students participating from these locations.

## Study Setting

Technology, processes, and materials were prepared for local team access from a common learning management system that is, Blackboard server. This allowed a comparison across the VTs by controlling for resources and processes. The VTs interacted synchronously and asynchronously over the course of the 8-week project using the Blackboard technology supporting instant messaging, forums, and e-mail. Three videoconference sessions were planned for each VT: (a) the virtual meeting at the start of the project, (b) the intermediate meeting to discuss and agree on research questions, and (c) the final meeting at the completion of the project.

## Task

The task was designed to be challenging (Harkins & Petty, 1982) and attractive (Zaccaro, 1984). It placed participants in a situation of positive task interdependence within the VT (van der Vegt, Ermans, & van Vliert, 1999). Each VT was required to build a Web-based e-book chapter on an information system (IS) topic equally challenging that had been preselected by the faculty. Examples of topics were trends in embedded software, the impact of software defects, managing large software projects, and labor shortages in software. All team members received the same grade for the project, which was determined by a pool of four independent instructors.

The task was complex and required a high level of coordination. The VTs completed a sequential set of activities planned by the instructors over the 8-week schedule. Structure was embedded into the Blackboard system to facilitate conversation and reduce overload (Leidner & Jarvenpaa, 1995). First, the students indicated a preference for a research topic in the 1st week and the VTs were formed. The VTs were asked to develop a management plan based on a common template to help the team accomplish its goal. In the 2nd week, the VTs brainstormed to generate a set of research questions. In the 3rd week, the VTs selected three research questions representative of the importance of each culture in the domain studied. During the following 3 weeks, the VTs coordinated their activities to build a first draft of the report. During the 7th week, the VTs received feedback from the other VTs, as well as faculty. When they considered these comments relevant, they revised their reports and integrated them with the other e-book chapters during the last week before the final deadline.

## Measures

Questionnaires were administered prior to, and upon the completion of, the student project. We used a pretest composed of the original items of the cognitive absorption scale ($k = 9$) as a control condition. We also used a posttest composed of the same items adapted to the virtual context of the project to measure the state of cognitive absorption with the technologies used to communicate in the VT. Thus, the dimensions of cognitive absorption, respectively temporal dissociation and focus immersion, were measured *a priori* prior to the beginning of the project and were measured *a posteriori* at the end of the project in association with ICT preferences, interpersonal conflict, and VT performance ("in-virtual-context" condition).

To assess validity, we conducted two component factor analyses with Varimax rotation. One factor analysis was conducted on the items measuring cognitive absorption (i.e., focus immersion and temporal dissociation) in-virtual-context. The results are displayed in Appendix A. A second factor analysis was conducted on items measuring performance and interpersonal conflict (see Appendix B). All items measuring the constructs in this study loaded onto the appropriate factor and the factor loadings were high (i.e., .630 or higher).

Based upon intercorrelations of the items, we determined that there was convergent validity and discriminant validity because the correlations for items measuring the same construct were greater than the items measuring other constructs (Campbell & Fiske, 1959; Straub, Boudreau, & Gefen, 2004). The only exception was for one item measuring temporal dissociation (i.e., "Time flew when you were using Blackboard system to communicate with your team members"). It was slightly more correlated with three measures of focus immersion than with the other items measuring temporal dissociation. The constructs and their reliabilities are discussed in greater detail below. Also, Table 1 presents the mean values, standard deviations, Pearson

**Table 1**
**Means, Standard Deviations, Pearson Correlation Coefficients, and Significant Relationships Between Variables Aggregated at the Team Level (*n* = 13) In-Virtual-Context**

| Measure | M | SD | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|---|---|
| Performance | –0.04 | 1.03 | | | | | | |
| Temporal dissociation | –0.1 | 1.04 | –.335 | | | | | |
| Focus immersion | 0.01 | 1.03 | .794** | –.181 | | | | |
| Forum | 6 | 1.5 | .617* | –.688** | .569* | | | |
| Instant messaging | 4 | 2 | .763** | –.190 | .634* | .422 | | |
| Videoconference | 2.61 | 2.15 | .772** | –.115 | .785** | .444 | .464 | |
| Interpersonal conflict | –0.11 | 1 | –.225 | .682* | .086 | –.388 | .133 | –.113 |

*Significant at .05. **Significant at .01.

correlation coefficients, and significant relationships between the variables in the study aggregated at the team level (*n* = 13) in-virtual-context.

## Assessment of Cognitive Absorption With Technology In-Virtual-Context

This study addresses two dimensions, temporal dissociation and focus immersion, of the construct of cognitive absorption adapted from Agarwal and Karahanna (2000). First, we categorized focus immersion and temporal dissociation (high versus high medium versus low medium versus low) in-virtual-context to ascertain whether varying degrees of states of focus immersion and temporal dissociation influence preferences for synchronous and asynchronous ICT. Second, we measured the collective amount of cognitive absorption on both dimensions to test their effects at the team level on interpersonal conflict and performance.

Because the primary focus of the study was on the state of cognitive absorption with the technologies used to communicate in the VT (i.e., in-virtual-context), we concluded that at least two persons must be engaged in the act of communication. In other words, we chose to work under the assumption that the amount of the characteristic possessed by each team member increases the collective pool of that characteristic more than any one individual can significantly affect the outcome (highest versus lowest score). Based on the heterogeneous nature of the VT, the standard deviation did not allow a clear categorization on the dimensions of cognitive absorption. Devine and Philips (2001) demonstrated that different operational definitions of cognitive ability within teams, using different parametric (e.g., mean and variance) or nonparametric measures (e.g., high and low individual scores), led to an unstable evaluation of performance. Moreover, a dispersion index such as standard deviation was unrelated to team performance when using a cognitive variable (Devine & Philips, 2001). Based on these arguments, we chose the most common method, according to Barrick, Stewart, Neubert, and Mount (1998), to operationalize group personality composition variables: the mean score.

The original items ($k = 9$) of the dimensions of cognitive absorption, respectively temporal dissociation and focus immersion (Agarwal & Karahanna, 2000), were first presented in the pretest questionnaire administered in the 1st week of class to measure the individuals' overall state of cognitive absorption with computers a priori to the 8-week virtual project (control condition). Second, the items were adapted in-virtual-context and presented in the posttest questionnaire administered in the last week of class to measure a posteriori the state of cognitive absorption on the dimensions of focus immersion and temporal dissociation with the Blackboard technologies used to support communication in the VT during the 8-week project. The result demonstrates first that the score of the cognitive absorption state a priori positively correlates with the score of cognitive absorption state a posteriori ($r = .642$, $p = .001$). This result supports the idea of a relative stability in the individual's personality disposition for cognitive absorption (i.e., trait), as previously demonstrated by the findings of Kumar, Pekala, and Cummings (1996). Second, the results of the paired-samples tests for unequal samples size revealed no significant difference between the state of cognitive absorption a priori and a posteriori within the VTs, ensuring a certain control on the potential effects of the team assignment. In response to concerns about threats to internal validity, it could be argued that most students completed both questionnaires, and there appeared to be little regression to the mean or cause for concern about history effects over the relatively short period of the study.

Five and four items for measuring temporal dissociation and focus immersion in-virtual-context, respectively, are presented in Appendix C. Measures are reported on 7-point Likert-type scales ranging from 0 *(not at all)* to 7 *(very much)*. Two are reversed to control for acquiescence response bias.

We assessed reliability in two ways. First, Cronbach's (1950) alpha coefficient was used as an index of internal consistency. The coefficients exceed the threshold of .60 suggested by Nunnally (1978) and also by Straub, Boudreau, & Gefen (2004) as being acceptable reliability for exploratory research, and approximate the .70 level for confirmatory research, indicating correct internal consistency reliability. The Cronbach's alpha coefficient is .72 for the dimension of temporal dissociation and .86 when deleting the reversed item. The Cronbach's alpha coefficient is .60 for focus immersion and .69 when deleting the reversed item. To improve the reliabilities, we deleted the reversed items when operationalizing the two dimensions of cognitive absorption.

Second, Bartlett scores of regression were computed on both factors to provide a score measure of temporal dissociation and focus immersion with deletion of both reversed items in-virtual-context. Bartlett-score estimates are most appropriate when factor interpretation is based on the factor pattern (Beauducel, 2005). The scores produced a mean of 0. The aggregation of Bartlett score of regression on focus immersion and temporal dissociation was obtained by averaging individual score separately on each dimension to derive team-level mean scores on focus immersion and temporal dissociation (Barrick et al., 1998).

## Assessment of Interpersonal Conflict and Performance

The general properties of disagreement, interference, and negative emotion are used to define interpersonal conflict in the study. The scales, originally constructed and validated in the research of Barki and Hartwick (2001), measure interpersonal conflict in the management of IS development teams. Seven of the original items were adapted to assess the frequencies of conflict, disagreement, and negative emotion during the 8-week VT project. The seven items for interpersonal conflict ($k = 7$) are presented in Appendix C. Measures are reported on 7-point Likert-type scales ranging from 0 *(not at all)* to 7 *(very much)*.

Consistent with the definition used in a recent meta-analysis, we defined team performance as the degree to which the team accomplished its goal or mission (Devine & Philips, 2001). We used a subjective evaluation of team members concerning their performance that is similar to that discussed by Devine and Philips (2001). We adapted eight items of the original scale ($k = 9$) from the work of Henderson and Lee (1992) that was designed to measure performance in managing information system design teams. The general properties of knowledge and skills of the team members, the amount of work, and the quality of work procedure were used to assess subjective team performance in the original study of Henderson (1988). Measures are reported on 7-point Likert-type scales ranging from 0 *(not at all)* to 7 *(very much)*. The eight items measuring performance are presented in Appendix C.

Here again we used Cronbach's alpha and Bartlett scores to assess the reliability performance and interpersonal conflict. The Cronbach's alpha coefficient of .86 for conflict and of .82 for subjective performance indicated adequate internal consistency reliabilities. Bartlett scores of regression were computed on the factors without deletion of items to provide a score measure of interpersonal conflict and based on the results of factor analysis with deletion of three items to provide a reliable measure of subjective performance (see Appendix C).

### Assessment of Communication and Technology Use

Five measures were used to assess technology preferences in term of use for the VT communication. The first three measures were reported on 7-point Likert-type scales. The asynchronous (i.e., forum and e-mail) and synchronous (i.e., instant messaging and videoconference) tools were each evaluated ranging from 0 *(not at all essential to the virtual teamwork activities)* to 7 *(very essential to the virtual teamwork activities)*. The second two measures were reported on ordinal scales. They assess the frequency of instant messaging usage during the project as well as the individual preferences of asynchronous and synchronous technologies from 1 *(least important)* to 4 *(most important)* to the virtual teamwork completion.

## Results

Results of the study were analyzed at two levels. First, to test Hypotheses 1a and 1b, analyses for the whole sample of 118 participants were carried out between groups to ascertain whether varying degrees of high versus low states of focus immersion and temporal dissociation have any effects on synchronous and asynchronous communication media evaluation and preferences. Second, to test Hypothesis 2a, 2b, and 2c, analyses were carried out between teams ($n$ = 13) by averaging individual scores separately on each dimension of focus immersion and temporal dissociation to derive team-level aggregated mean scores.

### Between Groups

To test Hypotheses 1a and 1b, analyses were carried out between groups varying in degrees of high versus low states of focus immersion and temporal dissociation on the five measures used to assess technology preferences. The measure of focus immersion and temporal dissociation at the individual level were categorized based on +/–1 *SD* and averaged at the group level according to four levels: high, high medium, low medium, and low.

As predicted by Hypothesis 1a, the first set of between-subject multiple comparison tests using Fisher *LSD* tests indicate that individuals with a high mean score on focus immersion rate asynchronous forum technology as significantly (two-tailed $p = .03$, $p = .04$) more useful ($m = 6.3$, $SD = 1.5$) than participants with a low medium mean score ($m = 5.5$, $SD = 1.6$) and a low mean score ($m = 5.4$, $SD = 1.9$) on focus immersion. As predicted by Hypothesis 1b, a second set of between-subject multiple comparison tests using Fisher LSD test indicate that individuals with a high mean score on temporal dissociation rate synchronous instant messaging technology as significantly ($p = .004$, $p = .04$) more useful ($m = 5.16$, $SD = 1.8$) than participants with a high medium mean score ($m = 3.4$, $SD = 1.9$) and a low medium mean score ($m = 4$, $SD = 2$) of temporal dissociation.

When ranking their preferences for asynchronous and synchronous technologies from 1 *(least important)* to 4 *(most important)* when working on VTs, the results based on the mode value of the frequency distribution revealed three main results. First, individuals with a high mean score of focus immersion equally rank instant messaging and videoconferencing to be the least important technologies and forum and e-mail equally the most important. Second, individuals with a high mean score of temporal dissociation rank forum, e-mail, and instant messaging to be equally unimportant technologies. The videoconference is ranked as the most important technology. Congruently, individuals with a low mean score on temporal dissociation rank instant messaging and videoconference to be the least important technologies, while ranking e-mail and forum to be the most important.

Most interesting are the results addressing the frequency of instant messaging sessions initiated by the participants during the project. The results indicate clearly that participants with a high mean score on temporal dissociation more frequently initiated instant messaging sessions (73.3% twice a week, 13.3% once a day) than participants with low mean score on temporal dissociation (53% twice a week, 0% once a day).

Overall, the results partially support Hypotheses 1a and 1b, suggesting that state of focus immersion and temporal dissociation with the technologies in-virtual-context leads to different evaluations of the asynchronous and synchronous technologies, and consequently toward different preferences for asynchronous and synchronous technologies based on the dimensions of cognitive absorption.

## Between Teams

To test Hypotheses 2a, 2b, and 2c, analyses were carried out between teams ($n = 13$) by averaging individual scores separately on each dimension of focus immersion and temporal dissociation to derive team-level aggregated mean scores. Because our sample was small, we used nonparametric Mann-Whitney *U* for two independent samples and the Kruskal-Wallis test for four independent samples to test our hypotheses. Table 2 presents the mean Bartlett scores of regression and standard deviations for focus immersion and temporal dissociation in-virtual-context establishing two degrees of high versus vow states (+/–1 *SD* above or under Bartlett regression mean score of 0).

First, analyses were carried out between teams to ascertain whether varying degrees of high versus low states of focus immersion in-virtual-context influence performance (Hypothesis 2a). The results of the Mann-Whitney *U* for two independent samples test indicate that VTs with a high mean score of focus immersion (mean rank [*mrk*] = 9.83) perform significantly better ($U = 4$, $p = .015$) than VTs with a low mean score (*mrk* = 4.57). The results support Hypothesis 2a.[1] Second, analyses were carried out between teams to ascertain whether varying degrees of high versus low states of temporal dissociation in-virtual-context influence interpersonal conflict (Hypothesis 2b). The results of the Mann-Whitney *U* for two independent samples test indicate that VTs with a high mean score of temporal dissociation (*mrk* = 9.71) reported significantly more conflict ($U = 2$, $p = .004$) than teams with a low mean score (*mrk* = 3.83). The results support Hypothesis 2b.

Third, analyses were carried out between teams to ascertain whether varying degrees of high versus low states of temporal dissociation and focus immersion in-virtual-context have any interactive effects on the reported levels of interpersonal conflict and overall performance (Hypothesis 2c). Table 3 presents the results of the Kruskal-Wallis test for four independent samples for the measures of performance and interpersonal conflict aggregated at the VT level.

The results of the Mann-Whitney *U* for two independent samples tests indicate first that VTs with a high mean score on focus immersion and a low mean score on temporal dissociation do perform significantly better than VTs with a low mean score on focus immersion and a low mean score on temporal dissociation ($U = 0$, $p = .05$) and than VTs with a low mean score on focus immersion and a high mean score on temporal dissociation ($U = 0$, $p = .034$). However, they do not perform significantly better than VTs with a high mean score on focus immersion and a high mean score on temporal dissociation.

## Table 2
## Mean Bartlett Scores of Regression and Standard Deviations for Focus Immersion and Temporal Dissociation In-Virtual-Context

| Team ID | | 10 | 9 | 1 | 3 | 12 | 2 | 7 | 11 | 13 | 5 | 4 | 6 | 8 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Cognitive absorption dimension | *n* | 7 | 7 | 8 | 9 | 7 | 8 | 8 | 7 | 6 | 10 | 9 | 6 | 6 |
| Focus immersion | *M* | 0.92 | 0.2 | 0.1 | 0.33 | 0.24 | 0.2 | –0.1 | –0.2 | –0.5 | –0.04 | –0.32 | –0.48 | –0.5 |
| | *SD* | 0.88 | 1 | 1 | 1.7 | 1 | 0.72 | 1.1 | 0.75 | 1.1 | 0.57 | 1 | 0.32 | 0.9 |
| Temporal dissociation | *M* | –0.5 | –1.3 | –0.4 | 0.36 | 0.4 | 0.18 | –0.3 | –0.28 | –0.4 | 0.5 | 0.01 | 0.24 | 0.3 |
| | *SD* | 1.1 | 0.75 | 1.1 | 1.5 | 0.8 | 1.1 | 0.7 | 0.8 | 0.8 | 0.5 | 0.9 | 0.8 | 1.2 |

**Table 3**
**Results of the Kruskal-Wallis Test on the Measures of Performance and Interpersonal Conflict Aggregated at the Virtual Team Level (*n* = 13)**

| | Focus Immersion High | | | | | | |
|---|---|---|---|---|---|---|---|
| | High | | Low | | | | |
| | Temporal Dissociation | | | | | | |
| | Low | High | Low | High | *df* | Chi-Square | *p* |
| Number of teams | 3 | 3 | 3 | 4 | | | |
| Performance (mean rank) | 11.33 | 8.33 | 3.67 | 5.25 | 3 | 7.07 | .07 |
| Interpersonal conflict (mean rank) | 3.67 | 11.33 | 4 | 8.5 | 3 | 8.28 | .04 |

Second, the results of the Mann-Whitney *U* for two independent samples tests indicate that VTs with a high mean score on focus immersion and a low mean score on temporal dissociation do report significantly less interpersonal conflict than VTs with a low mean score on focus immersion and a high mean score on temporal dissociation ($U = 0$, $p = .034$), or with VTs with a high mean score on focus immersion and a high mean score on temporal dissociation ($U = 0$, $p = .05$), but not significantly less interpersonal conflict than VTs with a low mean score on focus immersion and a low mean score on temporal dissociation.

## Discussion

The aim of this study was to examine the effects (a) of individual states of cognitive absorption, and more especially of the dimensions of focus immersion and temporal dissociation, on individual preferences for ICTs; and (b) on interpersonal conflict and performance in VTs when aggregated at the team level.

Study results suggest that both dimensions of cognitive absorption differentially affect technology preferences (Hypotheses 1a and 1b). The results are consistent with the theory on group personality composition that entertains a task personality-relationship distinction (see Halfhill et al., 2005). They also support the idea of a personality-technology fit. Task-oriented traits such as conscientiousness and achievement motivation aid in the completion of the work, whereas relationship-personality-oriented traits such as agreeableness and cooperation facilitate interpersonal interaction. One may expect a personality-technology fit to emerge when addressing cognitive characteristics such as attention focus (focus immersion) and time distortion (temporal dissociation). Our results lead us to speculate that task-oriented traits (e.g., conscientiousness) are good predictors of focus immersion with the technology, whereas relationship-oriented personality traits (e.g., cooperation) are potential predictors of temporal dissociation.

We also found that cognitive absorption can sometimes be a good thing when it comes to VTs. In particular, we found that focus immersion and temporal dissociation when aggregated at the team level are linked to interpersonal conflict and VT performance. More specifically, the results from our study reveal that both dimensions of cognitive absorption map differently on interpersonal conflict and performance. Results aggregated at the VT level demonstrate that teams with a high mean score on focus immersion perform significantly better than teams with a low mean score (Hypothesis 2a). Also, VTs with a high mean score of temporal dissociation report significantly more conflict than team with a low mean score (Hypothesis 2b), but teams do not perform significantly differently as a function of their score of temporal dissociation (low or high, $p > .73$).

Finally, we found support for considering the two dimensions in tandem (Hypothesis 2c). VTs with a high mean score on the dimension of focus immersion and a low mean score of temporal dissociation report less interpersonal conflict than VTs with a high mean score of temporal dissociation for either high or low mean scores on focus immersion. That is, focus immersion plays a secondary role to temporal dissociation when it comes to interpersonal conflict.

## Limitations and Future Directions

Solomon Asch (1952) expressed the complexity of team composition using a chemical analogy:

> A substance like water is made up of the elements hydrogen and oxygen and yet has different proprieties from either constituent. Furthermore, these same molecular constituents when differently organized or structured produces

> substances with quite different characteristics such as ice, water or steam. Thus in the real sense the compound H2O is not the simple aggregate of its constituents but is crucially affected by their arrangement. So too with human compounds, or groups. (p. 261)

Assembling teams based on skills and knowledge is not sufficient (Banner, Kalisch, & Peery, 1992). Personality states of the team members, including cognitive absorption, must also be considered. Our results led us to speculate that an effective strategy in VTs when task performance is at stake is to ensure a composition which reflects a preference for high focus-immersed individuals over high temporally dissociated ones. When the task requires more interpersonal relationships and negotiation, an effective strategy could be to have a majority of temporally dissociated individuals. However, because we found that a team that is high on temporal dissociation is more likely to experience interpersonal conflict, this strategy is risky: This strategy may generate considerable dysfunctional interpersonal conflict (Amason, 1996). This requires further research.

Supporting teams indiscriminately with ICTs is not a good idea. Each team has its own distinct characteristics and ICT experience. VTs and team members not only have to learn and select the appropriate technologies to support their tasks (Saunders, 2000), but they also need to be sensitive to broader organizational considerations, if appropriate. For example, Intel Corporation raised an alarm about the potential negative impact on performance resulting from excessive ICT variety as members move across teams in organizations (Lu, Watson-Manheim, Chudoba, & Wynn, 2006). Project management should select the appropriate ICT portfolio from the wide range of available technologies. This is especially salient with lean ICT support and bandwidth as might occur when some team members are from less developed countries (Qureshi, Liu, & Vogel, 2006). However, developing a sense of shared context can help offset technological limitations (Barkhi, Amiri, & James, 2006).

Like any study, this study comes with its share of limitations. One limitation of our study is that the objective measure of performance (VT grades) did not have enough variance to be used to test our hypotheses. Thus, we used subjective measures of performance provided by the individuals, and not the performance ratings of observers outside of the team. We present in Appendix D the mean Bartlett score of regression and standard deviation for subjective performance in decreasing order as well as the score for objective performance (VT grade) for each of the 13 VTs. Despite the fact that the objective measure of performance did not have enough variance to test our hypotheses, the performance ratings of observers outside of the team support the results of the nonparametric test (see Table 3). The highest and the lowest scores (VT grades) were respectively obtained by the VT 1 (high focus immersion/low temporal dissociation) and by the VT 13 (low focus immersion/low temporal dissociation).

Because we could not use a more objective measure of performance, a related limitation emerged. We ended up using questionnaire responses to measure all of our constructs. This could lead to common method bias. However, to avoid common method bias we counterbalanced the item order. We also conducted Harman's single-factor test. Using the unrotated factor solution that included all items used in our study, none of the factors accounted from more than 27% of the variance, suggesting a lack of common method bias (Podsakoff, MacKenzie, Lee, & Podsakoff, 2003).

Another limitation is related to the use of our cognitive absorption measures. English, Griffith, and Steelman (2004) reported that context specificity increases predictive validity when using personality measures. We measure focus immersion and temporal dissociation in-virtual-context and therefore we cannot recommend using the scale per se to evaluate a priori team members who never join a VT without control.

Furthermore, some team members were assigned to topics based on personal preferences and not randomly. This may have biased the findings to the extent that the final project grades might have shown little variance because the teams could each choose a topic that played to the strengths of its team members. On the other hand, allowing teams to choose their topic created a greater likelihood of focus immersion. The team members may have been more focused on their assigned projects because they were interested in them. It should be noted that the approach applied in this study is similar to the approach used for other studies using student teams (Piccoli, Powell, & Ives, 2004; Sarker & Sahay, 2003). Finally, like past studies (e.g., Cramton, 2001; Kayworth & Leidner, 2000, 2001-2002; Sarker, Lau, & Sahay, 2001; Sarker & Sahay, 2003; Zornoza, Ripoll, & Peiro, 2002), our sample size for testing the hypotheses related to teams is rather small, $n$ = 13. However, the results based on nonparametric statistics are both significant and striking.

In the future, cognitive absorption should be tested in relation to cognitive styles such as the intuitive-analytic dimension (see Armstrong & Priola, 2001). Cognitive styles are unconsciously applied, and they influence almost all human activities, including individual perception, problem solving, and interpersonal functioning (Messick, 1976; Witkin, Moore, Goodenough, & Cox, 1977). Future research should extend beyond technical expertise and experience with the technology to address in detail personality traits that could predict, or indirectly measure the level of cognitive absorption.

Finally, results from the study support the idea of a personality-task-technology fit in line with research by Hollingshead and McGrath (1995). They demonstrated that the type of task is a key input variable. When combined with technologies and attributes of the team members, it affects the team's interactions, performance, efficiency, satisfaction, and consensus. Future research should pay closer attention to the exact nature of the task. Experiments should be designed to test the effect of the dimensions of temporal dissociation and focus immersion and of the technology selection (asynchronous versus synchronous) for the sequential tasks of planning, creativity, decision making, cognitive conflict, and contests/battles.

## Conclusion

This study is one of the first to link cognitive absorption with technology use, interpersonal conflict, and performance. The significant findings suggest that an understanding of focus immersion and temporal dissociation could be used by managers to improve performance and reduce interpersonal conflict. Although they are both dimensions of cognitive absorption, considering focus

**Appendix A**
**Summary of the Factor Loadings in Principal Component Analyses, Varimax With Kaiser Normalization for Cognitive Absorption**

| Dimension and Item ID | Factor Loading | Initial Eigenvalue |
|---|---|---|
| Temporal dissociation | | 3.707 |
| Td1 | .845 | |
| Td2 | .710 | |
| Td3 | .795 | |
| Td4 | .867 | |
| Focus immersion | | 1.527 |
| Fi1 | .651 | |
| Fi2 | .762 | |
| Fi3 | .842 | |

## Appendix B
## Summary of the Factor Loadings in Principal Component Analyses, Varimax With Kaiser Normalization for Team Behavior Components

| Construct and Item ID | Factor Loading | Initial Eigenvalue |
|---|---|---|
| Interpersonal conflict | | 5.263 |
| Conf1 | .831 | |
| Conf2 | .846 | |
| Conf3 | .695 | |
| Conf4 | .686 | |
| Conf5 | .690 | |
| Conf6 | .742 | |
| Conf7 | .742 | |
| Subjective performance | | 2.863 |
| Perf2 | .845 | |
| Perf3 | .842 | |
| Perf6 | .630 | |
| Perf7 | .840 | |
| Perf8 | .853 | |

## Appendix C
## Questionnaire Items

| Construct | Dimension | Item ID | Item | Cronbach's Alpha |
|---|---|---|---|---|
| Cognitive absorption in-virtual-context (adapted from Agarwal & Karahanna, 2000) | Temporal dissociation | Td1 | Sometimes you lost track of time when you used the blackboard system to communicate with your team-members | |
| | | Td2 | Time flew when you were using Blackboard system to communicate with your team-members | |
| | | Td3 | Most times when you got on to the Blackboard system you ended up spending more time than you had planned | |

## Appendix C (continued)

| Construct | Dimension | Item ID | Item | Cronbach's Alpha |
|---|---|---|---|---|
| | | Td4 | You often spent more time on the Blackboard system than you intended | |
| | | Td5 | Time happens to be very slow when you were using the Blackboard system to communicate with your team-members (reversed item deleted) | .86 |
| | Focus immersion | Fi1 | When you were using the Blackboard system to communicate with your teammates you were able to block out most other distractions | |
| | | Fi2 | While using the Blackboard system, you were immersed in the task you were performing | |
| | | Fi3 | While using the Blackboard system, you were absorbed in what you were doing | |
| | | Fi4 | When you used the Blackboard system, your attention got diverted very easily (reversed item deleted) | .69 |
| | Interpersonal conflict (Barki & Hartwick, 2001) | Conf1 | How frequent were the conflicts within your virtual team? | |
| | | Conf2 | How intense were the conflicts within your virtual team? | |

**Appendix C (continued)**

| Construct | Dimension | Item ID | Item | Cronbach's Alpha |
|---|---|---|---|---|
| | | Conf3 | Were there important differences between your virtual team members concerning the goals and objectives of the project? | |
| | | Conf4 | Were there important differences between your virtual team members concerning the content of your e-book chapter? | |
| | | Conf5 | Were there important differences between your virtual team members concerning how the project should be managed? | |
| | | Conf6 | During the project, did your virtual team members do things that made the virtual team feel frustrated? | |
| | | Conf7 | During the project, did your virtual team members do things that made the virtual team feel angry? | .86 |
| Subjective performance (adapted from Henderson & Lee, 1992) | | Perf1 | Your virtual team worked hard enough to get the task done well | |
| | | Perf2 | Your virtual team applied enough knowledge and skills to the work to get the task done well | |
| | | Perf3 | The way your virtual team proceeded with the work was fully appropriate for the tasks to be done | |

**Appendix C (continued)**

| Construct | Dimension | Item ID | Item | Cronbach's Alpha |
|---|---|---|---|---|
| | | Perf4 | Your virtual team sometimes was told that it did not produce enough work | |
| | | Perf5 | Your virtual team sometimes was told that the quality of the work produced was not satisfactory | |
| | | Perf6 | The methods and procedures your virtual team used in working together were just right for the tasks to be performed | |
| | | Perf7 | Members of your virtual team exhibited a great deal of skill in working on your virtual group tasks | |
| | | Perf8 | Members of your virtual team worked very hard to accomplish the tasks to be completed | .82 |

## Appendix D
## Mean Bartlett Score of Regression and Standard Deviation for Subjective Performance in Decreasing Order and Brute Score for Objective Performance (Grade)

| | | High Focus Immersion/Low Temporal Dissociation | | | High Focus Immersion/High Temporal Dissociation | | | Low Focus Immersion/Low Temporal Dissociation | | | Low Focus Immersion/High Temporal Dissociation | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Team ID | | 10 | 9 | 1 | 3 | 2 | 12 | 7 | 13 | 11 | 4 | 6 | 5 | 8 |
| | *n* | 7 | 7 | 8 | 9 | 8 | 7 | 8 | 6 | 7 | 9 | 6 | 10 | 6 |
| Subjective | *M* | 1.1 | 0.37 | 0.23 | 0.6 | –0.1 | –0.2 | –0.17 | –0.36 | –0.8 | –0.08 | –0.14 | –0.24 | –0.9 |
| performance | *SD* | 1.3 | 0.83 | 0.9 | 0.8 | 0.9 | 0.9 | 0.8 | 1.2 | 1 | 0.9 | 0.46 | 1.2 | 1 |
| Objective performance (virtual team grade) | | 8 | 7 | 9 | 7 | 6 | 7 | 7 | 5 | 8 | 7 | 6 | 8 | 7 |

immersion and temporal dissociation separately tells us important stories about communication media preferences, interpersonal conflict, and performance in VTs. The results indicate that a variety of communication technologies should be provided until we have a better understanding of effective tools for different levels of cognitive absorption. Such an approach accommodates highly focus-immersed team members who prefer asynchronous communication media and highly temporally dispersed team members who prefer synchronous communication media. However, with the flexibility that a portfolio of communication technologies provides is the need to establish technology norms early in the life of the team to ensure their most effective use of the technologies. VTs are commonplace in industry nowadays, and virtual capabilities are increasingly requested in the job requirements. The research may also help to operationalize the required virtual capabilities of a team member.

## Note

1. Temporal dissociation does not significantly impact performance, that is, for score of temporal dissociation low or high ($p > .73$).

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