Team Climate and Media Choice in Virtual Teams

Abstract *– As work teams become more distributed, effective computer-mediated communication is increasingly impacting their performance. This study investigates how team climate influences communication frequency among team members and their use of different communication media. Data were collected in two information systems courses offered at an Austrian university in which 50 student teams developed web-based applications and conducted usability tests. A team climate framework based on task and social orientation was used to assess the teams' performance and communication patterns. We found that both task and social dimensions of team climate were positively related to higher communication frequency as well as objective and subjective performance. Among other things, the results suggest that a task-oriented climate is especially linked to the use of e-mail, while social orientation is linked to the use of face-to-face meetings. We also found differences in communication patterns and performance across four different types of team climates (fully functioning, cozy, cold, and dysfunctional). The results underscore the importance of both task and social dimensions for a team to perform well. Our study contributes to both the academic literature that investigates factors affecting media choice and the practitioner literature that examines how to manage virtual teamwork effectively.*

Index Terms *– computer-mediated communication, computer-supported collaborative work, media choice, team climate*

Introduction

Virtual communication plays an increasingly important role in many task contexts in today's global work environment. The use of virtual communication and other media has been explored in many information systems studies (e.g., Bélanger and Watson-Manheim, 2006; Berry, 2006; Chuang et al., 2001; DeLuca and Valacich, 2005, 2006; Dennis et al., 2008; Dennis and Valacich, 1999; Rutkowski et al., 2007; Watson-Manheim and Bélanger, 2007; Wong and Dalmadge, 2004). Many of these studies focused on capabilities of media that appear to influence media choice and use.

Interpersonal team-based processes have long been seen as important factors in providing a deeper understanding of media use. For example, Sivunen and Valo (2006) demonstrated that accessibility and social distance are relevant for media choice in teams. We follow this line of research and focus on an area that has grown in interest among researchers, but has not yet been assessed empirically in the context of media choice—team climate (e.g., Pirola-Merlo et al., 2002). A positive team climate is posited to improve team communication, team performance, and team well-being (e.g., Marks et al., 2001), which in turn leads to a more positive, long-term working climate and higher staff retention. However, more work is still needed to understand the impacts of team climate (Tse et al., 2008). This study considers team climate, in combination with media choice and use, as a way to improve team performance. We draw on social presence (Short et al., 1976), media richness (Daft and Lengel, 1986), and media synchronicity theory (Dennis et al., 2008) to explain potential media influences. Research suggests that no single medium is always the most appropriate for a certain task (Dennis et al., 2008). For example, a face-to-face meeting is not the only medium well suited for equivocal tasks. Rather, the selection and use of an adequate medium depends on the medium's features, situation, and social context. Therefore, we studied combinations of media

use based on data collected in a natural team-based environment in which subjects were free to choose media for communication in their teams.

The implications of addressing these issues are twofold. From a theoretical perspective, investigating these issues offers an opportunity to test the concept of team climate as a relevant factor influencing media use and media choice, and thereby to extend existing theoretical frameworks on media choice. From a practical perspective, knowledge gained as a result of the present study should inform management on how to specifically promote team communication and performance according to the respective team climate.

The remainder of this paper proceeds as follows: We first introduce the theoretical underpinnings of team performance and team climate. We then present an overview of relevant media choice theories and related research on how computer-mediated communication technologies alter team communication, giving particular attention to those means of communication vital for the present study. We follow with the research model, hypotheses, study design and methodology, analyses, results, and the implications of the results with respect to media theories and team climate.

Literature Review

Teamwork

A *team* is herein defined as two or more individuals with shared goals who work together on interdependent tasks to achieve a desired outcome (Baker et al., 2005). This definition also implies that team members make decisions together and that there is some cooperative work and coordination. Johnson and Johnson (2006) further note that specific member roles and a limited lifespan are important characteristics of teams.

In team research literature, *team performance* is conceptualized as the degree to which the output of a team meets "the standards of the quantity, quality, and timeliness of the people

who receive, review, and/or use that output" (Hackman, 1990, p. 6). Generally, most team performance models follow an input-process-output approach (Stewart and Barrick, 2000; Tannenbaum et al., 1992). Our work is framed within this theoretical perspective—we examine a critical input variable—team climate—and its influence on team communication patterns with different media (representing a mediating process variable) resulting in team performance (representing an output).

Team Climate

Climate in general has a long tradition of research in organizational psychology (e.g., Lewin et al., 1939). Although climate is often researched at the wider organizational level, researching climate at the team level offers better construct validity (Howe, 1977), since interaction, common goals, and task interdependence are necessary to build the foundation for a shared perception of climate. Tse, Dasborough, and Ashkanasy (2008) agree that the team level is the most appropriate level of analysis, but for different reasons. They claim that differences in climate are due to work group–specific differences rather than organizational differences, and that increased social interaction processes result in stronger homogeneity of climate perceptions among team members within teams and greater variation across teams.

Team climate is often viewed as a shared perception of the team within a work environment (Anderson and West, 1998). Accordingly, Basaglia et al. (2010, p. 544) propose the following definition which is used this paper: "At the team level, climate is defined as shared perceptions of the kinds of behaviors, practices, and procedures that are supported within a team." Similarly, according to González-Romá et al. (2009, p. 512), team climate provides "a shared representation of the work team that enables team members to assign shared meaning to events that are important for the team, and determine the actions that will lead to desired outcomes."

One of the most researched aspects of team climate is climate for innovation (Anderson and West, 1998), although it is very specific and may not apply to all working groups. For instance, in teams developing products or processes, a climate for innovation correlates only weakly with team performance because finding innovative ideas is not central to the team's tasks (Bain et al., 2001). Looking at team climate in a general sense, West (1994, p. 2) states that there are "two fundamental dimensions of team functioning: the task the team is required to carry out, and the social factors that influence how members experience the team as a social unit." The conceptualization of a task versus social dimension in teamwork can be traced back to Cartwright and Zander (1968) who distinguished between two types of team tasks: task-oriented goal achievement and social group maintenance. The duality of a task versus social dimension can further be found in several studies of teamwork including task versus social/relationship conflict (Gamero et al., 2008) or task versus social cohesion (van Vianen and De Dreu, 2001). Correspondingly, task and social/interpersonal orientation are two main dimensions of team climate that can be applied to most teams (Kauffeld, 2001). *Task orientation* is displayed in the team's ability to achieve its goals and objectives to the highest possible standards and in the team's concentration on their tasks. High task orientation includes a shared concern for and commitment to the quality of the task performance (Anderson and West, 1998). The team can achieve high-quality task performance with high motivation, high standards and performance criteria, monitoring, and reflexivity. *Social orientation* is concerned with the team's ability to promote the well-being of its members; it includes social support, conflict resolution, and a focus on good personal relationships among members (Kauffeld, 2001). When considering two levels of task and social orientation, a four-cell matrix with four types of team climates results, as proposed by West (1996) and Kauffeld (2001). Table 1 summarizes key characteristics of those four types of team climate. Both aspects—task and social orientation—have an impact on team effectiveness, which includes

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task effectiveness, well-being of team members (low stress, development of members), and team viability. In this context, *team viability* is defined as "the likelihood that a team will continue to work together and function effectively" (West, 1994, p. 3). *Cold* teams (i.e., unsociable but efficient teams) focus solely on tasks. They offer their members little social support and a poor social climate. *Cozy* teams concentrate on social aspects and ignore their tasks. Although these teams offer warmth, support, and cohesion among members, the low task effectiveness can adversely affect an originally high team member well-being in the long run. In *dysfunctional* teams where both social and task orientations are low, team members are dissatisfied with their team's relationships and task achievement (West, 1994). *Fully functioning teams* show high task and social orientation. They tend to be the most effective team type.

Table 1. Characterization of Different Team Climates (adapted from Kauffeld (2001) and West (1994))

	Low social orientation	High social orientation
High task orientation	Cold team • High task effectiveness • Short-term viability • Poor member well-being	Fully functioning team • High task effectiveness • Long-term viability • Good member well-being
Low task orientation	Dysfunctional team • Poor task effectiveness • Very low viability • Poor member well-being	Cozy team • Poor task effectiveness • Short-term viability (team members wish to continue to work together, but organization's satisfaction with team performance is low) • Average member well-being

Overview on Media Choice Research

Media Theories

Research on new media uses several theories to understand and explore the factors influencing the choice and suitability of communication media for various communication processes and tasks. Most early theories endorse the underlying concept of rational media

choice. They posit that the choice of a particular medium is influenced by weighing its costs versus benefits in executing a communication task.

Additionally, media theories build on the concept of task-technology fit (Goodhue and Thompson, 1995). That is, individuals or teams choose those media that best assist them in completing their tasks and in satisfying the communication demands imposed by the tasks. A better task-technology fit should affect team performance positively (Maruping and Agarwal, 2004). Though it has not been studied thus far, team climate may be useful in understanding the fit between task and media choice.

We rely on three widely used media choice theories to inform our research: social presence, media richness, and media synchronicity. *Social presence* is defined as the perception that there is personal, sociable, and sensitive human contact in the medium (Short et al., 1976). It denotes the subjective feeling that others are involved in a communication process. The original definition (Short et al., 1976) puts a strong emphasis on the role of the medium—the more communication channels a medium has, the higher the sense of presence in the interlocutors; therefore, face-to-face meetings have high social presence, while a textual communication medium, such as e-mail, has considerably less.

In contrast to social presence theory, media richness theory by Daft and Lengel (1986) deals with the suitability of media for specific communicative tasks in a more differentiated way. According to media richness theory, "rich" media (e.g., face-to-face meetings) are useful in reducing equivocality associated with ambiguous tasks. Conversely, media that can convey a lot of information (e.g., e-mails) should be used for uncertain tasks. A medium that is too rich can make the task even more complicated, since media richness can be distracting and thus increase rather than reduce insecurity with the recipient. Media conveying little richness, on the other hand, may lead to oversimplification because inadequate feedback and a low degree of personal contact would make it difficult to develop a common understanding. In a number

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of studies, media richness theory was not supported for choices among "new virtual media," such as e-mail versus voicemail at the individual choice level, (e.g., Dennis et al., 2008; El-Shinnawy and Markus, 1997; Kock, 2005). To account for these findings, researchers have proposed various social influence adaptations to media richness theory. (Dennis et al., 2008; Kock, 2005).

Dennis, Fuller, and Valacich (2008) were pioneers in recognizing the importance of the media's ability to support synchronicity among individuals working together. Synchronicity is determined by five media capabilities: transmission velocity, symbol variety, parallelism, rehearsability, and reprocessability (as described in Table 2). *Media synchronicity* is defined as "the extent to which individuals work together on the same activity at the same time" (Dennis and Valacich, 1999).

Table 2. Media Capabilities (Dennis et al., 2008)

Media capability	Description
Transmission velocity	Transmission velocity refers to the immediacy of transmission and feedback supported by a medium; it enables synchronous interaction and improves shared focus.
Parallelism	Higher parallelism of a medium means that more team members can participate in the communication process at the same time, and more communication processes, including information transmission, can take place simultaneously. Therefore, parallelism lowers shared focus and coordinating becomes more difficult because more simultaneous conversations are possible.
Symbol sets	Media with a more natural symbol set or media with a symbol set better suited to the message support synchronicity and a shared focus more strongly. *Symbol set* refers to the variety of cues that can be processed and exchanged in a medium. Some tasks require only limited symbol variety; others require more variety, (e.g., pictures, voice or non-verbal symbols). It may affect team performance negatively if symbols important for a communication task are missing.

Rehearsability	Using media with high, rather than with low, rehearsability, makes it easier to compose messages ahead of time with the intended meaning. Rehearsability is especially important for communication on unfamiliar topics, but delays due to rehearsing and revising a message before sending may reduce shared focus and synchronicity.
Reprocessability	Reprocessability enables communication partners to reread, reconsider, and reuse prior messages; a receiver can process or re-examine the message as many times as he or she needs to understand it. Reprocessability is important for conveyance processes, but it is less needed for convergence processes and developing a sharing understanding.

In media synchronicity theory, the fit between the media's capabilities and the task's communication process influences media use and appropriation, which, consequently, influences performance. A communication process basically consists of the conveyance of information and convergence of meaning (Miranda and Saunders, 2003). *Conveyance* means delivering as much information to as many recipients as possible. Groups can use this greater amount of information to make better decisions. Media with low synchronicity can be used when sending large amounts of information to several receivers. *Convergence* refers to developing a common understanding among group members and a joint interpretation of the information. It benefits from media with high synchronicity. Both convergence and conveyance emerge during teamwork. According to Dennis and Valacich (1999), when teams first start working together, they need higher synchronicity and a greater variety in symbol sets when communicating. The degree of synchronicity and social presence can be gradually reduced over time. Established teams need media with lower levels of synchronicity, especially when executing assigned tasks. Teams require higher levels of synchronicity for settling conflicts and solving problems. Evidence supporting synchronicity theory was found in several studies (e.g., Carlson and George, 2004; DeLuca and Valacich, 2005; Murthy and Kerr, 2003). Additionally, it is argued that using a variety of media in teams is better than

using just one medium: multiple media are more likely to support both conveyance and convergence processes that take place, and mixing media balances the effects of media on the receiver's motivation and information-processing ability (Dennis et al., 2008; Robert and Dennis, 2005). For example, information can be conveyed by e-mail and convergence can be reached via phone.

Characterization of Communication Media

Table 3 presents media capabilities. Face-to-face meetings and telephoning are communication devices with high media synchronicity, since they offer fast feedback and lower parallelism. In contrast, e-mail, with slow feedback and high parallelism, has low media synchronicity.

Although these discussed capabilities of media are objective physical characteristics, individual communicators may perceive them differently, and their perceptions may also change over time (e.g., Carlson and George, 2004). Furthermore, people may use a medium's capabilities inappropriately (Dennis et al., 2008) or in a manner unintended by its designers (e.g. DeSanctis and Poole, 1994).

Appropriate use of media may be a function of fit to the task (Goodhue and Thompson, 1995; Maruping and Agarwal, 2004) or contextual influences. Contextual factors that may influence actual media choice include urgency and importance of a decision, proximity, accessibility, effort, time, and task pressure. For example, a study by Sivunen and Valo (2006) on media choice suggests that there are two main social factors (i.e., accessibility and social distance) and two main task-related (i.e., idea-sharing and informing) factors that influence media choice in virtually communicating teams.

Table 3. Characterization of Media (adapted from Dennis et al., 2008)

	F2F meetings	E-mail	Phone	Instant messaging
Social presence (Köhler, 1999)	very high	low	medium	low
Media richness (Daft and Lengel, 1986)	high	low	medium	low (Kock, 2005)
Synchronicity (Dennis et al., 2008)	high	low	medium	medium
-Information transmission	fast	slow	fast	medium
-Information processing	low	high	low	low-medium

Effects of Computer-Mediated Communication on Teamwork

A long tradition of research has compared conventional teams that work face-to-face with virtual teams and teams using different communication media (Powell et al., 2004). This section summarizes study results on virtually communicating teams performing computer-supported collaborative work.

Media and Team Climate

According to Hollingshead's (1995) review of research on computer-assisted teams, virtual teams communicate less frequently, but more equally, among members compared to traditional face-to-face teams. Furthermore, virtual teams show less argumentation, more uninhibited communication, more positive socio-emotional communication, and more attempts to influence members.

Studies in the context of computer-mediated communication further reveal that team communication via media with low social presence may lead to increased voicing of radical opinions, reduced social inhibition (e.g., flaming), status differentials, and a feeling of equality between communication partners (Kiesler and Sproul, 1992; Potter and Balthazard, 2002). Moreover, researchers claim that virtual communication is more appropriate for task-oriented communication than for social or emotional exchanges, owing to its low social presence and impersonal nature (Walther, 1996). When compared to virtual communication

media with low social presence or richness, media with high social presence or richness tend to promote communication reciprocity and are considered to have a positive effect on the depth of information sharing and the social construction of shared meaning (Miranda and Saunders, 2003). Rocco (1998) suggests that trust in teams can be built more easily with the help of rich media (e.g., face-to-face meetings) compared to virtual communication, but virtual communication can help sustain an already achieved level of trust.

Based on their review of virtual teams, Powell, Piccoli, and Ives (2004) observe that face-to-face interaction is a crucial factor for team building and development, especially at the beginning of a team project, when it is used to gain shared language, build relationships, and enhance trust and respect among members. Regular face-to-face meetings are also helpful during a project for team coordination. Similarly, Robey, Koo, and Powers (2000) argue that virtual teams value face-to-face meetings, especially for personally getting to know their teammates when communicating remotely. In general, when compared to traditional face-to-face teams, it is more difficult for teams communicating virtually to build relationships and gain team cohesion and trust. Virtual communication media lack the synchronicity needed for convergence. Independent of specific media use, communication frequency has been shown to be a main factor for a positive team climate (Figl, 2008).

Maruping and Agarwal (2004) build on media synchronicity theory and describe which communication technologies are most appropriate for supporting interpersonal team processes. According to a temporal perspective of team development, the need for media with high feedback and symbol variety is more important for all interpersonal processes in early stages of team collaboration. Concerning the social dimension of teams, Maruping and Agarwal (2004) argue that relationship conflicts are best managed via synchronous communication (e.g., via telephone). Media providing parallelism and synchronous communication are effective for motivating, confidence-building and affect management in

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teams. Regarding the task dimension in teams, media rehearsability and reprocessability help team members resolve conflicts and agree on task execution and responsibilities. E-mail and instant messaging are appropriate media for these tasks since they enable structured decision making.

Media and Team Performance

Research results concerning virtual team performance are inconsistent. Some studies show that computer-mediated communication leads to both lower information exchange and negative performance (Walther and Bunz, 2005). Conversely, Potter and Balthazard (2002) point out that interaction styles of virtual teams are comparable to face-to-face teams and similarly affect team performance and processes. In order for teams to be effective, many researchers recommend that they initially meet face to face (e.g., Hertel et al., 2005; Powell et al., 2004). However, a recent study of open-source software development teams found that even when virtual communication media predominated early project phases, the teams were still effective (Bradner et al., 2005).

Using rich media can both positively and negatively impact team performance. The negative impacts occur when interpersonal interactions facilitated by rich media distract team members (Yoo and Alavi, 2001). Further, rich media can reduce task participation, while lean media may direct the members' attention to solving the task (Phillips and Santoro, 1989).

Research Model and Hypotheses

Our research was designed to answer the main research question: How does team climate impact teams' choices and use of media for communication, as well as team performance? Having laid out the relevant theoretical foundation of team climate and media use, we now propose several hypotheses to suggest how team climate and team communication patterns influence team performance. To our knowledge, no studies have related team climate types to

media choice and team performance. To study these relationships, we constructed a four-cell matrix for team climate based on varying levels of task and social orientation. Figure 1 depicts the research model of team climate that incorporates the work of Kauffeld (2004) and West (1996) and displays relationships among team climate, team communication patterns, and team performance. Figure 1 incorporates Kauffeld and West's four team climate types: fully functioning teams (high in both social and task orientation), cozy teams (high only in social orientation), cold teams (concentrating only on task performance, not on social considerations such as team well-being) and dysfunctional teams (low in both dimensions). Additionally, Figure 1 indicates hypotheses that we describe more fully in the next section. First, we propose that certain team climates are more likely to be related positively to subjective and objective performance (H1). Although this relationship does not include media use, it is relevant to fully analyze our research model. Second, we expect team climate to influence team communication patterns including communication frequency and media choice (H2). Third, we hypothesize that team communication patterns influence team performance (H3).

Thus, the dependent variable is performance (subjective and objective); the independent variable is team climate (task orientation and social orientation); and team communication patterns are a mediating variable.
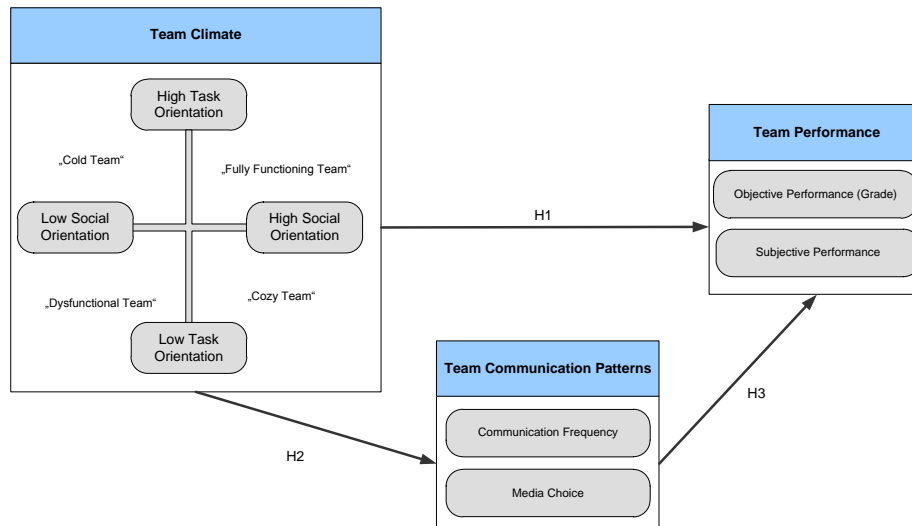
Figure 1. Research Model of Study

Further, team variables, such as team size, may influence the relationships among the variables. Therefore, team size has to be taken into account as a control variable; prior studies have shown the effects of size on media choice as well as team climate. Lower team size, for instance, has been shown to correlate positively with enjoyment in working together, active participation, and awareness of team goals (Bradner et al., 2005). Additionally, smaller teams are more likely than larger teams to choose media supporting synchronous communication (Bradner et al., 2005). The team work environment, as reflected in the course settings in which the study took place, was similar for all teams in the study. Project complexity may influence team communication patterns (Roberts et al., 2002), and thus was also held constant.

Team climate is viewed in terms of social and task orientation. Therefore, hypotheses are presented first for social and task orientation of teams in general (H1.1, H2.1). Using the team climate matrix, we then hypothesize about the different performance (H1.2) and communication patterns (H2.2) of the four team types, which reflect different climates based on varying levels of social and task orientation.

H1: Team Climate and Team Performance

H1.1: *Social and Task Orientation*

If teams are oriented toward completing their task, they are more likely to perform well (Anderson and West, 1998; Beckhard, 1972). These teams are also more likely to reflect on the problems they face and explore ways to reach their goals. They continually assess team needs and which team members can best fulfill those needs (Hoegl and Parboteeah, 2006). Thus, teams with a climate of high task orientation should demonstrate high performance (measured subjectively or objectively) because they are more focused on completing their assigned task. This may be especially true in short-term teams whose primary focus is on the task and who have little time to focus on social interactions (Saunders and Ahuja, 2006). In research and development teams, Pirola-Merlo et al. (2002) found high and significant correlations between both task effectiveness (objective measure) and satisfaction with performance (subjective measure) and task orientation, which they called a climate for excellence. Loo (2003) suggested that task orientation helped to improve team performance in the student teams that he studied qualitatively.

We do not know from previous research if there is a relationship between social orientation and performance. However, empirical evidence suggests that while team performance is positively influenced by task cohesion in teams, no effect of social cohesion on performance could be found (Bahli and Buyukkurt, 2005). As task and social cohesion are similar concepts to task and social orientation of teams, it is likely that task orientation is positively related to team performance but not to social orientation. Hence, for short-term teams such as those in our study, we hypothesize only about task orientation:

- **H1.1a:** There is a positive relationship between task orientation and objective performance.

- **H1.1b:** There is a positive relationship between task orientation and subjective performance.

H1.2: Team Climate Types

According to the team climate model, fully functioning teams should perform well whether their performance is measured with subjective or objective measures. They offer good member support and are able to pursue their goals. While fully functioning teams can be expected to perform well, it is more difficult to conjecture the performance of the other three types of teams (i.e., non-fully functioning teams). Compared to fully functioning virtual teams (called constructive teams), cozy virtual teams (called passive teams) produce lower-quality decisions (Potter, Balthazard and Cooke, 2000). In cozy teams, subjective performance may be adequate, but objective performance may be low since cozy teams do not give enough attention to task issues. However, it is also possible that these teams can enjoy one another and highly rate their subjective performance. The opposite is true for cold teams; they focus on getting the task done, but do not tend to their social aspects. They would likely score high on objective measures of performance but not on subjective measures of performance. In dysfunctional teams, the subjective and objective performance would both be low. With this research, we introduce the concept of team climate fit to the extent that, in general, teams with a fully functioning climate perform the same or better on both objective and subjective performance measures than do non-fully functioning teams. Focusing on the types likely to show the clearest distinctions, we summarize the relationships in Table 4 and hypothesize:

- **H1.2a:** Fully functioning and cold teams perform better than dysfunctional and cozy teams using an objective performance measure.

- **H1.2b:** Fully functioning teams perform better than dysfunctional teams using a subjective performance measure.

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Table 4. Hypotheses on Team Climate and Team Performance

		Fully functioning teams	Cozy teams	Cold teams	Dysfunctional teams
	Social orientation	+	+	-	-
	Task orientation	+	-	+	-
H 1.2a	Objective performance	+	-	+	-
H 1.2b	Subjective performance	+	~	~	-

H2: Team Climate and Team Communication Patterns

A basic assumption of this set of hypotheses is that some teams use communication media according to social and task orientation more rationally than others, and thus achieve a better task-technology fit than others. For example, why have more synchronicity than needed for an editing task? It usually makes editing come to a standstill when a committee tries to write a memo real-time. However, negotiating is easier and more effectively conducted in a committee meeting than via e-mail, which could persist for weeks. Media with high synchronicity are preferable for negotiating. Below we discuss in greater detail how team climate and communication variables such as frequency of communication and choice of media supporting synchronicity are interrelated.

H2.1: Social and Task Orientation

As discussed earlier, research shows that many interpersonal processes such as trust (Rocco, 1998), emotional exchange (Walther, 1996), and the social construction of shared meaning (Miranda and Saunders, 2003) are promoted by media that possess higher social presence and synchronicity. Therefore, we hypothesize that there is a positive relationship between social orientation and communication with media with high synchronicity. This is also supported by the findings of Watson-Manheim and Bélanger (2007) and Hertel et al. (2005), who found that meetings are preferred for relationship development. Teams with a high social orientation climate may choose to communicate frequently and to use media with high synchronicity that

support trust, social interactions, and the social construction of meaning. Hence we hypothesize:

- **H2.1a:** There is a positive relationship between social orientation and frequency of communication.

- **H2.1b:** There is a positive relationship between social orientation and the use of communication media with higher synchronicity.

H2.2: Team Climate Types

It is very probable that teams use media differently depending on their task and social orientation. Cold teams may communicate as much as demanded by the task, but no more, because their social orientation is low; dysfunctional teams may communicate even less frequently. Cozy teams, which focus on social processes, may communicate more than necessary to fulfill tasks, and fully functioning teams may also communicate a bit more frequently than necessary to support team well-being. The frequency of non-task related (i.e., social) communication has been shown to correlate positively with both effectiveness and team members' satisfaction (Hertel et al., 2005). It is possible that communicating more frequently facilitates important social processes such as cohesion and trust.

Fully functioning teams should prefer media with high synchronicity to support team well-being because it allows team members to learn more about one another; cozy teams probably use these media even more. In contrast, cold teams may choose the media with the best cost-to-benefit ratio. That is, they probably use media with high accessibility and low effort that are still suitable to convey the necessary amount of information. Therefore, they probably meet face to face less often. This position is substantiated by prior research showing that rich media with high social presence can distract team members due to interpersonal interactions (Yoo and Alavi, 2001) and reduce task participation, while lean media may direct their

attention to solving the task (Phillips and Santoro, 1989). Dysfunctional teams may communicate less than necessary to fulfill the tasks.

We conjecture that the relationships may be a function of climate/technology fit. Though no previous research has assessed this fit, our conjectures suggest differences in media usage across the climate cells, as described in Table 5.

Table 5. Hypotheses on Team Climate and Team Communication Patterns

		Fully functioning teams	Cozy teams	Cold teams	Dysfunctional teams
	Social orientation	+	+	-	-
	Task orientation	+	-	+	-
H 2.2a	Communication frequency	+	++	~	-
H 2.2b	Use of media supporting synchronicity	+	++	~	-

H3: Team Communication Patterns and Team Performance

Higher communication frequency using all types of communication media (online as well as present media) positively influences both subjective and objective team performance independent of team type. Frequent communication helps provide a comprehensive understanding of interrelated activities (Hirst and Mann, 2004). The increased communication should convey additional information for performing the task and coordinating the efforts of the team members. We posit:

- **H3a:** There is a positive relationship between communication frequency and objective performance.

- **H3b:** There is a positive relationship between communication frequency and subjective performance.

Method

Study Design

We studied teams in a controlled setting in which project complexity and team work environment were held constant for all teams. All teams had similar goals and tasks. They all used the same e-learning platform to upload the deliverables of their teams' work.

Description of Study Context

The empirical study was conducted in two university courses, Web Engineering and Human Computer Interaction, which were both held at an Austrian university as part of the information systems curriculum. The courses were selected for this study because they included an intensive team project that was conducted over one term. The courses were held in parallel groups (15–20 students each) with a total of 115 students in 50 teams. In both courses, teams of students had to develop a design for a (web-based) application prototype. Further, the learning goals of the Human Computer Interaction course included gaining hands-on experience in collaborative-user interface design and usability engineering, and a goal in the Web Engineering course was to learn about methods and processes to plan, model, and develop web information systems. Teams comprised of two to four students as proposed by several authors (Adams, 2003; Johnson and Johnson, 2006) for team projects in a cooperative learning setting. According to Wells (2002), it is important to keep team sizes under five, so that all team members can still be involved with all parts of the team project. The projects were conducted over the entire term (15 weeks) and employed a milestone structure; in each phase teams elaborated milestone solutions, delivered them online via the course platform, and presented them in class. Grades were based on active participation in the lab sessions, project deliverables, and presentations. Teams in the study were characterized as computer-assisted teams, since they use "information access and processing, performance structuring, and communication" (Hollingshead and McGrath, 1995) in the context of their

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teamwork. However, on a continuum ranging from full face-to-face to fully virtual, the teams were closer to the fully face-to-face end since face-to-face meetings took place in at least five course sessions.

Questionnaire and Measures

The students completed a questionnaire during the last lecture session of the course, which was written in German to motivate all students to complete it. We employed the "questionnaire on teamwork" by Kauffeld (2004) for measuring team climate. This questionnaire builds on the Team-Reflexivity-Model (West, 1994) and the SGRPI-Model (Beckhard, 1972). It measures two scales with two subscales: social orientation (twelve items measuring team cohesion and willingness to accept responsibility) and task orientation (nine items measuring task accomplishment and goal orientation). Other researchers measured different facets of team climate. The well-known team climate inventory (Anderson and West, 1998), for instance, focuses on innovation and measures vision, participation safety, support for innovation, and task orientation. Despite the high popularity of the team climate inventory, we preferred to use the Kauffeld/West typology to focus on two measures that are particularly useful in understanding more fully the role media choice and use play in team performance. Moreover, the team climate inventory (Anderson and West, 1998) measures constructs that do not fit well when room for innovation is limited by course requirements (Loo, 2003) or by set project goals in information system development teams (Bain et al., 2001; Loo, 2003).

The "questionnaire on teamwork" measure is a copyrighted, psychometrically-sound instrument and has been used in a variety of studies (e.g., Körner, 2010). Despite the fact that such team climate surveys are often used for team development and improving their performance, they are also applicable for describing the climate of student teams in the present study.

The items are anchored on two opposite poles with a seven-point rating scale. The questionnaire uses a referent-shift consensus model to measure team climate (Klein et al., 2001). Respondents answer items referring to the individuals' perception of team climate including terms like "The team members" or "In our team," which are then aggregated to the team level. For example, the anchors of an item of the social orientation scale (sub-scale team cohesion) range from "Some of us are selfish" to "The focus is on the team, not on individuals." The anchors for an item of the task orientation scale (sub-scale task accomplishment) range from "The team members knew their tasks" to "The team members did not know exactly what they had to do."

In a psychometric validation of the questionnaire with 232 participants in 22 teams, factor analysis confirmed the structure of two scales (Kauffeld and Frieling, 2001), explaining 51.9% of the total variance. Furthermore, the external validity of the questionnaire was examined; the questionnaire scales correlated with subjective work achievement and job satisfaction. Cronbach's Alphas in our sample were high: .92 for social orientation and .89 for task orientation, which were similar to the values reported by Kauffeld and Frieling (2001). The questionnaire had to be slightly modified for the context of this study since it was originally formulated for ongoing teamwork in industry. Items were reformulated in past instead of present tense, since students described teamwork during the term. Furthermore, one item referring to the goals of the entire business organization was excluded because there was no appropriate equivalent for teamwork in a university course.

Additionally, the questionnaire included two items that measured subjective performance by asking students to assess the overall achievement and collaboration of their team on a five-point scale (r=.716). Furthermore, students estimated their frequency of using seven different communication media for communicating in their team on a six-point scale, ranging from

never to *daily*. A pilot study ascertained the variety of communication media used by students (Figl, 2007).

Further, we used dropout rates as a proxy for team dysfunctionality. Dropout rate was operationalized as the difference between the number of those who started on the team and the number of team members who actually passed the course and received a grade.

The mean value of all team members' grades was used as the measure of the "objective performance" construct.

Participants

Sixty-eight students on 30 teams in the Human Computer Interaction course, and 47 students on 20 teams in the Web Engineering course completed the questionnaire. The students were an average of 23.32 years old (SD=2.93) and had completed 6.29 semesters (SD=4.54); 77.6% were male, and 21.6% were female.

Data Analysis and Preparation

Since the unit of analysis was the team, individual responses were aggregated to team level. Scale means for social and task orientation were calculated from single item measures, so that each team was characterized by two climate values (social and task orientation). We separated the teams into two (high or low) groups for each of the climate values by performing a median split on their score. This led to the placement of each team into one of four team climates or cells. According to common team definitions as summarized by Baker et al. (2005, p. 235), "a team consists of two or more individuals who must interact to achieve one or more common goals that are directed toward the accomplishment of a productive outcome(s)." The 50 participating teams consisted of at least two, and no more than four, students.

For all judgments made by two or more team members, standard deviations were calculated to assess whether inter-rater reliability was high enough. Mean standard deviations were all below 1 ($SD_{\text{social orientation}}$=.60; $SD_{\text{task orientation}}$=.53; $SD_{\text{e-mail use}}$=.76; $SD_{\text{face-to-face use}}$=.70; SD_{phone}

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use=.96). A normal distribution of answers assumes that scale means of different team members mostly remain below a distance of one gradation point from each other. A standard deviation of less than one gradation suggests that all raters are in relative agreement with one another.

Team Climate Types

Twenty teams (out of 50) in our sample were characterized as fully functioning teams on the social and task orientation dimensions, measured by the "questionnaire on teamwork" (Kauffeld, 2001). Only five were cozy teams. These teams focused more strongly on social aspects than on tasks. The low number of cozy teams could be due to the high level of Hofstede's measure of individualism (55 compared to a world average of 43) and masculinity (79 compared to a world average of 50) in Austria, where these data were collected (Hofstede, 2011). Thus, it is possible that in a culture high on individualism and masculinity there tends to be less of a social orientation in teams. Five other teams concentrated only on tasks and not on the social well-being of team members (cold teams). The remaining 20 teams, which displayed low values for both social and task-orientation, were characterized as dysfunctional based on the way they had described themselves in the questionnaire (see Appendix A). Distribution of team types was comparable for both courses (see Figure 2).
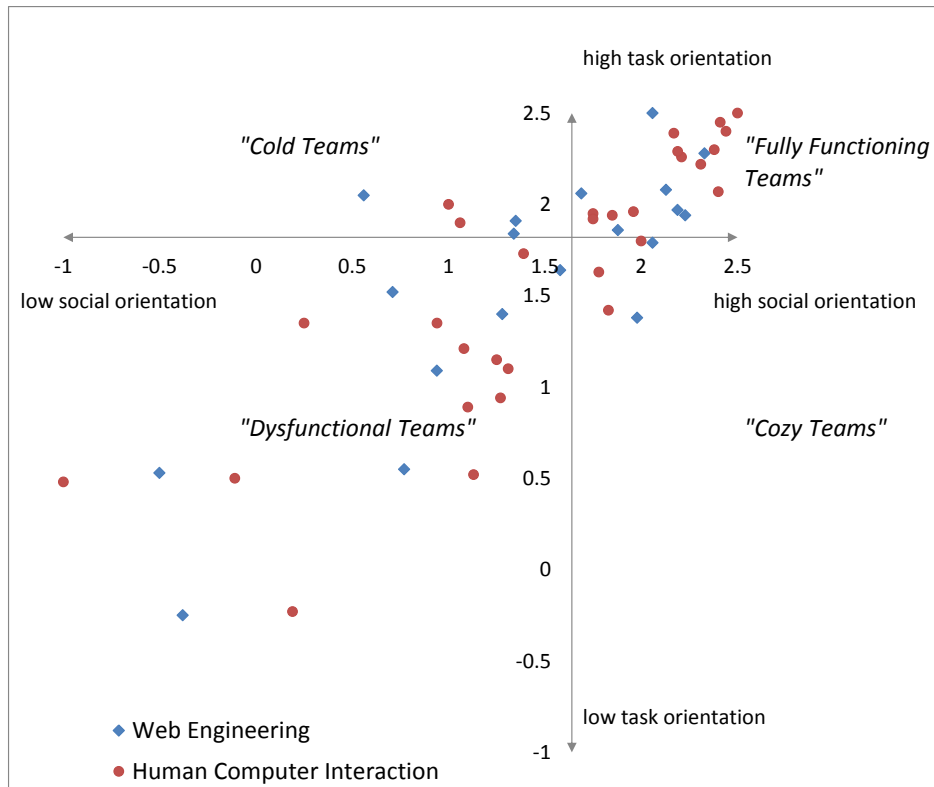
Figure 2. Team Climate in Student IS Development Teams.

Frequency of Use of Communication Media in Student Teams

Figure 3 depicts how often students used different media (e.g., e-mail, face-to-face meetings, phone, instant messaging) to communicate in their teams. In general, e-mail was the communication medium used most frequently (M=4.44; SD=1.09); on average it was used once a week. Teams also met about once a week (M=3.98; SD=1.09). Instant messaging and phone were used between once a week and once a month by most teams. Interestingly, the use of instant messaging varied greatly across teams (M=3.14; SD=1.97). Texting was used less frequently for team communication. The communication medium forum was excluded from further analysis, because with a mean of .41 (SD=1.27) and a maximum rating of once a month, it did not seem to play a significant role in the communication of any of the student teams.
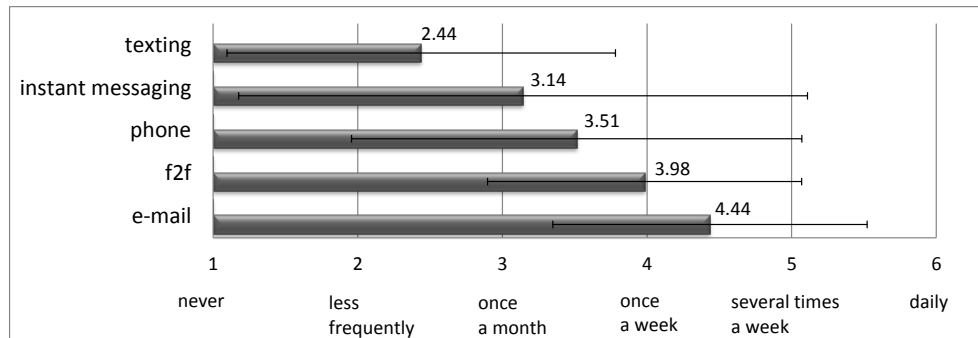
Figure 3. Communication Frequency, n=50 Teams, M+/- SD.

We employed the frequencies of communication media use to calculate two summarizing indicators: overall communication frequency and a synchronicity index. Since a single meeting instance is likely to convey more information and last longer than a single message instance, communication frequency does not necessarily correspond directly to the amount of exchanged information. However, communication frequency is a good measure of contact among team members. Thus, overall communication frequency was calculated as follows:

- Overall communication frequency per team (unweighted) = MEAN (frequency of face-to-face meetings, frequency of e-mail communication, frequency of phone calls, frequency of instant messaging, frequency of texting)

The reliability of overall communication frequency was convincing (Cronbach's Alpha=.784).

Additionally, a synchronicity index was calculated based on the weighted characterization of media capability in media synchronicity theory (Dennis et al., 2008): synchronicity was highest in face-to-face meetings (factor 3), medium for phone and instant messaging (factor 2) and lowest for e-mail (factor 1), which was transferred in this formula:

- Synchronicity index per team = MEAN (frequency of face-to-face meetings*3, frequency of e-mail communication*1, frequency of phone calls*2, frequency of instant messaging*2, frequency of texting*2)

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The frequency ratings of teams were measured on a six-point rating scale (ranging from never to daily). Using perceptions of the frequencies of use was not as accurate as using the exact data values for communication (e.g., the number and word count of e-mails). Hence, this index was only a gross estimator for the frequency of communication with high synchronicity in teams.

Intercorrelations of Communication Media Use

Since the frequency ratings of teams were based on a six-point ordinal rating scale (from never to daily), non-parametric correlation coefficients (Spearman) were calculated in the following analyses. The Spearman correlation measures the relationship between two variables on an ordinal scale of measurement (Gravetter and Wallnau, 2008). The overall communication frequency and synchronicity index were highly correlated with the single frequency ratings of all communication media used, since they were calculated as weighted and unweighted mean values of single ratings (r=.498-.836 and r=.450-.847, respectively). In general, results (see Appendix B) showed that frequencies of use for different communication media were highly and positively intercorrelated. Teams whose members communicated frequently did so with a variety of media. Only the use of e-mail with texting and instant messaging were not significantly correlated. Teams did not appear to use communication media as substitutes for each other which would lead to negative correlations between pairs of variables. There were no negative correlations among any pairs in this set. Due to the high multicollinearity, regression analysis did not seem to be appropriate to investigate relationships between variables. Therefore, separate single correlations (Spearman) were calculated to answer the research questions.

Results

H1: Team Climate and Team Performance

H1.1: Social and Task Orientation

Team task and social orientation correlated most with subjective team performance and a bit

less, but still significantly, with objective performance. Thus, H1.1a and H1.1b were

supported. Task and social orientation were not independent dimensions, since they show

high correlation ($r=.825$, $p=.000$). The team size control variable did not significantly

influence these relationships. All correlations can be found in Table 6.

Table 6. Team Climate, Team Performance, and Team Communication

	Team climate		Team performance	
	Task orientation	Social orientation	Subjective performance	Objective performance (grade)
Team climate				
Task orientation	-	. 825***(.883***)	.717*** (.879***)	.474** (.427*)
Social orientation	. 825***(.883***)	-	.745** (.868***)	.357* (.364*)
Team performance				
Subjective performance	-	-	-	.509*** (.518**)
Communication				
Overall communication frequency	.450** (.490**)	.529*** (.498**)	.521*** (.595**)	.221(.217)
Synchronicity index	.437** (.490**)	.529*** (.509**)	.515** (.595**)	.226 (.194)
E-mail	.427** (.524**)	.399** (.451*)	.407** (.558**)	.440** (.366*)
F2F	.574*** (.644***)	.622*** (.662***)	.573*** (.670***)	.339 (.219)
Phone	.357* (.416*)	.388** (.394*)	.361** (.485**)	.058 (.041)
Texting	.180 (.343)	.270 (.344)	.236 (.378*)	.056 (.213)
Instant messaging	.175 (.122)	.276 (.206)	.380** (.311)	.181 (.070)

Note. n = 50 teams. Partial correlations (controlled for "team size") are put in brackets.

* $p < .05$. ** $p < .01$. *** $p < .001$.

H1.2: Team Climate Types

To determine if teams with different team climate types differed in objective and subjective

performance, we used Mann-Whitney-U tests. Figure 4 and Table 7 show descriptive

statistics. In the first analysis, we compared two groups (group 1: fully functioning and cold

teams vs. group 2: dysfunctional and cozy teams) and used objective performance as the dependent variable. The groups differed significantly (U=408.50, p=.008). Objective performance was highest in cold teams, followed by fully functioning and cozy teams, supporting H1.2a. Likewise, H1.2b predicted that fully functioning teams would perform better than dysfunctional teams using a subjective performance measure, and results supported that hypothesis (U=371, p=.000). Fully functioning teams subjectively performed best, followed by cozy teams and cold teams. As expected, dysfunctional teams performed the worst.
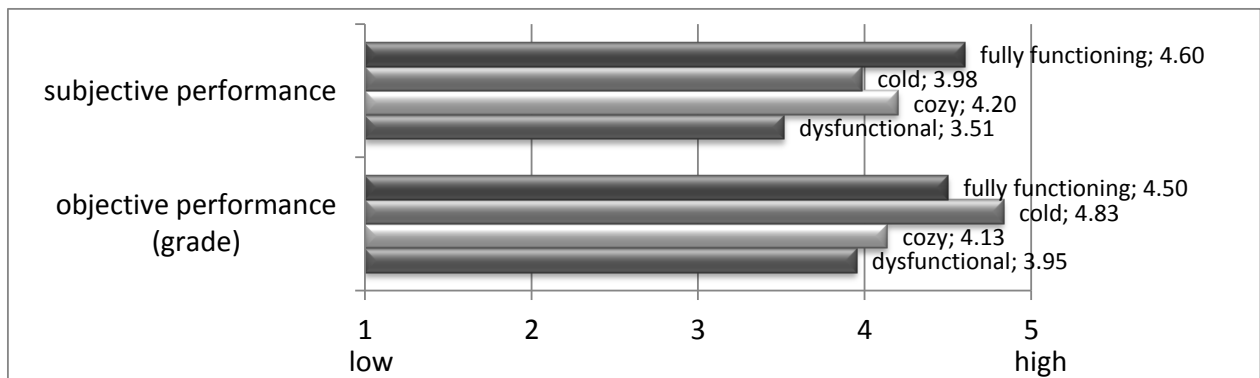

Figure 4. Objective and Subjective Performance in Different Team Types, n=50 Teams, Mean.

Table 7. Team Climate Types, Team Performance and Communication with Media (Mean and SD. Range of scales: task/social orientation: -2.5–2.5; objective/subjective performance: 1–5; team communication: 1–6)

	Dysfunctional teams		Cozy Teams		Cold teams		Fully functioning teams	
	Mean	*SD*	Mean	*SD*	Mean	*SD*	Mean	*SD*
N	5		5		20		20	
Task orientation	.79	*.79*	1.60	*.20*	1.94	*.08*	2.17	*.21*
Social orientation	.59	*.85*	1.93	*.12*	1.06	*.32*	2.14	*.25*
Team climate and performance								
Objective performance (grade)	3.95	*.99*	4.13	*.49*	4.83	*.41*	4.50	*.37*
Subjective performance	3.37	*.81*	4.20	*.61*	3.98	*.24*	4.60	*.83*
Team communication								

Overall communication frequency	2.07	*1.08*	2.58	*.83*	2.44	*.48*	2.91	*.95*
Synchronicity index	4.03	*2.24*	5.00	*1.96*	4.68	*1.07*	5.80	*1.93*
E-mail	3.90	*1.31*	4.57	*.72*	4.93	*.15*	4.78	.87
F2F	3.36	*1.11*	3.77	*1.08*	3.93	*.72*	4.68	*.73*
Phone	3.05	*1.68*	3.40	*1.69*	3.67	*.85*	3.94	*1.51*
Texting	2.17	*1.29*	2.83	*.97*	2.33	*1.00*	2.63	*1.56*
Instant messaging	2.91	*1.87*	3.33	*2.25*	2.33	*1.65*	3.52	*2.11*

Statements by students about feedback they gave their colleagues showed that students of dysfunctional teams described problems that had arisen in the team, while qualitative statements of students belonging to fully functioning teams indicated good collaboration (see Table 8).

Table 8. Statements by Selected Fully Functioning and Dysfunctional Teams.

Team		Statement
Fully functioning team	2.1	"The collaboration went outstandingly well on all levels. . . . Especially helpful were: fair distribution—everyone was from the beginning ready to take a fair share of work; mutual trust—the feeling that we can count on each other; tasks were fulfilled reliably and on time, and no one ducked out or left the team suddenly."
Fully functioning team	3.2	"I would work together with them again anytime."
Fully functioning team	3.4	"It was great working together with them. They are very reliable and work diligently! I hope to work with them more often in future!"
Dysfunctional team	4.1	"If you are working in a team, the workload should be split fairly. E-mails should be answered. . . . one should communicate beforehand that he or she doesn't have time to work."
Dysfunctional team	3.1	"My (former) teammate wasn't really a help. It was better for me that he dropped out earlier."
Dysfunctional team	1.8	"Work more autonomously, meet deadlines."

H2: Team Climate and Team Communication Patterns

H2.1: Social and Task Orientation

A main contribution of this study is its findings concerning the influence of team climate on media use. Table 6 depicts all relevant correlations. In line with our expectations related to H2.1a and H2.1b, correlations suggested that more socially oriented teams communicated more frequently with e-mail, met each other and phoned more often. Task orientation was

also associated positively with these communication media. H2.1b predicted that teams with higher social orientation would use communication media with synchronicity more often, and, indeed, correlations of face-to-face meetings were stronger for social orientation ($r=.622$) than for task orientation ($r=.574$), while the use of e-mail correlated stronger with task ($r=.427$) than with social orientation ($r=.399$).

Correlations with the overall communication frequency and the synchronicity index were very similar. The weighting according to media capabilities seemed to be redundant and did not provide a higher correlation with team climate than the overall communication frequency.

H2.2: Team Climate Types

To examine if the team climate type in general had an influence on the use of communication media, we first ran Kruskal-Wallis tests with the four team climate types as independent variables and the communication frequencies of several media as well as the synchronicity index as dependent variables. To identify whether the team climate types differed as expected, we compared the means (see Figure 5). The results indicated that the four team types differed in their use of face-to-face meetings ($X^2_{df=3}=15.06$, p=.002) and team climate type tended to impact overall communication frequency ($X^2_{df=3}=6.62$, p=.09). Team climate type tended to impact the synchronicity index ($X^2_{df=3}=6.39$, p=.09) and the use of e-mail ($X^2_{df=3}=7.11$, p=.07) as well. There was no effect for the use of phone, texting, and instant messaging. These results were consistent with correlations among social and task orientation and the communication media, which were strongest with face-to-face meetings. Contrary to theory (H2.2), however, face-to-face meetings did not take place most often in cozy teams as predicted, but in fully functioning teams, followed by cold teams. In line with our expectations related to H2.2, dysfunctional teams had the lowest values in all communication related values. Cold and fully functioning teams used e-mail most often.
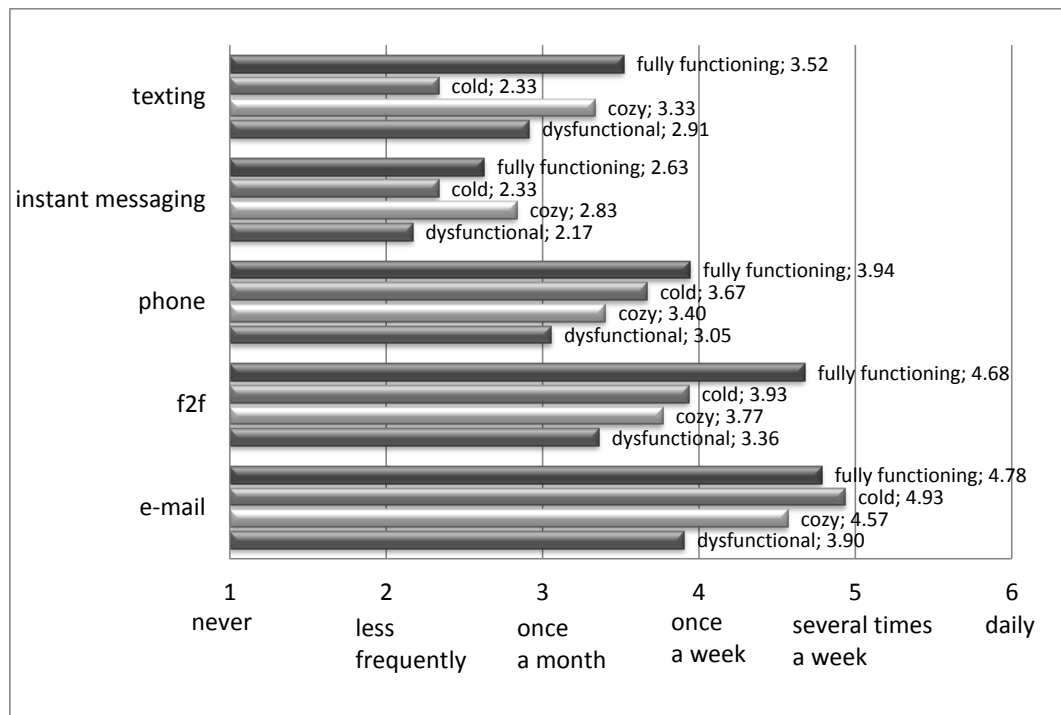
Figure 5. Use of Communication Media in Different Team Types, n=50 Teams, Mean.

Team Communication Patterns and Team Performance (H3)

H3 speculated that there would be positive associations between communication frequency and objective (H3a) and subjective (H3b) performance. As shown in Table 6, the use of e-mail, face-to-face meetings, phone, and instant messaging were positively correlated with subjective performance, lending support to H3b. The correlation with texting might be due to the fact that texting is probably a medium reserved for emergencies or urgent messages. The perceived subjective performance of teams further correlated with the overall communication frequency and the synchronicity index.

In contrast to subjective performance, objective performance (grade), interestingly was most highly correlated with the use of e-mail (r=.440, p=.001); correlations with the use of other communication media were lower and insignificant. Therefore, H3a could only be partially supported. When the model accounted for the team size, the positive correlation between objective performance and e-mail use diminished slightly, but remained significant (p<.5).

Maybe e-mail was the best measure for working on deliverables of the task (e.g., how many different versions of documents students sent each other) compared to meetings or instant messaging, which also could have been used for social communication purposes. Teams that used texting and instant messaging did not differ from other teams concerning their performance.

Summary of Hypothesis Testing Results

The results of the hypotheses testing are summarized in Table 9 and Table 10.

Table 9. Summary of Hypothesis Testing Results (Social and Task Orientation)

Hypothesis	Independent variable	Relationship	Dependent variable	Results	Comment
H1.1a	Task orientation	+	Objective performance	Supported	
H1.1b	Task orientation	+	Subjective performance	Supported	
H2.1a	Social orientation	+	Communication frequency	Partly supported	For all communication media except texting and instant messaging
H2.1b	Social orientation	+	Higher synchronicity communication media	Supported	
H3a	Communication frequency	+	Objective performance	Partly supported	For e-mail
H3b	Communication frequency	+	Subjective performance	Partly supported	For all communication media except texting

Table 10. Summary of Hypothesis Testing Results (Team Climate Types)

Hypothesis	Dependent Variable	Fully functioning teams	Cozy teams	Cold teams	Dysfunctional teams	Results	Comment
H 1.2a	Objective performance	+	-	+	-	Yes	
H 1.2b	Subjective performance	+	~	~	-	Yes	
H 2.2a	Communication frequency	+	++	~	-	Partly supported	Higher for fully functioning teams than for cozy teams

H 2.2b	Use of media supporting synchronicity	+	++	~	-	Partly supported	For fully functioning and dysfunctional teams

Discussion

This study is one of the first to investigate the relationships among team climate, team communication patterns, and team performance. A total of 115 students in 50 teams participated. Most teams were characterized as fully functioning teams with high social and task orientation. These teams communicated most often via e-mail and face-to-face meetings, usually weekly. Since frequencies of media use were highly positively intercorrelated, it appears that teams that communicated frequently did so using a variety of media.

A possible explanation for this result is that teams realize the benefits of using a combination of media (Dennis et al., 2008; Watson-Manheim and Bélanger, 2007). Most relationships in the research model were found to be significant as hypothesized. Our results indicate that team climate was clearly important. In line with our predictions, we found that teams with more task-oriented team climates that communicated more frequently also performed the best on the design and implementation task. Therefore, both frequent communication and a task-oriented team climate were important for performance. Unlike González-Romá et al.(2009), we found a relationship between team climate and performance, not only for subjective but also for objective performance.

Teams with a climate displaying social orientation frequently used face-to-face meetings, e-mail, and phone calls. We had expected that teams with a high social orientation climate choose to communicate more often with media that provide high social presence and synchronicity, which can better promote such interpersonal processes as trust (Rocco, 1998) and emotional exchange (Walther, 1996). However, all teams preferred to use e-mail over face-to-face meetings, apparently because e-mail conveyed a lot of information with relatively

little effort. E-mail, as compared to face-to-face communication, is considered to be especially helpful in overcoming the geographical distance between team members of virtual teams. The team members on most teams appeared to use e-mail for task-oriented communications. However, the virtual teams that we studied, even the cozy teams, might have spent less time creating a social environment through media with high synchronicity, such as face-to face meetings. Instead, the members of virtual teams might have done their socializing with co-located colleagues. In other words, people might have gotten their "socialization fix" from co-located colleagues rather than from colleagues with whom they worked virtually.[1]

The more task-oriented teams (i.e., cold and fully functioning teams) used e-mail more frequently than the less task-oriented teams (i.e., cozy and dysfunctional teams). Ironically, the cold teams displayed a higher mean objective performance than did the fully functioning teams. The cold teams also e-mailed more than the fully functioning teams, but they phoned and met face-to-face less often than did the fully functioning teams. Thus, their efficient use of communication media might have played a role in their higher objective team performance (i.e., grades) when compared to other team types. The judicious use of media by task-oriented teams was probably important for their performance. The socially oriented, cozy teams did not use high-synchronicity media as much as the fully functioning and cold teams. They did, however, use texting more than the other teams. This medium might not have been as well suited to their task as the high-synchronicity media.

Results suggest that both the social and task dimensions of team climate are important for performance, and there appears to be a fit between the most appropriate team climate type (i.e., fully functioning teams) and all measures of performance. In contrast, using the team climate matrix, dysfunctional teams communicated less frequently, met less often, and

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[1] We are indebted to one of the reviewers for this insight.

performed more poorly than in the other types of team climates. These findings further suggest the relevance of the fit of team climate type for communication with media and team performance. From a more general perspective, combined with Sivunen and Valo's (2006) results illuminating social influence on media choice, this research provides additional evidence of the complex interplay between team and media capabilities for choosing team communication media types

Limitations and Future Research

Although the effects found in this research are clearly evident and in line with prior findings, we acknowledge that the research results presented here are subject to a number of limitations, including the use of student subjects. However, a university course setting provided better control for investigating the relationship between media use and team climate than teams in a natural organization, because many factors, including the basic task, were comparable for all investigated teams. Although generalizations to real teams in the workforce should be undertaken with caution, we also point out that studying teams in information systems courses is valuable, since working efficiently in teams is a core competence for the information systems field (Figl, 2010). Further, studying student teams makes it possible to explore new constructs when teams in a business environment are not available. The student samples may also be useful in studying processes underlying organizational phenomena (Greenberg, 1987) such as information system development.

Further, these teams, like many work teams, were not totally virtual. In most cases, they met at least five times during the term because of compulsory attendance in the course. The students did not have explicitly allocated class time to work and talk about their team projects. However, the team members coordinated their project efforts before and after class or on their breaks. Thus, this generalization to most work teams seems reasonable. As is often the case,

both student and industry teams frequently have few occasions to meet. Hence, they must schedule some additional face-to-face meetings to complete their project. Additionally, significant correlations between frequency of media use and grade demonstrated that the variation in media use was sufficient to make a difference.

Due to the cross-sectional study design, it is difficult to determine the direction of causal effects. That is, do teams with higher team social orientation get along well with each other and, therefore, like to meet face to face? Or, does a higher frequency of face-to-face meetings cause higher team social orientation? Team climate dimensions that promote a psychologically safe communication climate can also facilitate computer-mediated communication, which in turn leads to interaction effects and reduces possible negative effects of virtuality on team performance (Gibson and Gibbs, 2006). It is difficult to artificially vary both frequency of face-to-face meetings and team social orientation in a natural setting. We therefore encourage longitudinal studies designed to measure both variables over a longer period of time, supplemented with in-depth interviews, to fully answer these questions and to determine the causal effects.

As was the case with previous research (González-Romá et al., 2009), there were high intercorrelations of team climate dimensions. Future studies could also evaluate the climate of the teams to supplement the questionnaire items. We noted that almost no questionnaire respondents rated their team on the lower end of the scale. This could be either due to the generally positive team climates or as result of the response bias of "acquiescence"—the tendency of respondents to prefer higher ratings over lower ratings (Podsakoff et al., 2003). However, we obtained clear results concerning differences between teams categorized as dysfunctional versus fully functioning teams, supporting the validity of our team climate categorizations.

When the study context allows for a combination of media, it is difficult to isolate the influence of individual communication media. Calculating our newly proposed synchronicity index and a general communication frequency did not solve this problem. The overall unweighted communication frequency index seems to be a good indicator compared to the indices weighted with judgments by media synchronicity theory.

Implications for Research and Practice

The work presented in this paper has important implications for future research and practice. Our study adds to the current body of knowledge by investigating team climate as a salient factor for media choice in teams. It explores the nuances of team climate by incorporating Kauffeld and West's four team climate types in relation to team communication patterns and performance. Thus, we believe that our work serves as a valuable initial contribution. Future research could extend this work and examine in greater detail the role of team climate and media fit for different tasks. Given that these factors may moderate the relationship between team communication and team climate, and teams may adopt media for specific tasks, understanding their interplay is desirable.

Looking ahead, free tools for online collaboration such as Google Groups may be more widely used. By representing team project documents, these tools can create more transparency and shared meaning in team settings than exchanges via e-mail (Bjørn and Ngwenyama, 2009). Thus, opportunities exist for fellow scholars to extend our approach to meaningfully examine the relationship between team climate and team communication by evaluating the potential of emerging collaboration tools for the different cells in our team climate matrix.

Our work not only provides an important extension to the literature, but also helps in generating guidelines to help managers promote a positive team climate and better team

performance in practice. The bottom line is that both the task and social dimensions of team climate are important for performance. In general, high communication frequency seems to be positively related to social and task orientation of teams. If managers only want to improve team performance, they should focus on providing basic technical support for online team communication and arranging regular synchronous meetings. The regular synchronous meetings should increase the frequency of task-related communications around the meeting time (Maznevski and Chudoba, 2000). However, if they also want to improve the social dimension of team interactions, managers should arrange face-to-face meetings. In any event, they should work to create a supportive team climate. They might also include at least one individual on the team who has demonstrated ability to create supportive work environments. The members could be selected based on their preferred ideal climates as measured by Burch and Anderson's (2004) team selection inventory (TSI). An alternative would be to include some training on hints for creating supportive work environments in the early face-to-face meetings of the team members.

Though e-mail theoretically has low social presence and is a lean medium, it was very useful in this study's information system development task. Managers may want to promote its effective use, especially for information processing, by establishing e-mail etiquette, reducing the volume of unnecessary e-mail exchanges, and promoting the use of other media to prevent misunderstanding and conflict escalation that may occur due to e-mail's reduced cues. Additionally, understanding the effect of different team climate types on communication patterns offers potential for the management to exert their influence. Managers may consider assessing team climate, which can be used to provide guidance. For instance, if a team is identified as "cozy," management might determine whether there are too many face-to-face meetings or there is too much instant messaging irrelevant to team tasks. Because the performance of the cozy teams was relatively low on objective performance in this study,

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managers may need to ensure that they provide cozy team members with sufficient performance feedback about each virtual team member.

Conclusion

In this study, we contribute to computer-mediated communication research by providing a theoretical and empirical analysis of team climate as a relevant factor that influences media choice and communication in teams. In conclusion, our study has uncovered a rich and contextualized understanding of the associations between the social and task orientation dimensions of team climate and the use of media in teams. Our findings offer preliminary evidence that task-oriented teams achieve a better task-technology fit in their communication and a better overall performance than other teams.

References

Adams, S. G. (2003) "Building Successful Student Teams in the Engineering Classroom," *Journal of Science Mathematics, Engineering and Technology* (4) 3 & 4, pp. 1-6.

Anderson, N. and M. West (1998) "Measuring Climate for Work Group Innovation: Development and Validation of the Team Climate Inventory," *Journal of Organizational Behaviour* (19) 3, pp. 235-58.

Bahli, B. and M. D. Buyukkurt (2005) "Group Performance in Information Systems Project Groups: An Empirical Study," *Journal of Information Technology Education* (4), pp. 97-113.

Bain, P. G., L. Mann, and A. Pirola-Merlo (2001) "The Innovation Imperative," *Small Group Research* (32) 1, pp. 55-73.

Baker, D. P., L. Horvarth, M. A. Campion, L. Offermann et al. (2005) "The All Teamwork Framework," in T. S. Murray, Y. Clemont, and M. Binkley (Eds.) *International Adult Literacy Survey, Measuring Adult Literacy and Life Skills: New Frameworks for Assessment*. Ottawa: Ministry of Industry, pp. 229-272.

Basaglia, S., L. Caporarello, M. Magni, and F. Pennarola (2010) "It Knowledge Integration Capability and Team Performance: The Role of Team Climate," *International Journal of Information Management* (30) 6, pp. 542-551.

Beckhard, R. (1972) "Optimizing Team-Building Efforts," *Journal of Contemporary Business* (1), pp. 23-32.

Bélanger, F. and M. Watson-Manheim (2006) "Virtual Teams and Multiple Media: Structuring Media Use to Attain Strategic Goals," *Group Decision and Negotiation* (15) 4, pp. 299-321.

Berry, G. R. (2006) "Can Computer-Mediated Asynchronous Communication Improve Team Processes and Decision Making? Learning from the Management Literature," *Journal of Business Communication* (43) 4, pp. 344-366.

Bjørn, P. and O. Ngwenyama (2009) "Virtual Team Collaboration: Building Shared Meaning, Resolving Breakdowns and Creating Translucence," *Information Systems Journal* (19) 3, pp. 227-253.

Bradner, E., G. Mark, and T. D. Hertel (2005) "Team Size and Technology Fit: Participation, Awareness,and Rapport in Distributed Teams," *IEEE Transactions on Professional Communication* (48) 1, pp. 68-77.

Burch, G. J. and N. Anderson (2004) "Measuring Person-Team Fit: Development and Validation of the Team Selection Inventory," *Journal of Managerial Psychology* (19) 4, pp. 406-426.

Carlson, J. R. and J. F. George (2004) "Media Appropriateness in the Conduct and Discovery of Deceptive Communication: The Relative Influence of Richness and Synchronicity," *Decision and Negotiation* (13) 2, pp. 191-210.

Cartwright, D. and A. Zander (1968) *Group Dynamics: Research and Theory*, 3rd edition. Evanston, IL: Row, Peterson, and Co.

Daft, R. L. and R. H. Lengel (1986) "Organizational Information Requirements, Media Richness and Structural Design," *Management Science* (32) 5, pp. 554-571.

DeLuca, D. and J. S. Valacich. (2005) "Outcomes from Conduct of Virtual Teams at Two Sites: Support for Media Synchronicity Theory." in *Proceedings of the 38th Annual Hawaii International Conference on System Sciences*. Hawaii, *2005*.

DeLuca, D. and J. S. Valacich (2006) "Virtual Teams in and out of Synchronicity," *Information Technology & People* (19), pp. 323-344.

Dennis, A. R., R. M. Fuller, and J. S. Valacich (2008) "Media, Tasks, and Communication Processes: A Theory of Media Synchronicity," *MIS Quarterly* (32) 3, pp. 575-600.

Dennis, A. R. and J. S. Valacich. (1999) "Rethinking Media Richness: Towards a Theory of Media Synchronicity." in *Proceedings of the 32nd Annual Hawaii International Conference on System Science*. Hawaii, *1999*.

DeSanctis, G. and M. S. Poole (1994) "Capturing the Complexity in Advanced Technology Use: Adaptive Structuration Theory," *Organization Science* (5) 2, pp. 121-147.

El-Shinnawy, M. and M. L. Markus (1997) "The Poverty of Media Richness Theory: Explaining People's Choice of Electronic Mail Vs. Voice Mail," *International Journal of Human-Computer Studies* (46) 4, pp. 443-467.

Figl, K. (2007) "Media Choice in Students' Communication." in *Proceedings of the World Conference on Educational Multimedia, Hypermedia & Telecommunications (ED-MEDIA)*. Vancouver, *2007*.

Figl, K. (2008) "Exploring the Effects of Communication Frequency and Media Choice on Team Climate in Student Teams." in *Proceedings of the World Conference on Educational Multimedia, Hypermedia & Telecommunications (ED-MEDIA)*. Vienna, *2008*.

Figl, K. (2010) "A Systematic Review on Developing Team Competencies in Information Systems Education," *Journal for Information Systems Education* (21) 3, pp. 323-338.

Gamero, N., V. González-Romá, and J. M. Peiró (2008) "The Influence of Intra-Team Conflict on Work Teams' Affective Climate: A Longitudinal Study," *Journal of Occupational & Organizational Psychology* (81) 1, pp. 47-69.

Gibson, C. B. and J. L. Gibbs (2006) "Unpacking the Concept of Virtuality: The Effects of Geographic Dispersion, Electronic Dependence, Dynamic Structure, and National Diversity on Team Innovation," *Administrative Science Quarterly* (51) 3, pp. 451-495.

González-Romá, V., L. Fortes-Ferreira, and J. M. Peiró (2009) "Team Climate, Climate Strength and Team Performance. A Longitudinal Study," *Journal of Occupational and Organizational Psychology* (82) 3, pp. 511-536.

Goodhue, D. L. and R. L. Thompson (1995) "Task–Technology Fit and Individual Performance," *MIS Quarterly* (19) 2, pp. 213–236.

Gravetter, F. J. and L. B. Wallnau (2008) *Statistics for the Behavioral Sciences*, 8th edition. Belmont: Wadsworth Publishing.

Greenberg, J. (1987) "The College Sophomore as Guinea Pig: Setting the Record Straight," *The Academy of Management Review* (12) 1, pp. 157-159.

Hackman, J. R. (1990) *Groups That Work (and Those That Don't)*. San Francisco: Jossey-Bass.

Hertel, G., S. Geister, and U. Konradt (2005) "Managing Virtual Teams: A Review of Current Empirical Research," *Human Resource Management Review* (15) 1, pp. 69-95.

Hirst, G. and L. Mann (2004) "A Model of R&D Leadership and Team Communication: The Relationwhip with Project Performance," *R&D Management* (34) 2, pp. 147-160.

Hoegl, M. and K. P. Parboteeah (2006) "Team Reflexivity in Innovative Projects," *R&D Management* (36) 2, pp. 113-125.

Hollingshead, A. B. and J. E. McGrath (1995) "Computer-Assisted Groups: A Critical Review of the Empirical Research," in R. A. Guzzo and E. Salas (Eds.) *Team Effectiveness & Decision-Making in Organizations*. San Francisco, CA: Jossey-Bass, pp. 46-78.

Howe, J. G. (1977) "Group Climate: An Exploratory Analysis of Construct Validity," *Organizational Behavior & Human Performance* (19) 1, pp. 106-125.

Johnson, D. and F. Johnson (2006) *Joining Together – Group Theory and Group Skills*, 9th edition. Boston: Pearson.

Kauffeld, S. (2001) *Teamdiagnose*. Göttingen: Hogrefe.

Kauffeld, S. (2004) *Fragebogen Zur Arbeit Im Team*. Göttingen: Hogrefe.

Kauffeld, S. and E. Frieling (2001) "Der Fragebogen Zur Arbeit Im Team (F-a-T)," *Zeitschrift für Arbeits- und Organisationspsychologie* (45) 1, pp. 26-33.

Kiesler, S. and L. Sproul (1992) "Group Decision Making and Communication Technology," *Organizational Behavior and Human Decision Processes* (52) 1, pp. 96-123.

Klein, K. J., A. Buhl Conn, D. B. Smith, and J. Speer Sorra (2001) "Is Everyone in Agreement? An Exploration of within-Group Agreement in Employee Perceptions of the Work Environment," *Journal of Applied Psychology* (86) 1, pp. 3-16.

Kock, N. (2005) "Media Richness or Media Naturalness? The Evolution of Our Biological Communication Apparatus and Its Influence on Our Behavior toward E-Communication Tools," *Professional Communication, IEEE Transactions on* (48) 2, pp. 117-130.

Köhler, T. (1999) "Sozialwissenschaftliche Theorien Und Befunde Zur Computervermittelten Kommunikation," in W. Frindte and T. Köhler (Eds.) *Kommunikation Im Internet*. Frankfurt am Main: Lang, pp. 137-182.

Körner, M. (2010) "Interprofessional Teamwork in Medical Rehabilitation: A Comparison of Multidisciplinary and Interdisciplinary Team Approach," *Clinical Rehabilitation* (24) 8, pp. 745-755.

Lewin, K., R. Lippitt, and R. White (1939) "Patterns of Aggressive Behavior in Experimentally Created Social Climates," *The Journal of Social Psychology* (10) 2, pp. 269-299.

Loo, R. (2003) "Assessing "Team Climate" in Project Teams," *International Journal of Project Management* (21) 7, pp. 511-517.

Marks, M. A., J. E. Mathieu, and S. J. Zaccaro (2001) "A Temporally Based Framework and Taxonomy of Team Processes," *The Academy of Management Review* (26) 3, pp. 356-376.

Maruping, L. M. and R. Agarwal (2004) "Managing Team Interpersonal Processes through Technology: A Task–Technology Fit Perspective," *Journal of Applied Psychology* (89) 6, pp. 975–990.

Maznevski, M. L. and K. M. Chudoba (2000) "Bridging Space over Time: Global Virtual Team Dynamics and Effectiveness," *Organization Science* (11) 5, pp. 473-492.

Miranda, S. M. and C. S. Saunders (2003) "The Social Construction of Meaning: An Alternative Perspective on Information Sharing," *Information Systems Research* (14) 1, pp. 87–106.

Murthy, U. and D. Kerr (2003) "Decision Making Performance of Interacting Groups: An Experimental Investigation of the Effects of Task Type and Communication Mode," *Information & Management* (40) 5, pp. 351-60.

Phillips, G. M. and G. M. Santoro (1989) "Teaching Group Discussion Via Computer-Mediated Communication," *Communication Education* (38) 2, pp. 151-61.

Pirola-Merlo, A., C. Härtel, L. Mann, and G. Hirst (2002) "How Leaders Influence the Impact of Affective Events on Team Climate and Performance in R&D Teams," *The Leadership Quarterly* (13) 5, pp. 561-581.

Podsakoff, P. M., S. B. MacKenzie, J.-Y. Lee, and N. P. Podsakoff (2003) "Common Method Biases in Behavioral Research: A Critical Review of the Literature and Recommended Remedies," *Journal of Applied Psychology* (88) 5, pp. 879–903.

Potter, R. E. and P. A. Balthazard (2002) "Virtual Team Interaction Styles: Assessment and Effects," *International Journal of Human-Computer Studies* (56) 4, pp. 423-443.

Powell, A., G. Piccoli, and B. Ives (2004) "Virtual Teams: A Review of Current Literature and Directions for Future Research," *SIGMIS Database* (35) 1, pp. 6-36.

Robert, L. P. and A. R. Dennis (2005) "Paradox of Richness: A Cognitive Model of Media Choice," *IEEE Transactions on Professional Communication* (48) 1, pp. 10-21.

Roberts, T. L., P. H. Cheney, and P. D. Sweeney (2002) "Project Characteristics and Group Communication: An Investigation," *IEEE Transactions on Professional Communication* (45) 2, pp. 84-98.

Robey, D., K. Huoy Min, and C. Powers (2000) "Situated Learning in Cross-Functional Virtual Teams," *IEEE Transactions on Professional Communication* (43) 1, pp. 51-66.

Rocco, E. (1998) "Trust Breaks Down in Electronic Contexts but Can Be Repaired by Some Initial Face-to-Face Contact." in *Proceedings of the SIGCHI conference on Human factors in computing systems*. Los Angeles, California, United States*, 1998*.

Rutkowski, A.-F., C. Saunders, D. Vogel, and M. van Genuchten (2007) "Is It Already 4 A.M. In Your Time Zone?," *Small Group Research* (38) 1, pp. 98-129.

Saunders, C. S. and M. K. Ahuja (2006) "Are All Distributed Teams the Same? Differentiating between Temporary and Ongoing Distributed Teams," *Small Group Research* (37) 6, pp. 662-700.

Short, J., E. Williams, and B. Christie (1976) *The Social Psychology of Telecommunications*. New York: Wiley.

Sivunen, A. and M. Valo (2006) "Team Leaders' Technology Choice in Virtual Teams," *IEEE Transactions on Professional Communication* (49) 1, pp. 57-68.

Stewart, G. L. and M. R. Barrick (2000) "Team Structure and Performance: Assessing the Mediating Role of Intrateam Process and the Moderating Role of Task Type," *The Academy of Management Journal* (43) 2, pp. 135-148.

Tannenbaum, S. I., R. L. Beard, and E. Salas (1992) "Team Building and Its Influence on Team Effectiveness : An Examination of Conceptual and Empirical Developments," in *Issues, Theory, and Research in Industrial/Organizational Psychology*. New York: Elsevier, pp. 117-153.

Tse, H. H. M., M. T. Dasborough, and N. M. Ashkanasy (2008) "A Multi-Level Analysis of Team Climate and Interpersonal Exchange Relationships at Work," *The Leadership Quarterly* (19) 2, pp. 195-211.

van Vianen, A. E. M. and C. K. W. De Dreu (2001) "Personality in Teams: Its Relationship to Social Cohesion, Task Cohesion, and Team Performance," *European Journal of Work & Organizational Psychology* (10) 2, pp. 97-120.

Walther, J. B. (1996) "Computer-Mediated Communication: Impersonal, Interpersonal and Hyperpersonal Interaction," *Human Communication Research* (23) 1, pp. 3-43.

Walther, J. B. and U. Bunz (2005) "The Rules of Virtual Groups: Trust, Liking, and Performance in Computer-Mediated Communication," *Journal of Communication* (55), pp. 828-846.

Watson-Manheim, M. B. and F. Bélanger (2007) "Communication Media Repertoires: Dealing with the Multiplicity of Media Choices," *MIS Quarterly* (31) 2, pp. 267-293.

Wells, C. E. (2002) "Teaching Teamwork in Information Systems," in E. B. Cohen (Ed.) *Challenges of Information Technology Education in the 21st Century*. Hershey, PA: Idea Group Publishing, pp. 1-24.

West, M. A. (1994) *Effective Teamwork*. Exeter: BPC Wheatons Ltd.

West, M. A. (1996) "Reflexivity and Work Group Effectiveness: A Conceptual Integration," in M. A. West (Ed.) *Handbook of Work Group Psychology*. Chichester, England: Wiley, pp. 555–579.

Wong, R. M. and C. Dalmadge. (2004) "Media Choice for Complex and Knowledge-Intensive Processes." in *Proceedings of the 37th Hawaii International Conference on System Sciences*. Hawaii*, 2004*.

Yoo, Y. and M. Alavi (2001) "Media and Group Cohesion: Relative Influences on Social Presence, Task Participation, and Group Consensus," *MIS Quarterly* (25) 3, pp. 371-390.

Appendix A: Questionnaire

Dear Students,

Thank you for taking the effort to fill out the questionnaire! This questionnaire is used

exclusively for research purposes about teamwork in the studies and therefore is analyzed

anonymously and of course, has no effect on your grade!

General Data

How old are you? _____

Please indicate your sex. _____

How many semesters have you completed? _____

Subjective Performance

	very bad	bad	average	good	very good
I perceived the achievement of our team as…	○	○	○	○	○
I perceived the collaboration of our team as…	○	○	○	○	○

What kind of feedback would you give to your teammates? (We do not forward the feedback,

but we encourage you to communicate it to your colleagues.) _____

Team Communication

In which ways and how often did you communicate with your team over the course of the

term?

	never	less frequently	once a month	once a week	several times a week	daily
E-mail	○	○	○	○	○	○
F2F meetings (besides course)	○	○	○	○	○	○
Phoning	○	○	○	○	○	○
Texting	○	○	○	○	○	○

Instant messaging (ICQ, MSN Messenger, etc. . . .)	○	○	○	○	○	○
Forum	○	○	○	○	○	○

Evaluation of Teamwork

Below you find several dimensions in which teams can be characterized on two opposed

poles. Please indicate how much these statements apply to the team, of which you were a part

during the course.

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Please refer to the copyright owner (Hogrefe) or contact the author of the questionnaire

directly (s.kauffeld@tu-bs.de).

Appendix B: Correlations of Team Climate, Performance, and Communication with Control Variable Team Size

	Team Size
Team climate	
Task orientation	-.111
Social orientation	.011
Team performance	
Subjective performance	-.063
Objective performance	.040
Communication	
Overall communication frequency	.101
Synchronicity index	.130
Focus on F2F instead of online communication	-.137
E-mail	-.061
F2F	.023
Phone	.113
Texting	.181
Instant messaging	.189

Appendix C: Intercorrelations of Communication Media Use

	Synchronicity index	E-mail	F2F	Phone	Texting	Instant messaging
Overall communication frequency	.995**	.498**	.836**	.823**	.679**	.726**
Synchronicity index	-	.450**	.847**	.830**	.678**	.725**
E-mail	.450**	-	.394**	.339*	.267	.254
F2F	.847**	.394**	-	.735**	.403**	.515**
Phone	.830**	.339*	.735**	-	.568**	.343*
Texting	.678**	.267	.403**	.568**	-	.349*
Instant messaging	.725**	.254	.515**	.343*	.349*	-

Note. $n = 50$ teams.
* $p < .05$. ** $p < .01$. *** $p < .001$.