

# COLLABORATING GLOBALLY: CULTURE AND ORGANIZATIONAL COMPUTER-MEDIATED COMMUNICATION

*Completed Research Paper*

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## **Abstract**

*Culture shapes interpersonal communication. However, little is known about how culture interacts with computer-mediated communication (CMC) tools in a business context. We present a large-scale empirical study of cultural differences in computer mediated social interactions in a global company. Our dataset includes 9,000 volunteer users and more than 20 million records of their email and Instant Messaging conversations. We compared social network characteristics, preferences for CMC tools, and expression of sentiment across employees working in seven countries. Significant differences emerged and the patterns are consistent with the inherent cultural characteristics as suggested by cultural theories. In addition, we uncover the complex manner in which culture interacts with preference and use of different communication mediums. The existence of pervasive and complex cultural differences, points to the need to understand and account for such differences in designing cross-cultural collaborative systems.*

**Keywords:** cultural studies, computer-mediated communication (CMC), social interaction, social networks, organizational communication, Instant Messaging (IM), calendaring, sentiment analysis.

## **Introduction**

The tools we are designing for collaborative work should be addressing barriers in cross-cultural interactions (Ishii 1993). In the context of globalization, cultural differences appear across diverse ethnic groups, cultural orientations, value systems, economic mechanisms, and political ideologies, thus bringing tremendous challenges in cross-cultural collaboration.

Compared to the potential richness of this topic, prior work is limited in both scale and methodology, thus leaving a large area unexplored. For example, Kayan et al. (2006) surveyed the preferences of Asian users with respect to different Instant Messaging (IM) functions, such as multi-party chat, audio-video chat, and emoticons, relative to American users. However, most of these findings were derived from surveys and lab experiments, leaving open the question of their generalizability to practical and more complex contexts. In addition, prior research is also limited to comparing East vs. West culture broadly, thus little is known about the more nuanced differences among individual countries that have been suggested by cultural research (e.g., Matsumoto et al. 1998; Naumov 1996).

We present a large-scale empirical study investigating cultural differences in social interactions through computer-mediated communication (CMC) tools, in a giant global company. Our dataset includes 9,000 volunteer users and more than 20 million records of their email and Instant Messaging conversations. This unique dataset allows us to empirically investigate cultural differences when users adopt CMC tools in a global company, in which users share a comparable corporate culture and business environment across multiple nations.

We examine three interrelated aspects regarding the structure of social interaction through CMC tools: 1) the number and distribution of one's social contacts within the organization; 2) preferences for different CMC tools; and 3) expression of sentiment. Our analysis quantitatively reveals a variety of significant differences across cultures in all three aspects and suggests designing CMC tools to accommodate culturally specific characteristics in people's social interactions and collaborations.

This paper is organized as follows. First we briefly review cultural theories and cultural studies in Information Systems (IS), through which we derive several high-level hypotheses to guide our exploration. We then introduce our datasets and methods of analysis. We present results regarding the effect of culture on three aspects of social interaction, and lastly discuss the design implications of our findings.

## **Literature Background**

### ***Cultural Differences and Cultural Studies***

In cultural sociology and psychology, Western and East Asian cultures are often contrasted as one demonstrating a more analytic pattern and the other a more holistic pattern. Thus, Westerners tend to be context-independent, more narrowly focused, and use formal logic, while East Asians are context-dependent, broadly focused, situational, and dialectical (Nisbett et al. 2001; Varnum et al. 2010). This difference corresponds to the cultures' social orientation (independence vs. interdependence): Western cultures value independence, individualism, autonomy, and self-achievement (Hofstede 1980); in contrast, Asian cultures emphasize interdependence, harmony, relatedness, and connection (Hofstede 1983; Singelis 1994; Triandis 1995).

The covariation between cognitive patterns and social orientation is widely supported in the literature (e.g., Markus and Kitayama 1991; Nisbett et al. 2001), while the causal relationships and the links with other generic differences are still puzzling. For example, these Western and East Asian cultural groups significantly differ in their value systems (Aristotelian vs. Confucian intellectual traditions) (Lloyd 1996; Pye 1985), languages (Varnum et al. 2010), and religions (Dollinger 1988). Further, research has found many other important factors that can interact with social orientation and thus cognitive style, such as political systems (Greenfield et al. 2003), economic ideology (Ralston et al. 2007), and industrialization and geographic mobility (Kitayama et al. 2009).

Some research has started to explore cultural differences within these cultural groups. For example, East Europeans (Russians) are more interdependent and holistic than Americans (Matsumoto et al. 1998) and Germans (Grossmann 2009; Naumov 1996). Croats are also more interdependent and holistic than Americans (Varnum et al. 2008). Within Asia, cultures of individual countries also differ. Japan, as an ethnically and religiously homogeneous society, fosters internal and nationalistic allegiances (George 1992; Howard and Teramoto 1981) and an individualistically oriented economic ideology (Whitehill 1991). Chinese culture is rapidly evolving under the dramatic social transition from socialism to capitalism (Ralston et al. 1995). Although both are categorized into collectivism, China and Japan are featured differently by *guanxi* (Pye 1982) and *wa* respectively in people's social interactions (Alston 1989). In particular, *wa* is more oriented toward group identity and common interests, while *guanxi* encompasses personal ties between an individual and others (Jacobs 1980) that are fostered through the exchanges of favors (Pye 1982) and often cross institutional boundaries (Yang 1994). While India is often grouped with China and other East Asian countries in cross-cultural studies, its culture is rooted in Buddhism and other influences, and in some aspects, e.g. the individualism (Hofstede 1980) and context (Hall 1976; Hall and Hall 1990) dimensions, falls in-between the US and China.

### **Cultural Dimensions and Social Pattern**

High- and low-context is the primary cultural dimension that is associated with people's information processing and social patterns. As described by Hall (1976), high-context cultures are characterized by less verbally explicit communication and more reliance on internalized understanding. Members of high-context cultures share situational, rational, and context-based knowledge, and they frequently express in an indirect and nonverbal style (Ting-Toomey 1988). On the contrary, people from low-context cultures share codified, external, and transferable knowledge, and use an explicit communication style.

High- and low-context communication styles correspond to the social structures where people reside. High-context cultures tend to develop close, long-term, and multifaceted relationships. Within such relationships, high-context information can be assumed and further enhanced, and high boundaries among groups are created. On the other hand, members in low-context cultures more easily communicate across boundaries with explicit and external information, and tend to establish short-term relationships (Hall 1976; Hall and Hall 1990). As mentioned, a low-context cognition pattern is often associated with a more individualistic social orientation; thus, members of low-context cultures place more value on independence, and groups are loosely bounded. As such, people build individual-based relationships and they readily create new connections and cross social groups. Therefore, members of individualistic cultures tend to be more sociable with their individualistic orientation, explicit communication style, and minimal group identities and boundaries (Triandis 1989).

In addition, several other dimensions have been identified to measure culture: power distance, individualism, masculinity, uncertainty avoidance, time orientation, and long-term orientation (Hall 1976; Hall and Hall 1990; Hofstede 1983; Hofstede and Bond 1988). With regard to the most relevant dimensions to the present study, high-context cultures are often associated with high tolerance for uncertainty and a polychronic time orientation (Hall 1973). In particular, cultures accepting uncertainty present higher tolerance on ambiguous situations, and require fewer rules. Cultures with polychronic time value social interactions over tasks, and favor multitasking and are highly susceptible to interruptions. Oppositely, monochronic time cultures perceive time as linear and compartmentalized, and value commitment and punctuality.

Hofstede indexed over 60 countries based on these cultural dimensions, and found that although the differences between the Western and East Asian cultures generally exist, there are interesting and complex variances within these general cultural groups (Hofstede 2009). For example, as a traditional East Asian country, Japan possesses high-context and long-term orientation similar to China and South Korea, but presents a very high tendency of uncertainty avoidance even over many Western countries such as the United States and Germany. India is another case with mixed identity. India shares similar medium level of individualism as Japan, and presents very low uncertainty avoidance similar to China. This suggests that countries like Japan and India are more likely to fall along the continuum between the two extreme ends of these dimensions. The variety and inconsistency among these dimensions requires examining cultural differences on the national level and motivates us to understand how these complex cultural traits can shape computer mediated social interactions.

## **Cultural Studies in Information Systems**

Cultural studies in Information Systems have generally followed the above literature and mainly focused on the adoption and usage of collaboration tools between Western and East Asian cultures. For example, Asian users have been found to prefer features that support high-context communication: they prefer multi-party chat, audio-video chat, and emoticons in Instant Messaging (IM) (Kayan et al. 2006), benefit more from rich communication media in negotiation (Veinott et al. 1999), and tend to be less satisfied with asynchronous communication (Massey et al. 2001). Another study also found that Chinese managers tend to maintain a higher “bandwidth” using IT and rely on multiple cues and implicit contexts (Teng et al. 1999).

A few studies have also revealed cultural differences in people’s social and collaborative processes. For example, in a lab-experiment, American pairs viewed the collaborative task as an exercise in situation-specific compromise, while Chinese pairs perceived it as a consensus-reaching process (Setlock et al. 2004). The cultural differences might interact with specific social interaction contexts. The same study found that Chinese pairs talked more than American pairs in face-to-face interaction settings, and the differences were minimal when they conversed via IM. In contrast, another experimental study conducted by Wang et al. (2009) found that Chinese participants talked less than Americans in a brainstorming task through video and text chat. Similarly, Yang et al. (2010) in a study comparing three major Community-based Question-Answering (CQA) sites across countries, found that users of the American site Yahoo! Answers tend to be more active in replying to questions and the Q&A interactions tend to be more conversational than on the Chinese site Baidu Knows (zhidao.baidu.com). Despite the complexity of their social behavior, members of high-context cultures value social purposes and involve important social considerations during their information processes, for example, choosing an appropriate medium for communication tasks (Setlock and Fussell 2010) and motivating social Q&A behavior (Yang et al. 2011).

However, most of these studies did not include large-scale observation in culturally diverse and otherwise complex contexts. They are also limited in their comparison of East vs. West, thus little is known about the more nuanced differences among individual countries that have been suggested by cultural research (e.g., Matsumoto et al. 1998; Naumov 1996). Our unique dataset provides an invaluable opportunity to empirically investigate cultural differences in people’s social interactions through CMC tools in real business practice.

## **Hypotheses**

Our analysis is framed along three primary aspects regarding people’s social interaction through CMC tools in an organizational setting: 1) structure: the size and distribution of one’s social network; 2) channel: the preferences for different CMC tools; and 3) content: expression of sentiment. This study is primarily exploratory in its examination of national cultural differences over these three dimensions. However, prior cross-cultural research has suggested a few major directions for our exploration. In particular, high- and low-context and collectivism versus individualism are two primary and well-constructed cultural dimensions, based on which we derive several high-level hypotheses. In addition, other dimensions such as uncertainty avoidance, time orientation, and power distance are also taken into consideration.

### **H1: Size and distribution of social network.**

The size and distribution of a person’s social network are two important properties, indicating the structural pattern and capacity in social interactions. These properties have important implications for understanding individual sociability, strength and influence of social ties, and efficiency of communication structure.

The size of a social network is one measure of sociability. As discussed previously, low-context cultures are associated with an explicit communication style, open grouping pattern, and short-term and low-commitment relationships, while individuals in high-context cultures maintain high commitment and boundaries. This suggests that people in low-context cultures might readily build new social contacts with strangers, develop larger but loosely-bonded social networks. In contrast, Asians (high-context) might be

expected to maintain smaller but long-term networks (Hall 1976; Hall and Hall 1990; Triandis 1989). In addition, the newly emerging theory of residential mobility argues that people in mobile societies tend to have larger social networks, but the relationships are more volatile than in more stable cultures (Kitayama et al. 2009; Oishi 2010). The high- vs. low-context and mobility factors might interact with each other. Geographic mobility is associated with the degree of openness and industrialization of a society, and countries like China would have a lower social mobility than developed countries such as the United States (Kitayama et al. 2009; Oishi 2010). Integrating all these factors, we hypothesize that people from low-context countries such as the United States and the United Kingdom tend to acquire more social contacts (have a larger social network); people from high-context and low mobility countries like China and India would maintain smaller size of social networks, while countries like Japan might lie in between the two extremes on this dimension.

Low context cultures tend to employ function-based classification of social relationships (e.g., lover, boy- or girlfriend, best friend, close friend, chum, colleagues). In contrast, high-context cultures (Japanese) tend to have a steep categorization based on intimacy levels: in-groups, acquaintances, and strangers (Lewin 1984). High-context interactions would foster long-term, deep, and multifaceted social bonds with in-group members, thus we may expect that high-context people more heavily focus on a few strong ties and thus have a more skewed distribution of communication frequencies over all social contacts.

## **H2: Preference over CMC tools.**

Communication in high-context cultures is characterized as polychronic, highly distractible, and requiring high-context information. It is oriented toward social relationships and less concerned with privacy (Hall 1976; Hall and Hall 1990). Previous studies have found that Asian users prefer features that support high-context communication, for example, they prefer multi-party chat, audio-video chat, and emoticons in IM (Kayan et al. 2006), benefit more from rich communication media in negotiation (Veinott et al. 1999), and tend to be less satisfied with asynchronous communication (Massey et al. 2001). This all suggests that users from high-context cultures would be more likely to prefer IM, as it provides semi-asynchronous communication and richer information channels, with lesser concerns about privacy and interruption.

**H2a:** users from high-context cultures tend to use IM more than users from low-context cultures.

People from low-context cultures tend to reduce uncertainty and have monochronic time orientation (Hall 1976; Hofstede 1980). Thus they would make specific plans, compartmentalize time resources, and take time commitment seriously. On the other hand, high-context cultures have high tolerance for uncertainty and ambiguity, and are socially-oriented rather than task-oriented. Thus people in high-context cultures might prefer undefined, relatively arranged, and highly flexible time management. We hypothesize that users of high-context cultures are less likely to use scheduling (collaborative calendaring) tools, which imply a specific and institutionalized time commitment.

**H2b:** users from high-context cultures tend to use Calendar Meeting tools less.

However, as mentioned, Japanese culture exhibits both high-context and high uncertainty-avoidance, so it may be different from other high-context countries like China and India.

In addition, people from high-context cultures may adopt CMC tools more contextually. Interviews conducted by Setlock and Fussell (2010) revealed that when deciding about appropriate communication media, Asian respondents tend to involve more considerations concerning the social process in addition to the information task per se. Therefore we hypothesize:

**H2c:** users from high-context cultures are more likely to differentiate their social contacts by choosing different CMC tools.

## **H3: Sentiments in conversation.**

Sentiment represents an important feature of the content of social interactions. High-context communication relies on implicit and rich nonverbal contextual information. People in such cultures tend to be inward and contemplative, and less expressive of emotions and opinions (Russell and Yik 1996; Song 1985). In addition, driven by collectivistic social orientation, people in high-context cultures tend to

achieve conformity in their interpersonal interactions (Yamagishi et al. 2008), and they are more prevention-regulatory focused, i.e. behave more conservatively (Higgins 1997; Lee et al. 2000). In contrast, people in low-context cultures are more explicit and expressive of self-opinions, consistent with a greater focus on individualism. Thus we would expect to observe a relatively higher level of sentiment expressed in conversations in low-context than in high-context cultural settings.

## Data & Method

### Data

Our empirical study resides in an international company devoted to information technologies and consulting, with 400,000 employees across more than 200 countries. The globalization and specialization of the company provides us with an invaluable environment to explore how cultural differences matter in multinational collaborative work.

Collecting sensitive data about individuals' contact networks and communication is challenging, especially in an organizational context. The data used in this study were acquired from 8,952 volunteer users, who adopted an Intranet service and thus agreed to share their outgoing communication records. To preserve privacy, the original textual content of an email or text message was not saved. Instead, the content is represented as a vector of word frequencies after stemming and stop-word removal. In addition, to precisely capture the social interaction patterns, we removed spam and mass email announcements, leaving us with 20 million emails and text messaging conversations (see Wen and Lin (2010) for more technical details about data preprocessing).

The 8,952 users in our pool can be regarded as being sampled through a snowball method: individuals adopted the service through word-of-mouth referral within the company, and the process was started from the development team. As a result, users in our pool are scattered throughout different divisions and countries. A prior study based on the same dataset, which had fewer sampled users (7,043), compared the network characteristics and job roles of the sampled users to the rest of the firm and found minimal differences between the two distributions (Wu et al. 2009), thus further warranting our sampling method.

We selected a set of countries with sufficiently large numbers of users in the pool for the cross-cultural comparison analysis. Table 1 lists these countries with their abbreviated names and sample sizes, and we indicate their general cultural orientations. These cultural orientations are roughly defined and should generally follow the pattern of low-context and individualism for West and high-context and collectivism for East. However, we only use the general orientation to guide the comparison and we seek to comprehensively explore cultural diversity across countries.

Country	ID	Sample Size	Cultural Orientation
USA	US	2499	West
UK	UK	760	West
Canada	CA	381	West
Germany	DE	684	West
Japan	JP	377	East
China	CN	365	East
India	IN	1352	East

Table 1. Sample description

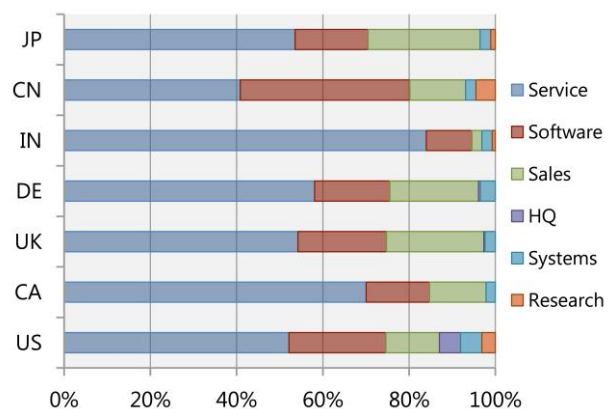


Figure 1. Distribution of divisions across countries

## **Independent Variables**

Our analyses involve a set of independent variables used to predict the presence of cultural differences. We use the country one works in as a proxy of cultural orientation. This will not be accurate for all individuals, e.g. those working in a country that is foreign to them, but it should generally hold. The United States may be an exception in that it has more diverse ethnic backgrounds. We note, however, that this might in fact resemble the actual “culture” of the US.

In addition, we include users’ position in the organizational hierarchy in assessing cultural difference to better understand the interaction between these two variables. To simplify the analysis, we only differentiate users who hold the title of “manager” from those who do not.

## **Dependent Variables**

As introduced, we primarily focus on three major aspects of social interaction through CMC tools in assessing cultural differences: number and distribution of social contacts, preferences over CMC tools, and sentiment expression. We developed a variety of measures to quantify each of these characteristics, which we will describe in more detail below.

### **Social network:**

We investigate the number and distribution of people’s communication contacts through the CMC tools used within the company. A contact is a person one has communicated with (by sending a message)<sup>1</sup> through one of the CMC channels. In particular, the size of one’s social network is defined by the number of contacts one had during a given time range, and we measure the frequency of communication with each contact to quantify how users distribute their communications within their social network.

### **Preferences of CMC tools:**

Three types of CMC tools are involved in our study: email, Instant Messaging (IM), and Calendar Meetings (coordinated through the format of email). We compare individuals’ relative preferences for each tool, in terms of adoption rate and frequency of usage. We will describe detailed measures for each in the Analyses and Results section.

### **Sentiments in conversations:**

Employing keyword frequency statistics, we evaluate the sentiments in people’s conversations. We adopt the subjectivity lexicon used in Wilson et al. (2005), which includes a list of 8,000 subjectivity clues that have been annotated as weakly (strongly) negative or positive. For example, “suggestion” is annotated as weakly positive, “wrong” as weakly negative, “successful” as strongly positive, and “suffering” as strongly negative. At the aggregate level, we calculate the frequency of all subjectivity terms to measure the overall degree of subjectivity of the conversation.

Term-frequency is a simplified method for sentiment analysis, and we recognize that it cannot precisely detect the sentiment of an individual conversation. However, this is sufficient to capture the aggregate sentiment pattern of an individual user, as we are interested in comparing these general differences of users across cultures. In addition, our subjectivity lexicon can only be applied to sentiment patterns in English text. Since English is the primary language in which business is conducted by the company and sentiment can be only reliably compared within a single language, we focus on conversations in English.

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<sup>1</sup> As described in the Data section, the volunteer users agreed to share their outgoing communication records thus only outgoing messages can be analyzed.

## **Confounding Variables and Limitations of the Data**

Controlling confounding variables is challenging for empirical studies. In this study, various methods were used to account for confounding factors. First, one of the most valuable things about this dataset is that it provides a controlled environment where people share a similar educational level, technical literacy, socioeconomic class, and professional context across countries. Second, we tested each of the available demographic variables (e.g., job role, division) on the dependent variables we were measuring, as well as their interaction effect with culture. When possible, we also tested the hypotheses just within a single job role: the group of business consultants who constitute the largest portion in the dataset. We sometimes did observe an effect for these demographic factors on our dependent variables (e.g., company division is related to the size of social network). However, cultural difference is consistently significant across all our dependent measures even while controlling for all these factors. We will report these statistics in the Analyses and Results section.

Due to the difficulty of accessing sensitive data, we could not obtain variables such as age and gender. However, we hand-coded gender for a random sample of users from different countries (around 1.5k users for 4 countries) and we did not find significant gender differences in the dimensions we were measuring (e.g., size of network, communication intensity).

We recognize that this cross-cultural comparison cannot be conducted in a fully controlled environment. Although we did not find significant gender differences in our small-scale test, we cannot exclude that demographic factors like gender and age might play an important role in social interactions. However, consistent with the result in Yang et al. (2011) that culture is the most significant predictor of social Q&A behavior compared to other demographic variables, cultural differences appear robust in our analyses. We are confident that the findings of this study confirm the existence of cultural differences in organizational CMC usage across countries.

## **Analyses and Results**

Our analysis is framed by the three important dimensions of people's social interactions through CMC tools. As expected, cultural differences emerge on all three dimensions across the countries we investigate. In general, countries fall in between the general categories of high-context versus low-context cultures, and they present behavior patterns that are largely consistent with our predictions based on their cultural traits. In addition, we further explore the variances across individual countries and the interactions between culture and other covariates, which are often significant and intriguing too.

### **Basic Characteristics of Social Networks**

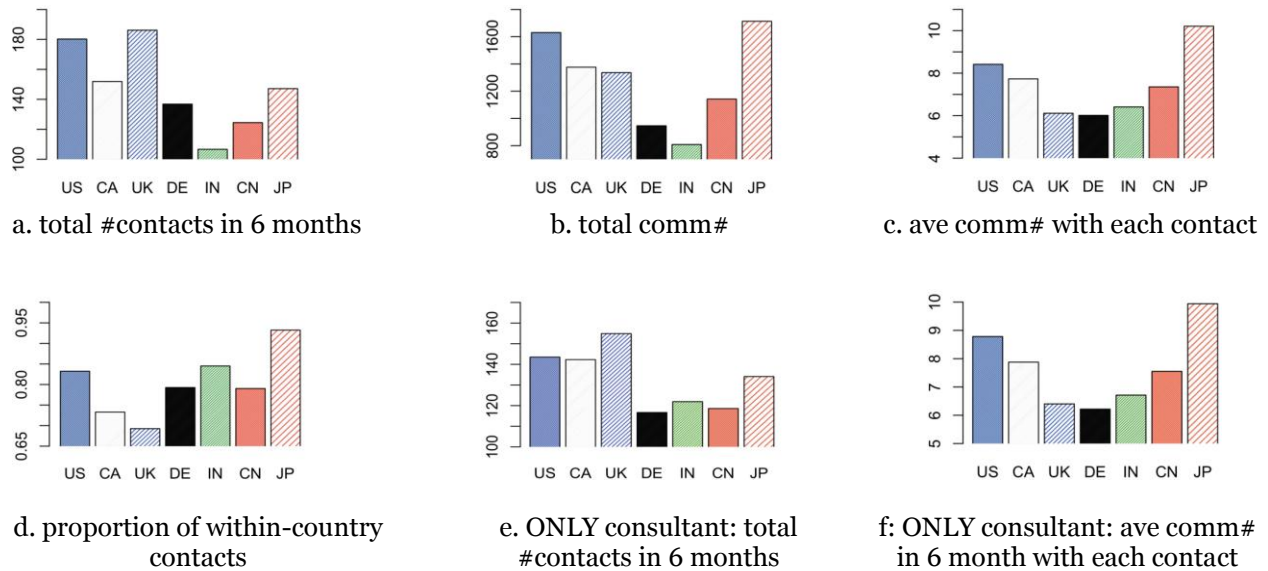
We first characterize the general patterns of individuals' communication and social networks across sampled countries. Figure 2 reports several primary statistics for each country: (a) total number of contacts one has sent messages to within the company (size of one's direct social network), (b) total number of communication instances through all channels (quantity of comm.), (c) average communication frequency (ave.Comm) per contact (note that there is a positive correlation between network size and ave.Comm,  $\rho=0.20$ ,  $p\text{-value}<10^{-15}$ ), and (d) ratio of within-country contacts to all contacts. To control for different durations of records over years, the counts are constrained to a 6-month period in 2008 (Jun~Dec). All regression tests on cultural factor are significant ( $p\text{-value}<10^{-15}$ ) and the results are robust with respect to selection of other time ranges<sup>2</sup>.

First, countries differ in the size of individuals' social networks: US/UK have significantly higher numbers of contacts than other countries and IN/CN have the lowest. DE is an outlier in Western countries, which may imply that Germans tend to be more conservative in developing social relationships. Considering the possible confounding factor of job role to the network size, we ran a regression using corporate division

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<sup>2</sup> We tested time ranges that are different from or overlapping with current selected time range in 2006 and 2008.



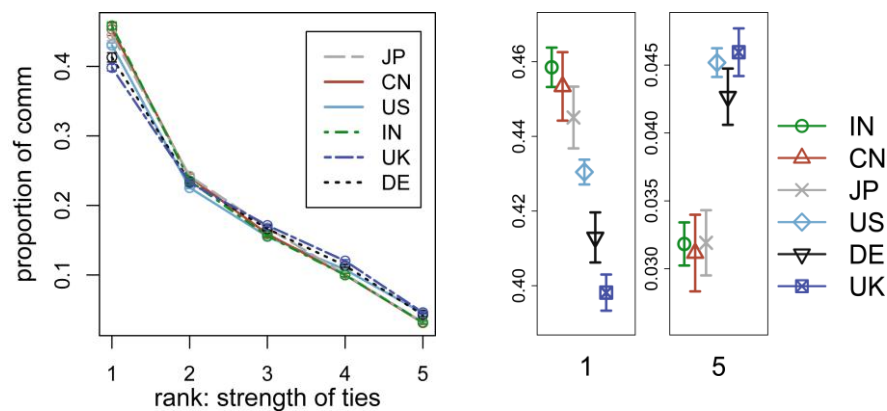


**Figure 2. Basic statistics of social network and communication patterns**

and country to predict network size. The result shows both to be significant ( $R_{\text{division}}^2=0.074$ ;  $R_{\text{country}}^2=0.0419$ ;  $R_{\text{together}}^2= 0.1045$ ;  $p\text{-value}<10^{-15}$ ). To further control for the job-role factor, we ran tests on the subset of users whose job title is consultant and the pattern is preserved (Figure 2.e-f show two examples of statistics for this group).

As mentioned, the number of contacts on the individual level is generally positively correlated with average communication frequency per contact (those who have more social contacts tend to also communicate with each contact more frequently). However, Japanese has the largest average number of communications within relatively smaller networks. In addition, US/CA and UK/DE are differentiated in that Americans and Canadians on average communicated more often with each of their contacts than did the British and Germans.

Notably, Western countries, in particular CA/UK, show a stronger tendency to acquire cross-country contacts (Figure 2.d). The US falls between Western and Eastern countries in this respect. One might expect two opposing factors in the proportion of cross-country contacts that Americans have: 1) there are



**Figure 3. Proportion of communication allocated into each group, ranked by communication frequency; right figure is zoomed in for rank1 and rank5 groups**

more people working within the same country, providing more opportunity for within-US communication; 2) as the US hosts the company's headquarters, Americans might hold jobs that require out-of-country communication. Finally, Japanese users have a very high proportion, higher than CN/IN, of within-country contacts, suggesting a greater within-country focus.

We also assess the cultural difference in how people distribute their communications over their social contacts. For each user who had more than 100 contacts during a 6-month range, we rank his/her contacts into 5 ordered groups from highest to lowest communication frequency: the 1~10th, 10~30th, 30~70th, 70~150th, and >150th. That is, the 1~10th group includes those 10 contacts with whom a given individual communicates most. We then examine the proportion of total communication being allocated to contacts of each rank.

As shown in Figure 3, CN/IN/JP present a slightly more skewed distribution than UK/DE, while US is in the middle. The differences among countries are significant in all ranks ( $p\text{-value} < 10^{-15}$ ). This suggests that relative to Western countries, Asian countries tend to communicate more frequently with their closest contacts, while less frequently with their weakest ties.

**Conclusion:** the result is consistent with **H1**. In general, people of low-context cultures such as US/CA/UK tend to develop larger social networks while people from high-context and low mobility countries like CN/IN/JP maintain smaller social networks and tend to be highly focused on their stronger ties. In addition, Germany appears to be different from other Western countries, as Germans tend to be conservative in developing social networks in terms of both size and intensity. Japan is also special in that Japanese tend to maintain higher frequencies of communication and have a strong tendency of making intra-country contacts.

### **Preference of CMC Tools**

As hypothesized, people show different preferences over CMC tools across cultures. In particular, the results support our hypotheses that users from high-context cultures prefer IM (**H2a**), while users from low-context cultures prefer scheduling tools (Calendar Meeting) (**H2b**).

In terms of preference for CMC tools, we quantify the proportion of one's social network that was contacted via each of the three CMC tools. Figure 4 presents a visualization of the pairwise ratios in the numbers of contacts over each communication channel: e.g. between IM and Email, and between Calendar Meeting and IM<sup>3</sup>. The ratios are calculated as:

$$preference_{IM} = \frac{n_{IM}}{n_{allContacts}}, overlapped\_preference_{IM \& Email} = \frac{n_{IM \& Email}}{n_{allContacts}} \quad (\text{Eq 1})$$

High-context countries such as China and India are more likely to use IM to communicate with their contacts, whereas Western countries have very few contacts through IM. Japan is again an exception among Asian countries, as it is the least likely to use IM and shows a preference for communicating through email for most contacts. Comparing Calendar Meetings and IM, we see an opposite usage pattern: users of low-context cultures tend to adopt Calendar Meetings for more contacts.

The preference of CN/IN for IM relative to other countries is significant in terms of both the ratio of contacts via IM (Figure 4) as well as the frequency of communication with each contact via IM (see Figure 5.a.). Since the preference for CMC tools might be affected by the job role one is performing, we examined this difference restricted to the group of business consultants, and we found that although the differences are diminished to some degree, the patterns are consistent (Figure 5.b)<sup>4</sup>.

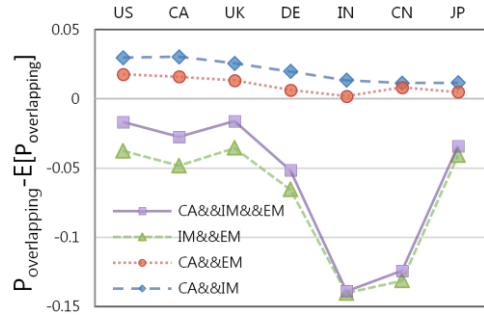
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<sup>3</sup> We use this two-way comparison between each pair of CMC tools because IM and Calendar Meetings involve a much smaller number of contacts than does Email.

<sup>4</sup> The preference of low-context cultures for Calendar Meeting also preserves for the group of business consultants but we only show the IM case in Figure 5.b.



**Figure 4. Relative preferences - ratio of contacts being allocated, between: IM vs. Email, Calendar Meeting vs. IM**



**Figure 6. Deviation of actual overlapping probability from expectation of the probability**

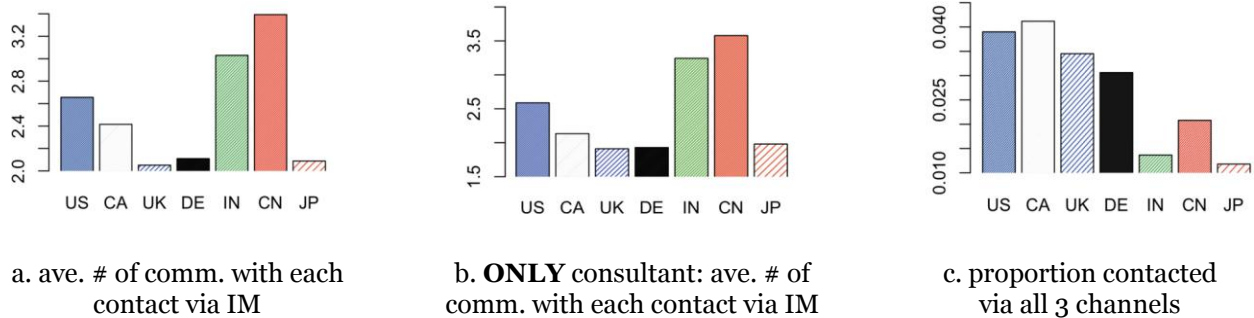
To test H2c, we measure whether people select different communication channels depending on the contact, or whether they use them uniformly. Figure 4 contrasts the proportion of contacts reached by 2 separate communication channels vs. proportion reached by both channels together. Figure 5c shows the proportion of contacts that have been reached via all 3 channels. It is clear that users from low-context cultures (US/CA/UK/DE) tend to have relatively larger overlapping areas than Asian countries.

To precisely quantify the degree of overlap versus divergence of contacts across communication channels, we measure the deviation of the observed overlap from the expected overlapping proportion of contacts one has. For example, if an individual uses email with 4/5<sup>th</sup> of her contacts, and IM with 1/2, then one might expect 4/5 \* 1/2 = 4/10 of them to receive both emails and IMs from this individual. In the 2-way IM vs. Email case we have:

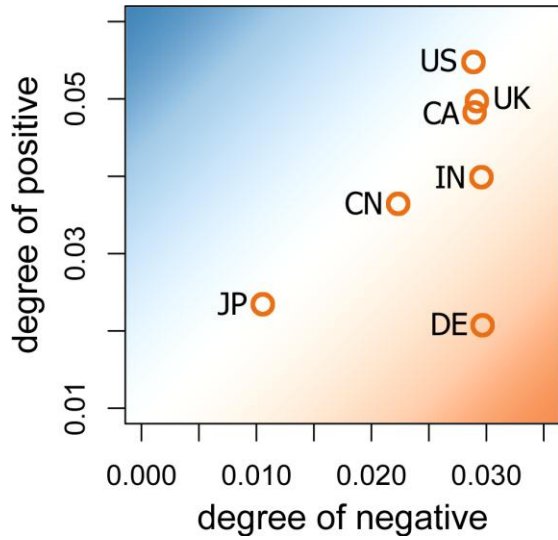
$$P_{observed-overlapping} - E[P_{overlapping}] = P_{IM \& \& Email} - P_{IM} \times P_{Email} \quad (Eq 2)$$

A negative deviation indicates a stronger tendency to differentiate contacts. As shown in Figure 6, countries of low-context cultures US/CA/UK present more overlap in their channel use, while high-context culture countries CN/IN/JP are more likely to choose distinct communication tools for different contacts.

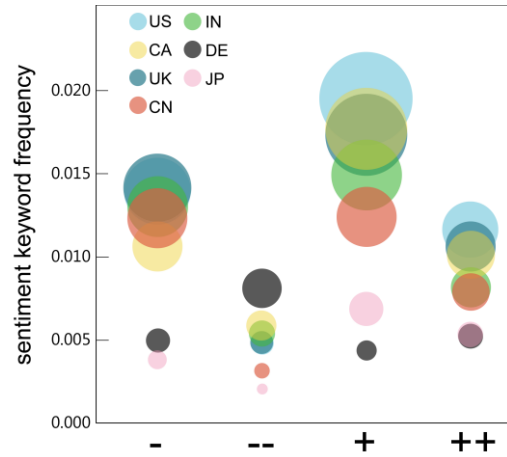
**Conclusion:** as hypothesized, high-context culture countries such as China and India present a strong preference for using IM (H2a), while being less likely to use calendaring tools to schedule meetings than low-context culture countries (H2b). However, Japan is again an exception in that individuals have few IM contacts and use IM infrequently in this organizational context. In addition, low-context culture countries all show a higher tendency to use multiple channels to communicate with the same individuals while users of high-context cultures tend to differentiate contacts by adopting different communication channels (H2c).



**Figure 5. Example statistics for CMC tool preference**



**Figure 7. Frequency of positive vs. negative sentiment.**



**Figure 8. Expression of weak vs. strong sentiment**

### Sentiment in Conversations:

#### Who is more subjective?

In this section, we analyze cultural differences in sentiment patterns. We quantify the degree to which people expressed sentiment in their conversations by calculating the frequencies of sentiment-laden keywords from the subjectivity lexicon in Wilson et al. (2005). As mentioned, the sentiment clues have been annotated as weakly (strongly) negative or positive, and in the figures and tables below we designate them using signs: “-” for weakly negative, “--” for strongly negative, “+” for weakly positive, and “++” for strongly positive.

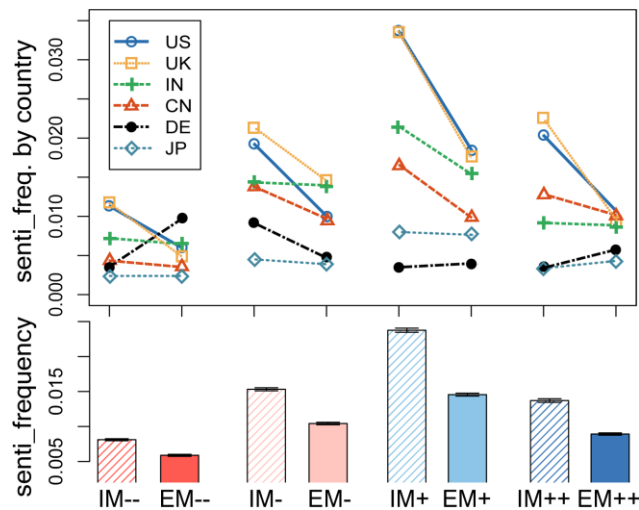
First, we characterize sampled countries into a 2-dimensional chart (Figure 7), along the primary axes of negative versus positive sentiments. For each valence, we take a simplified method to combine the keyword frequencies between weak and strong sentiments:

$$sentimentMeasure = \sum Frequency_{weakKeyword} + 2 \times \sum Frequency_{strongKeyword} \quad (Eq\ 3)$$

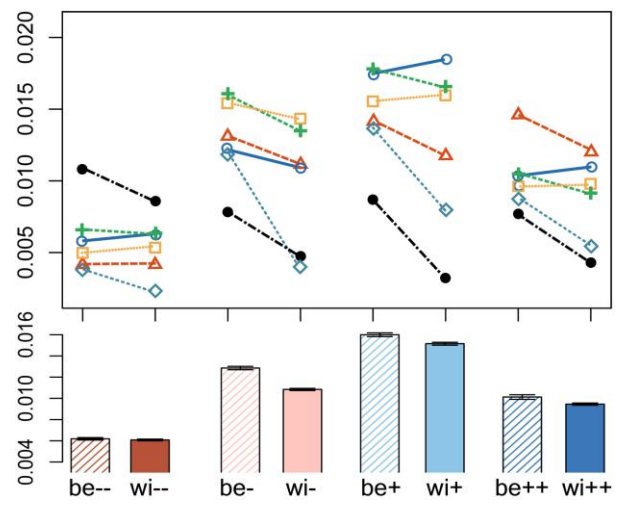
The factor of 2 in the second term assigns twice the weight to words carrying strong sentiment relative to weak sentiment words. Changing this factor only slightly changes the absolute position of each point but not the relative positions of the points to each other. As Figure 7 shows, countries roughly fall into 4 areas: JP uses sentiment-laden words the least, CN/IN are in the middle, and US/UK/CA express the most sentiment (both positive and negative) in their communication. Germany is an outlier that expresses negative sentiment more often than positive.

However, the combined sentiment measure cannot show nuanced differences in the degree of subjectivity. Figure 8 plots the countries according to the average frequencies of the sentiment keywords by valence and strength<sup>5</sup>. Countries are not consistent between weak and strong sentiments. For example, DE is not only the lowest in positive sentiments, but also very low in weakly-negative sentiment. Nevertheless, it is the most frequently strongly negative. UK tends to be intermediate in strongly negative, but the most weakly negative among all countries.

<sup>5</sup> Consistently across all 4 sentiment dimensions, culture is the most significant factor when controlling for individuals’ division and job role. E.g., for “++”:  $R_{culture}^2=0.11$ ,  $R_{division}^2=0.02$ ,  $R_{role}^2=0.04$ .



**Figure 9. Sentiment expression in IM vs. Email by users who had both kinds of conversations**



**Figure 10. Sentiment expression for communication within-country and between-countries.**

**Table 2. p-value: between IM vs. email**

	culture	IM or Email	Interaction term
--	< 2.2e-16 ***	< 2.2e-16 ***	< 2.2e-16 ***
-		< 2.2e-16 ***	
+		0.00089 ***	
++		< 2.2e-16 ***	

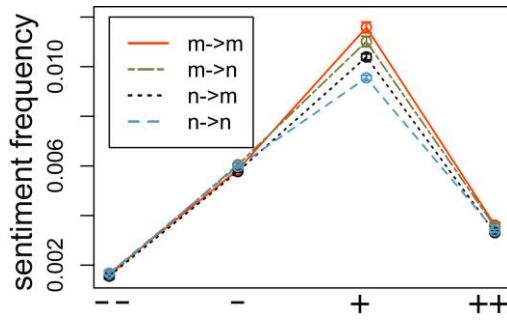
**Table 3. p-value: comparing within-country and between-countries**

	culture	intra vs. inter country	Interaction term
--	< 2.2e-16 ***	0.4563	1.300e-07 ***
-		< 2.2e-16 ***	2.237e-13 ***
+		6.391e-05 ***	< 2.2e-16 ***
++		0.00587 **	1.583e-06 ***

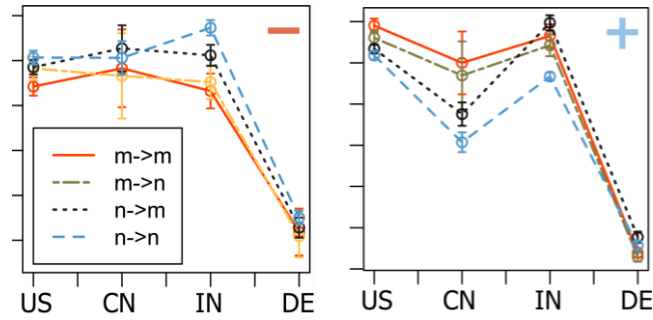
**Sentiments in different communication channels**

Because of the exploratory nature of this study, we are also interested in sentiment patterns broken down by context. As suggested by previous studies, people may present different social interaction patterns in different contexts (e.g., Wang et al. 2009), thus we hypothesize that cultural factors may vary and interact with particular modes of communication.

First, we compare the degree of sentiment expressed in conversations through IM versus Email. They provide different affordances for communication, thus we expect that people would use them differently in terms of both context and communication style. In general, users tend to express higher sentiment levels in their IM conversations than emails (Figure 9, Table 2), as IM is a more informal and conversational communication tool. However, the magnitude, and in one case, direction, of the difference varies across countries. In particular, US/CA/UK share very similar patterns (CA, which is almost identical to the US, has been omitted for clarity): a substantially higher amount of sentiment is expressed in IM than Email. CN/IN/JP show smaller differences between the two channels, and DE has one opposite pattern: strong-negative sentiments are more likely expressed in Email than in IM. The observation that CN/IN/JP have smaller discrepancies in sentiment expression between these two CMC tools might be partially due to their overall lighter use of sentiments than US/CA/UK (especially for Japan); whereas the more significant discrepancies for US/CA/UK may suggest that IM is perceived very differently from email, since it is used only with a very small group of contacts and less frequently than in CN/IN.



**Figure 11. Sentiments of different inter-hierarchy pairs (m = manager, n = non-manager)**



**Figure 12. Weak sentiments of inter-hierarchy by countries**

### Sentiment in cross-country communication

Another direction of comparison is considering whether the communication is occurring within the same country, or is crossing country borders. As shown in Figure 10, between-country communication exhibits higher levels of sentiment on each of the four measures (except for strong-negative), which suggests that people tend to express sentiment more frequently to others who are from a different cultural identity. However, the magnitude of differences is smaller than between IM vs. Email.

The interaction between culture and the inter- versus intra-country variable is consistently significant across all types of sentiments (Table 3). This implies that culture influences sentiment expression differently in different contexts. Interestingly, high-context countries CN/IN/JP and Germany share the same pattern of having significantly higher sentiment levels when communication is with someone in a different country, whereas low-context cultures US/CA/UK present an almost opposite pattern: within-country communications contain slightly more sentiment (except for weak-negative).

There are four potential reasons for the larger discrepancies in high-context cultures (Hall 1976): 1) high boundaries between the in-group and out-group; 2) conservative expression of sentiment in maintaining close relationships; 3) implicitness of sentiment in verbal communication within a group with a well-established and shared context; and lastly but perhaps most importantly, 4) greater likelihood of communicating with others from low-context cultures, thus encouraging adjustment to the more open and explicit communication style. Germans show the largest difference in sentiment expression, being less likely to express sentiment to other Germans. This observation would be an interesting topic of future study.

### Sentiment in cross-hierarchy communication

The last contextual factor we explore is cross-hierarchy communication. There are significant differences in levels of sentiment expressed in conversations between different cross-hierarchy pairs. To simplify, we differentiate 4 types of cross-hierarchy pairings: manager to manager, manager to non-manager, non-manager to manager, and non-manager to non-manager. Figure 11 presents how they differ in the 4 sentiment dimensions. In general, messages from managers tend to be more positive and less negative, and vice versa for messages from non-managers. The difference in weak-positive sentiment is the largest ( $p\text{-value} < 10^{-14}$ ), followed by weak-negative ( $p\text{-value} = 0.02$ ), while differences on strong sentiments tend to be non-significant ( $p\text{-value} \sim 0.2$ ). This trend may be consistent with managers boasting to other managers and rallying their troops.

We further explore whether countries vary on this pattern of differentiating cross-hierarchy pairs. On both the weak sentiment measures, the interaction between culture and organizational hierarchy is also significant (2-way ANOVA: interaction term on weak negative, “-”  $p\text{-value} < 0.01$ ; interaction term on weak



positive, “+” p-value<0.026)<sup>6</sup>. Figure 12 shows that the differences vary across 4 of the countries. In particular, US and India present significant differences across the different job role pairings on both of the two weak sentiment measures. With smaller sample size, India shows a stronger interaction effect than the US (1-way ANOVA on individual country level; IN on weak-negative: p-value<0.001; IN on weak-positive: p-value<10<sup>-4</sup>; compared to US, on weak-negative: p-value<0.05; on weak-positive: p-value<0.001). CN is significant on the weak-positive dimension with the smallest sample size (p-value<0.001) while DE is not significant across all pairs on all dimensions. Although CN’s non-significance on weak-negative might be due to its small sample size, we can see that on the weak-positive dimension Figure 12 shows relatively higher divergence among the different types of pairs for CN and IN, than US and DE. This suggests that IN/CN tend to be more conscious of hierarchy in their communication. This finding might be related to the fact that both China and India all rank very high in power distance index, which indicates a high level of inequality of power and wealth within the society (Hofstede 1983). However, larger sample and more in-depth analyses are required to accurately assess this interesting pattern.

**Conclusion:** our findings on sentiment patterns are generally consistent with **H3**, as users from low-context cultures (e.g., US/CA/UK) tend to express relatively higher level of sentiment in their conversations than people from high-context cultures such as CN/IN/JP. Germans are an exception as they tend to express positive and weak-negative sentiment less frequently than other cultures, but express strong-negative sentiment more often.

Sentiment patterns vary across different communication contexts (e.g., IM versus Email, and inter- versus intra-country conversations), and the patterns also appear to present significant interaction with culture. First, the level of sentiment expressed in IM conversations is generally higher than in emails. On the country level, surprisingly, low-context countries such as US/CA/UK present larger divergences between IM and Email in terms of sentiment level. This might be related to the fact that they use IM only with a very small portion of their social network and communicate with their IM contacts less often, thus they use IM differently than email, e.g. more informally.

In addition, more sentiment is expressed in conversations with between-country colleagues than within-country ones in a general sense. However, users of high-context cultures (CN/IN/JP) and DE show more significant discrepancies in sentiment expression between these two types of communications. This might correspond to CN/IN/JP’s more implicit and subtle in-group communication style and adaption to a more explicit communication style with their out-group (who are likely to be low-context users).

Furthermore, we found significant interaction between culture and hierarchy, which implies that across cultures, sentiment expression varies depending on the position of the individuals in the company hierarchy.

## Discussion

Along the three hypothetical dimensions, we discovered significant cultural differences in an organizational setting: users of high-context cultures (CN/IN/JP) tend to build smaller but more intensive social networks, prefer IM (except for Japan), express less sentiment, vary CMC tools by contact and express different levels of sentiment depending on hierarchy within the relationship. On the other hand, people in low-context cultures (US/CA/UK/DE) are more likely to acquire larger social networks (except for Germany) and communicate with contacts more evenly, prefer scheduling meetings, and present smaller differences in sentiment expression by context. These patterns are generally consistent with the cultural theories we mentioned above and are inherently interrelated with one another. For example, Chinese and Indian users’ preference for IM might be not only due to their high-context, flexible, and more socially oriented need for communication, but also because IM can better support social interactions for their highly focused strong ties. In addition, Asian employees (high-context) behave more contextually when allocating attention to their communication ties, and selecting communication tools depending on relationship.

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<sup>6</sup> Concerning the reliability of ANOVA analysis, sample sizes are all large in this study. In addition, we verified all the significant factors in ANOVA results with regression tests.

Our analyses also reveal interesting discrepancies within Asian and Western culture groups. In general, US/CA are fairly similar, followed by the UK, with Germany differing most from other Western countries. In particular, German employees tend to express the least positive and weak-negative sentiment but the highest amounts of strong-negative sentiment and they tend to be more conservative in developing social networks. On the other hand, CN/IN are highly similar in a variety of aspects, while JP tends to be often an exception among Asian countries. In particular, Japanese users are the least likely to use IM in organizational communications and they express very little sentiment in their conversations. They also show a high differentiation between inter- and intra-country communications in terms of sentiment, which might echo their strong social cohesion and nationalistic allegiance. These findings suggest that there are important individual differences within each cultural group as well as additional dimensions that might co-evolve with culture (e.g., economic ideology or industrialization).

Further, several interesting sentiment patterns have emerged from our exploratory analyses. First, by differentiating weak vs. strong sentiments, we detect variation across countries in terms of degrees of subjectivity in individuals' conversation. Second, IM conversations tend to contain more sentiment words than does email, and messages from managers tend to be more positive while less negative, and vice versa for messages from non-managers.

The interaction between cultural effect and communication context is complex. For example, although CN/IN users were predicted to be more context-dependent, they present smaller discrepancy in sentiment expression between IM and email than Western users. This might be related to Westerners' much smaller portion of contacts through IM and very infrequent usage of IM. In addition, CN/IN use fewer sentiment words in their within-country communications, whereas US/CA/UK present almost the opposite pattern. We might interpret it as that high-context culture users might want/need to communicate with in-group people in a more subtle way, and adapt to a more explicit communication style with out-groups (who are likely to be low-context users). The Germans, who are in a low-context culture, also show very different sentiment patterns in communication to the inter-country contacts compared to the within-country contacts. This might imply that national identity plays an important role in their social interactions. However, more research is required to understand these findings.

### ***Design Implications***

Our study indicates that people present different preferences and styles when using CMC tools in their organizational communications, which can reflect their inherent cultural characteristics. These cultural differences might hinder extensive cross-cultural collaboration. For example, a Chinese employee who has established a working style incorporating use of IM for prompt and negotiable communication with her Chinese colleagues may find it difficult to work with new colleagues from the West. Thus, it is important to recognize these barriers beyond language in designing and conducting collaborative work. In addition, it might be useful to design richer and more contextualized features for IM, to alleviate the concerns over its use (if, e.g., Japanese are more likely to perceive IM as improper interruption in a business context). Similarly, scheduling tools (e.g., calendaring tools) might also require higher flexibility to accommodate high-context culture users. For example, users might want features enabling the invitee to be more involved in scheduling or negotiating, or more diverse levels of formality in response (beyond "accept, decline, propose another time").

Our results also suggest that people in high-context cultures tend to differentiate their social contacts to a higher degree than those in low-context cultures, in terms of communication frequency, choice of CMC tools, and sentiment styles. Thus, it is important to further investigate how each of the CMC tools has been able to and should be better designed to support the specific need for particular types of social interactions, in specific cultural contexts. For example, high-context culture users might desire a more contextualized and personalized tool for contact management and need rich support for intensive social interactions with their strong-tie contacts. On the other hand, low-context culture users might desire tools that support uniform social interactions with their larger sized social networks.

On the perspective of sentiment, we show that cultures differ significantly and that sentiment has complex interactions with other factors such as communication channel and hierarchy relationship. Therefore, designers should recognize these differences and design their systems to foster mutual understanding and respect. For example, in virtual collaboration with foreign colleagues (e.g., sending email, setting up



meetings), one could provide awareness of the cultural background of the group and access to training materials. In addition, when developing products or services that automatically harvest expressed sentiment, cultural differences need to be taken into account.

### **Limitations & Future Work**

Culture is a complex phenomenon. There are always individual differences and differences between subgroups within a culture, thus measures and statistical tests can only capture the aggregate patterns. Further work should examine these findings in detailed field studies. In addition, although our analyses have shown significant differences across cultures that are consistent with the theoretical hypotheses, we cannot exclude the possibility that other factors interact with culture and shape the differences. Furthermore, quantitative analyses cannot provide the rationales behind the data. Therefore, we would like to address these limitations in our future work by conducting surveys and interviews to elicit individuals' rationale in choosing communication media and styles.

The second limitation stems from the setting of the study. While we were able to effectively control for many variables, such as professional context and socioeconomic status, by confining our analysis within a fairly uniform corporate environment, this inevitably limits the generalizability of the results to other kinds of user groups or contexts. In addition, our dataset may not be representative of all communication and social interactions within global companies, but it allows us to address the role of culture in computer-mediated communication for a set of individuals who share similar job roles in an international company.

We should also note that our sentiment analysis could only be applied to sentiment patterns in English. English is the primary language in which business is conducted by the company and it should capture the general sentiment patterns in their cross-cultural collaboration. In addition, sentiment can be only reliably compared within a single language. However, people might express sentiment differently when using a different language and we would like to explore this in our future work.

### **Conclusion**

To our knowledge, this is the first large-scale empirical study of cultural differences in terms of the social interaction patterns through CMC tools in an organizational context. Significant cultural differences emerge around the structures, preferences, and styles in social networking and communication through CMC tools, which echo the inherent cultural characteristics as suggested by cultural theories. These cultural differences can be largely predicted according to primary cultural dimensions: high- and low-context cognitive and communication patterns, individualistic versus collectivistic orientation, time perception, and uncertainty avoidance. Yet our results demonstrate interesting and complex variances across countries even within the same general cultural categories. In addition, we reveal the complex interactions between culture and different communication contexts (e.g., hierarchical relationship, and mode of communication). These important findings would prompt further investigation and design consideration for cultural differences in cross-cultural collaboration.

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