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8-2010

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ABSTRACT

The use of instant messaging (IM) technology at work is controversial, due to the interruptions it may cause and the difficulties associated with quantifying its benefits. In this study, we investigate the use and impact of IM tools in the workplace. Based on the communication performance theories and social network theory, we propose that the use of IM will result in work disturbance, improved communication quality and the establishment of trust between colleagues. These mediating variables will in turn enhance group outcomes. Our research model is validated by a survey of 253 working professionals. The data suggests IM can significantly contribute to communication performance in the workplace, where the benefits overwhelm the work interruption caused. Theoretical and practical implications are discussed.

Keywords

Instant Messaging (IM), Work Interruption, Communication Performance, Communication Quality, Trust, Group Outcomes.
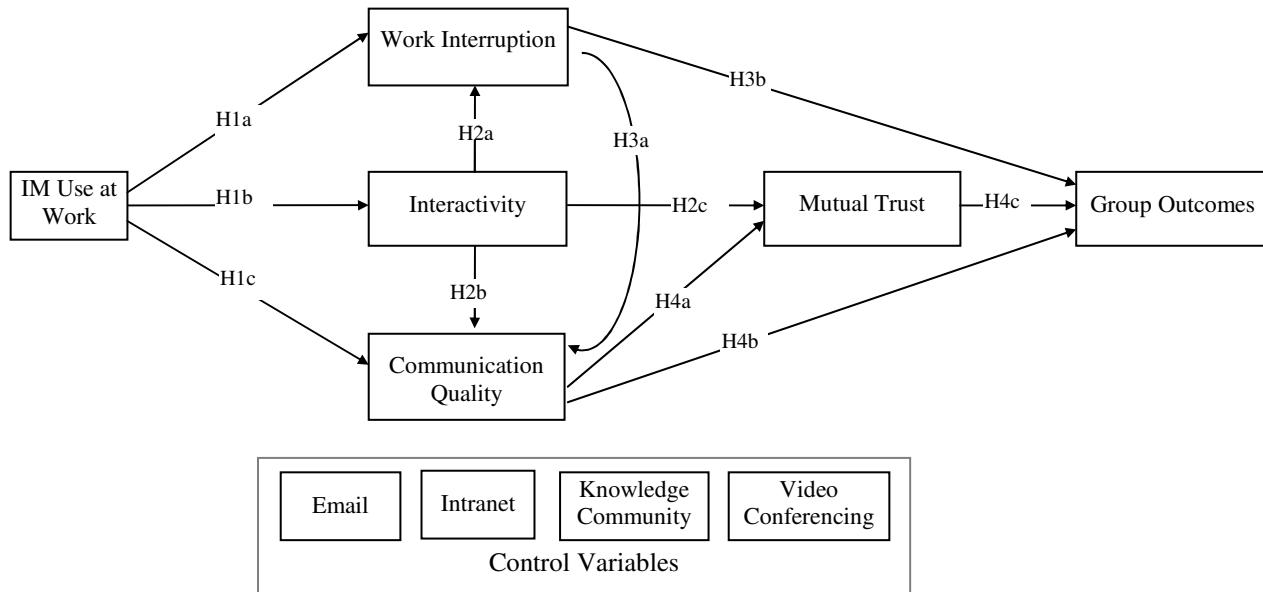
INTRODUCTION

Social networking tools like instant messaging (IM), blogs and wikis are widely adopted in society. Although Deloitte (2009) indicates that these tools are of great interest to companies, they are relatively under-utilized with only 41% of 750 responding companies using these tools at work. The major deterrent to IM application at work is the widespread belief that IM leads to increased interruption and decreased productivity (Nardi et al., 2000; Isaacs et al., 2002). However, recent research (Garrett and Danziger, 2007) suggests that IM users are no more interrupted than non-users. Nevertheless, the benefits that IM can bring to individual employees are as yet unexplored. Given these conflicting and incomplete research results, in this study we draw on social network theory (SNT) and theories of communication performance in a survey-based investigation of the phenomenon. We argue that given the highly interactive nature of IM, work interruptions may occur which may negatively influence both communication quality and the development of trust among colleagues. However, the interactive nature of IM may positively contribute to group outcomes through shaping communication quality and trust. We provide theoretical justifications for and develop hypotheses based on these arguments in the following section. Following a description of the survey method and data analysis, we discuss the findings and suggestions for future research. We conclude this paper with implications and contributions.

THEORETICAL DEVELOPMENT

In prior research on computer mediated communication (CMC), theories of communication performance, such as CMC Interactivity Model (CMCIM) (Lowry et al., 2009) and Media Synchronicity Theory (MST) (Dennis et al., 2008), have been applied to measure the impact of CMC tools on task performance. We adapt this work to measure the significance of IM use at work on shaping group outcomes. The choice of mediators - interactivity and communication quality - is based on CMCIM (Lowry et al., 2009) which proposes that they are influenced positively by CMC technologies. Meanwhile, SNT claims "social networks are based on communication and trust" (Börzel, 1998, p.262). We contend that IM is a powerful CMC tool, often used in the social networking context, that enhances employees' social relationships at work where communication quality and mutual trust are fundamental and high quality group work is the ultimate outcome. In addition to the positive effects of IM use at work, work interruption is a principal construct since we examine its negative influence on social networks. We control for the effects of other CMC tools on social networks, such as email, intranets and knowledge communities. Figure 1 presents the research model. Definitions of principal constructs are provided in Table 1.

Figure 1. Proposed Research Model

Principal Constructs	Definitions	Source
IM Use at Work	The employee's use of IM as a work-related contact and communication tool to ask and answer questions, share files and engage in work-related socialization	(Cho et al., 2005; Quan-Haase et al., 2005)
Work Interruption	IM interaction which is not initiated by the recipient is unscheduled and results in the recipient discontinuing their current work activity	(O'Conaill and Frohlich, 1995; Garrett and Danziger, 2007)
Interactivity	The extent to which an IM user believes that the IM tool enables interlocutors to actively control interactions and message exchange as they interact with each other, and the degree to which the communication is synchronized.	(Lowry et al. 2009; Teo et al., 2003)
Communication Quality	The employee's perception of the quality of communication in terms of being timely, adequate, accurate, complete, interactive and effective	(Mohr and Sohi, 1995)
Mutual Trust	The extent to which trust is placed by the members of the focal network in each other	(Lee et al., 2008; Nelson and Cooprider, 1996)
Group Outcomes	The employees' perceptions of group satisfaction, group outcome satisfaction, and outcome quality	(Fuller et al., 2006)

Table 1. Principal Constructs and Definitions

The Effects of Using IM at Work

Functioning primarily as a social networking tool, IM is widely used for the purpose of "being connected" (Li et al., 2005) in both social and work environments (Cho et al., 2005). IM allows users to maintain real-time contact with colleagues, no matter where they are located. Although IM users can signify their online status (available, busy or away), most users are available and so leave themselves open to interruption (Garrett and Danziger, 2007). IM users may engage in multiple simultaneous IM conversations, seriously distracting their concentration.

However, an IM also enables the creation of a two-way, near-synchronous and lifelike communication channel that is highly interactive (Dennis et al., 2008; Li et al., 2005; Lowry et al., 2009) in both social and work environments. Furthermore, IM

offers interlocutors a fine degree of control since they can leverage the IM's flashing avatar to decide whether or not to accept an incoming call and so maintain control over the initiation of communication. Overall, the use of IM technology improves the perception of communication interactivity and control in the work environment.

When interlocutors have the spatial capability for direct, personal interaction, quality communication is more likely to develop. As a highly interactive tool, IM mimics face-to-face communication patterns and so has been considered to contribute to the perception that communication is accurate, complete, timely and effective (Mohr and Sohi, 1995). In such a quality communication process, emerging issues can be discussed and mutual understanding among colleagues can be developed (Quan-Haase et al., 2005).

Consequently, we argue that there are both advantages and disadvantages to IM use at work and hypothesize that:

Hypothesis 1a: The use of IM at work increases work interruption.

Hypothesis 1b: The use of IM at work enhances interactivity.

Hypothesis 1c: The use of IM at work enhances communication quality.

The Influence of Interactivity

Work interruptions occur when unexpected interactions are initiated by another party (O'Conaill and Frohlich, 1995). Work interruption is therefore caused not only by the frequency of IM use at work, but also by the interactive nature of an IM, characterized by synchronicity and two-way communication. IM tools typically rely on spawned pop-up windows to enable communication, which are often automatically superimposed on top of all other application interfaces with flashing lights that are hard to ignore. The requirement for the message recipient to react immediately to the incoming call appears uniquely disruptive (Garrett and Danziger, 2007) and additional to interruptions caused by email and phone calls (Nardi et al., 2000; Renneker et al., 2003).

Regardless of an IM's interruptive effects, we argue that the interactivity of an IM can bring users considerable benefits. Interactivity has long been a desired characteristic of CMCs in website design (Teo et al., 2003; Jiang and Benbasat, 2007), virtual communities (Khalifa and Shen, 2004) and systems used for work-related tasks (Lowry et al., 2009). An IM's fine level of control (including initiating communications, archiving and transcript-searching capabilities) supports employees' complete and effective communication at work. We suggest that when two-way, synchronized communication enhances communication quality, employees will be more willing to be involved in IM interaction (cf. Lowry et al., 2009).

Trust is a critical factor in accomplishing group work (Kramer and Cook, 2004). Collocation is considered to reinforce co-workers' mutual familiarity and consequently enhance mutual trust among colleagues; however, such trust is relatively difficult to achieve in distributed environments (Jarvenpaa and Leidner, 1999). Contemporary, distributed work practices require working professionals to collaborate and communicate across multiple networks. Deployment of IM in this distributed workspace has the potential to enhance employees' mutual trust by enabling synchronized, two-way conversations with a fine degree of control. Indeed, IM may enable a new form of work incorporating informal interaction, connecting working professionals, overcoming the limitations of space, time and even cost, and thus helping employees establish mutual trust.

Considering the above issues, we argue that there are both advantages and disadvantages to IM's interactivity and hypothesize that:

Hypothesis 2a: IM's interactivity increases work interruption.

Hypothesis 2b: IM's interactivity enhances communication quality.

Hypothesis 2c: IM's interactivity enhances mutual trust.

The Influence of Work Interruption

Work interruption resulting from IM use has been considered the major barrier to company deployment of IM at work (Nardi et al., 2000; Isaacs et al., 2002). The primary concern relates to the perceived negative consequences of interruption: on average, a worker needs eleven minutes to return to a state of concentration on an interrupted task (Mark et al., 2005). Other consequences of interruption include errors, stress and reduced performance (Eyrolle and Cellier, 2000). Since the interruption is usually unrelated to the task at hand, IM message recipients may be reluctantly forced to mentally engage with a new topic that demands focused attention if quality communication is to be achieved. Such distractions are generally

considered a hindrance to an employee under pressure. If interruptions occur frequently, work performance may be significantly negatively affected. We thus hypothesize that:

Hypothesis 3a: Work interruption reduces communication quality.

Hypothesis 3b: Work interruption has a negative impact on group outcomes

The Social Network at Work

Group work is collaborative by definition, with group members required to engage in various activities if high quality outcomes are to be achieved. Group members working together often develop a strong social network because of mutual understanding and shared values. As articulated by SNT (Barnes, 1954), interaction is embedded in the social network. In companies, good teamwork requires constant communication and mutual trust (Jarvenpaa and Leidner, 1999), consistent with SNT: "networks are based on communication and trust" (Börzel, 1998, p.262). Mutual trust does not develop in a single information exchange event, but repeated interaction involving shared understandings and values (Gössling, 2004).

In China, where this research has been undertaken, work-related communication is both social and informational (Dologite et al., 1998), resulting in employees developing mutual trust (Jarvenpaa and Leidner, 1999). The more accurate, complete, timely, adequate and effective the interaction, the more information can be shared, mutual understanding and trust achieved, and so higher levels of teamwork accomplished. In contrast, a team lacking mutual trust will not share information or otherwise function effectively. In highly competitive business environments, group member coordination requires increased frequency of interactions with more rapid and direct access to information; this can be facilitated by IM technology. Such frequent and interactive communication nurtures trust and consequently an increase in both individual and team-based productivity and satisfaction. We thus hypothesize that:

Hypothesis 4a: Communication quality is positively related to mutual trust.

Hypothesis 4b: Communication quality is positively related to group outcomes.

Hypothesis 4c: Mutual trust is positively related to group outcomes.

Control Variables

In addition to IM, we expect that other communication tools, such as email, intranet knowledge communities and video conferencing, may contribute to social networks. Theories of communication performance such as MST (Dennis et al., 2008) suggest that the best medium for a given situation may be a combination of CMC tools because an integrated communication environment can balance the strengths and weaknesses of individual tools. We thus control for the effects of other CMC tools on the research model.

RESEARCH METHOD

We used the survey method to verify the research model. This section briefly explains the development and validation of measures, and the data collection procedure.

Measurement Development

We use existing measures from the literature to form the items used in this study. The independent variable, IM use at work, is measured with items (adapted from Kankanhalli et al., 2005) about the frequency of IM use at work for: contacts and communication; asking questions; answering questions; sharing files; and work-related socializations. The measures of work interruption are based on Garrett and Danziger's (2007) single question on the rarity of completing tasks without interruption, as well as two additional items (to ensure scale robustness) covering work disturbance and concentration inhibition. Interactivity items are adapted from Jiang and Benbasat (2007) and Lowry et al. (2009), covering two-way and synchronized IM conversations with a fine degree of control. Items about communication quality are from Mohr and Sohi (1995), covering timely, accurate, adequate, complete, effective and interactive communication. Mutual trust is measured with items from Nelson and Cooprider (1996) including "making decisions beneficial to each other; willingness to provide assistance to each without exception; counting on each other at all times and the level of trust exist between the participant and colleagues in general". Group outcomes are measured with items from Fuller et al. (2006) including group satisfaction, outcome satisfaction and outcome quality. Control variables (use of email, video conferencing, intranet and knowledge community) are measured by frequency of use at work on a never (1) to always (7) scale. Appendix I lists all items for the principal constructs.

Considering that the measures came from different sources, we conducted card sorting exercises to test their reliability and validity (Moore and Benbasat, 1991), with one work professional, an academic scholar and a research student acting as judges. In the first round, where the judges were not provided with the construct names but asked to label each item, the correct hit ratio was 84%. We then revised some wordings found by the judges to be ambiguous and conducted a second card sorting exercise with a new group of judges. Construct names were provided in this round and a 95% correct hit ratio was achieved, indicating sufficient item-construct reliability (Moore and Benbasat, 1991).

A pilot study of the survey was conducted with a sample of 30 ethnic Chinese postgraduate students from a major university in Hong Kong in order to collect feedback on the survey questions, enabling us to further revise the measures used in the subsequent large-scale data collection process.

Data Collection

We collected data on a voluntary basis from working professionals in China who are also undertaking part-time postgraduate study at one of the following universities: Tsinghua University (Beijing), University of Science and Technology (Hefei), Xi'an Jiao Tong University (Xi'an) and Shenzhen University (Shenzhen). Over a period of four weeks, we collected 253 valid data points (a 66% response rate). We determined that non-response bias was not a concern using Armstrong and Overton's (1977) method, showing that: (1) the respondents' demographic characteristics were similar to those currently registered at the universities concerned; (2) a t-test of the demographic characteristics of respondents in the first two weeks and in the second two weeks did not significantly differ (p>.10). We also compared responses from the four cities based on their demographics. The ANOVA test results showed insignificant differences in all comparisons between groups. Therefore these 253 data points formed the data set for subsequent statistical analysis (see Table 2 for demographic characteristics).

Items	Items	Percentage	Items	Items	Percentage
Gender	Male Female	62.9% 37.1%	Position	Non-Management Employee Manager Senior or Executive Manager	60% 22% 18%
Education level	Pre-college College Undergraduate Graduate/Master or above	3.6% 21.8% 49.2% 25.4%	Age range	18-25 26-35 36-45 46 and above	24.6% 64.3% 9.9% 1.2%
Company Location	Beijing (Northern China) Shenzhen (Southern China) Hefei (Eastern China) Xi'an (Western China)	22.9% 27.3% 27.3% 22.5%	Organization size (number of employees)	50 or below 51-100 101-500 501-1000 1001 or above	24.5% 16.1% 30.5% 11.2% 17.7%
Industry Type	Public Relations Manufacturing IT Commerce Tourism & Entertainment Telecommunication Government Services Logistics & Transportation Others	4.2% 18.4% 23.8% 5.9% 11.3% 5.0% 7.1% 6.7% 17.5%	Contacts in IM	None 1-10 11-20 21-50 51-99 100-200 201 or above	1.8% 23.6% 20.1% 29.7% 15.7% 7.8% 2.5%
Number of Different IM Tools (such as MSN, QQ, ICQ, Company Owned IM) used at work	None 1 2 3 4 5 or above	1.6% 13.3% 36.1% 36.5% 8.8% 3.6%	Work related IM contacts as a % of total contacts	None 1%-20% 21%-40% 41%-60% 61%-80% 80%-100%	1.8% 17.4% 23.8% 26.2% 23.3% 10.8%

Table 2. Demographic Characteristics (n=253)

DATA ANALYSIS

Before analyzing the research model, we first validated measures at the construct level. The robustness of the research model was then confirmed by PLS analysis and several additional checks.

Validating the Measures

We used SPSS and Partial Least Squares (PLS) to calculate construct validity and reliability. Convergent and discriminant validity were first confirmed with factor analysis: (1) the factor loading scores on their expected factors are all above 0.6. Moreover, the factor loading scores are much higher on their expected factors than on other factors; (2) all eigenvalues of the constructs are larger than 1.0; (3) the communality scores are all higher than 0.50. These results indicate adequate reliability Hair et al. (1995).

Second, construct reliability was assessed by identifying the composite reliability scores, all of which are above 0.90 (Table 3), suggesting acceptable internal consistency. The square roots of the Average Variance Extracted (AVE) are all above 0.80, which is greater than all other cross correlations. This shows that all constructs capture more construct-related variance than error variance. Taken together, these results demonstrate adequate convergent and discriminant validity for all constructs used in this study.

| Principal Constructs	Mean (STD)	Reliability	1	2	3	4	5	6
1. IM Use at Work	5.0 (1.3)	.91	**.84**					
2. Work Interruption	3.8(1.5)	.90	.19**	**.86**				
3. Interactivity	5.3(1.2)	.90	.56**	.14*	**.86**			
4. Communication Quality	5.0 (1.1)	.95	.47**	.07	.49**	**.85**		
5. Mutual Trust	4.9 (1.2)	.93	.36**	.12*	.49**	.67**	**.87**	
6. Group Outcomes	5.2 (1.2)	.90	.29**	.06	.39**	.50**	.64**	**.86**
**Correlation significant at p<0.01 level. Diagonal elements are the square root of the AVE from their indicators. Off-diagonal elements are correlations between constructs.								

Table 3. Descriptive Statistics, Correlation Matrix, and Average Variance Extracted of Principal Constructs

We also tested for common method bias: one principal factor counting for the majority of the variance explained (Podsakoff and Organ, 1986). Our principal components factor analysis indicates that each principal factor explains roughly equal variance (8.7%~22.4%), suggesting the lack of substantial common method bias. Furthermore, the correlation matrix (Table 3) shows that the highest inter-construct correlations are below 0.68, while common method bias is usually evidenced by extremely high correlations (r>.90) (Bagozzi et al., 1991). Finally, we included a marker variable (Lindell and Whitney, 2001), i.e. a conceptually un-related question, in the survey to adjust for common method bias. Three ex ante questions set for this marker variable were: "please indicate how satisfied you are (1) with your current study; (2) with your family; (3) with your life in general". The correlations of these items and the items used to measure the principal constructs were not significant (average r=0.05; average p=0.83), suggesting the lack of evidence for common method bias. Finally, to test for multicollinearity, collinearity diagnostics for constructs were also conducted. The analysis shows that the collinearity indicators – tolerance values and variance inflation factors – are all less than the acceptable cut-off points (Hair et al., 1995).

Analyzing the Research Model

The structural model was examined using PLS. As shown in Figure 2, the results indicate that the research model is largely supported by the data, except hypotheses H2a, H3a, H3b and H4b. IM use at work has a significant impact on work interruption (b=0.20, p<0.01), interactivity (b=0.58, p<0.01) and communication quality (b=0.24, p<0.01), supporting H1a, H1b and H1c. Interactivity is also found to significantly influence communication quality (b=0.31, p<0.01) and mutual trust (b=0.18, p<0.01), validating H2b and H2c. On the other hand, its influence on work interruption is only modest, rejecting H2a. The influence of IM on work interruption is not significant, rejecting H3a and H3b. Regarding the relationships among communication quality, mutual trust and the group outcomes, the results show support for H4a (communication quality → mutual trust: b=0.57, p<0.01) and H4c (mutual trust → group outcomes: b=0.57, p<0.01). However, the direct effect of communication quality on group outcomes is not supported by the data, rejecting H4b. The variance explained of interactivity, communication quality, mutual trust, and group outcomes is 32%, 37%, 54% and 40%, respectively. The R^2 scores for all dependent variables in this study, together with the factor loading, yield an excellent goodness-of-fit for the whole research model (Chin, 1998). In addition to the paths between principal constructs, the data also indicate that both email and knowledge forum contribute to strengthen communication quality and mutual trust at work, while other control variables (i.e., intranet and video conferencing) are not significant.

Figure 2. PLS Results of Structural Model
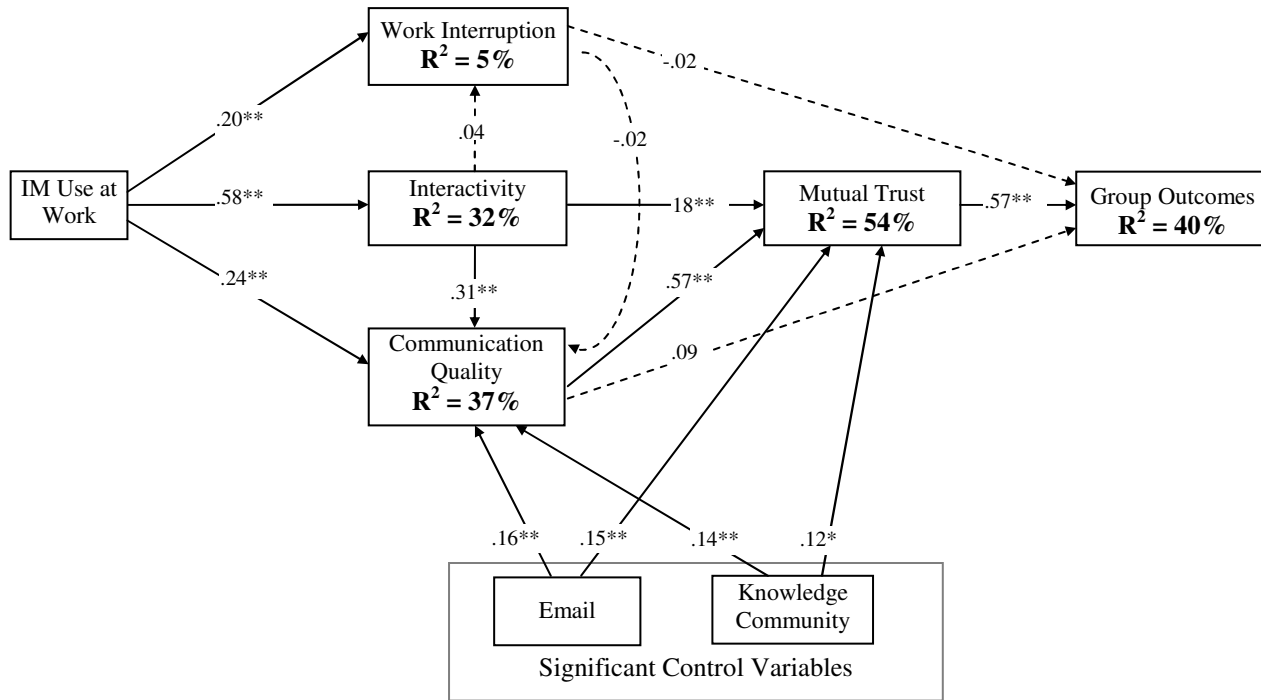
(Note: **p< 0.01; Paths in solid lines are significant links. Paths in dotted lines are insignificant links.
Significant control variables are shown.)

Robustness Checks

Our premise of the current research model is that IM use at work contributes to group outcomes through enhancing communication quality and mutual trust. In order to further verify the mediating effect of interactivity and communication quality, we follow Baron and Kenny's (1986) classical testing method for mediation. An alternative model capturing the direct link from IM use at work to mutual trust was structured and tested in PLS. The results showed that the original significant direct effect of IM use at work on trust (b=0.37, p<0.01) becomes insignificant when interactivity and communication quality are included in the model. This provides additional support for the full mediating role of interactivity and communication quality in the proposed research model. We use the same method to test the mediating role of trust in the model. When mutual trust is excluded from the research model, the effects of interactivity (b=0.16, p<0.05) and communication quality (b=0.37, p<0.01) on group outcomes are both found to be significant. These results confirm that mutual trust fully mediates the influence of interactivity and communication quality on group outcomes and provides a convincing explanation for the insignificant path between communication quality and group outcomes.

DISCUSSION, IMPLICATIONS AND FUTURE RESEARCH

This research has several key findings and implications, while indicating future research directions, as explained below. Firstly, although IM use is a significant predictor of work interruption, this interruption does not have a significant effect on group outcomes. This can be explained by the overwhelmingly positive effects of IM on shaping communication quality and trust in team work. Secondly, IM use and interactivity only explain 6% of work interruptions, suggesting that work interruptions occur for all employees and IM use does not make the situation worse. Thirdly, IM use has a significant impact on interactivity, which in turn is a critical mediating variable for the development of mutual trust and communication quality. This result suggests an important design principle for CMC tools – interactivity – which highlights the significance of two-way, synchronized communication with a fine level of control for designing CMC tools. Fourthly, organizational members' mutual trust fully mediates the effects of IM interactivity and communication quality on team outcomes. This finding suggests that trust is a fundamental driver for team work quality. IM use can contribute to this trust when mediated by

interactivity and communication quality. Taken together, the influence of IM use at work is now better understood, comparing positive and negative effects, and evidencing its significance towards work performance.

This research contributes to theories of communication performance by identifying the most important positive and negative effects of CMC tools. Theories of communication performance conceptualize the logic that links CMC technology with task performance. We advance the appreciation of communication performance theories by formally defining the roles of technological elements, such as IM, in the shaping of work performance. Meanwhile, we also provide theoretical explanations for the effective deployment of CMC tools at work by investigating how they contribute to work interruption and interactivity.

Finally, we provide empirical evidence that IM is a double-edged sword. Whilst it facilitates online connectedness it also contributes to work interruptions. However, by helping to shape a social network, enabling quality communication and trust, the negative effects are negligible. Indeed, we suggest that IM can usefully supplement other CMC tools and create an effective and comprehensive CMC environment in the workplace, leading to better work performance.

A key limitation of this study is its reliance on perception data. Future studies could usefully include objective data related to the precise nature of the group outcomes, such as productivity measures, sales volumes and other performance indicators. Furthermore, it would be useful to replicate the study in different cultural contexts. Future research on CMC will also benefit from social network analysis, depicting organizational members' inter-connections in their work-based social networks.

CONCLUSIONS

Social networking technologies such as IM have demonstrated their enormous influence in our daily lives, while their potential in business deployment has barely been investigated. IM appears to have the potential to play an instrumental role in group work because it strengthens the intercommunication and interconnectivity of work professionals, both of which are necessary for collaboration. This constitutes a compelling rationale to include social networking tools such as IM in the workplace and we look forward to more research that conceptualizes, operationalizes and empirically tests the significance of social network technology in the workplace.

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APPENDIX I. CONSTRUCT MEASURES

IM Usage at Work, Scale: Strongly disagree (1) – Strongly agree (7)	Principle Component Analysis*	Communalities
(1) I often use IM tools to contact other people for my work.	.756	.81
(2) I regularly use IM tools to communicate with colleagues or customers in my daily work.	.653	.78
The frequency of usage of IM tools to do the following things in my daily work is … Scale: Not at all (1) – Frequently (7)		
(3) Ask questions.	.858	.70
(4) Answer questions.	.881	.79
(5) Share files.	.707	.64
(6) Work-related socialization.	.705	.66
Work Interruption, Scale: Strongly disagree (1) – Strongly agree (7)		
(1) My work is always interrupted by IM messages.	.825	.728
(2) I felt IM messages are quite disturbing.	.909	.838
(3) Using IM tools inhibits my concentration on work.	.882	.771
Interactivity, Scale: Strongly disagree (1) – Strongly agree (7)		
(1) I am able to control my communication at IM tools.	.831	.798
(2) Via IM tools, the other parties can respond to my communication quickly.	.701	.754
(3) Using IM tools allows me to acquire information in an interactive way.	.655	.730
Communication Quality I feel that my communication with colleagues at work is …		
(1) 1. Untimely – 7. Timely.	.743	.698
(2) 1. Inaccurate – 7. Accurate.	.803	.804
(3) 1. Inadequate – 7. Adequate.	.857	.830
(4) 1. Incomplete – 7. Complete.	.822	.776
(5) 1. Ineffective – 7. Effective.	.789	.724
(6) 1. Non-interactive – 5. Interactive.	.808	.771
Mutual Trust, Scale: Strongly disagree (1) – Strongly agree (7) Considering my colleagues…		
(1) We make decisions beneficial to each other under any circumstances.	.705	.723
(2) We are willing to provide assistance to each other without exception.	.772	.795
(3) We can count on each other at all times.	.719	.688
(4) The level of trust that exists between us is in general 1 (low) – 7 (high).	.711	.697
Outcome Satisfaction, Scale: Strongly disagree (1) – Strongly agree (7)		
(1) I am satisfied with the project outcomes produced by my team.	.818	.788
(2) I am satisfied with my group members.	.765	.788
(3) The work produced by my team is of a high quality.	.797	.761

* Own loading scores are listed in this table, which are all higher than cross loading scores.

Cross loading scores are omitted here for brevity due to space limits.