Configurations of Relationships in Different Media: FtF, Email, Instant Messenger, Mobile Phone, and SMS

Hyo Kim

Media Division
CIT Ajou University

Gwang Jae Kim

School of Communication
Sogang University

Han Woo Park

Department of Media & Information
YeungNam University

Ronald E. Rice

Department of Communication
University of California, Santa Barbara

This study analyzes the configurations of communication relationships in Korea through face-to-face, email, instant messaging, mobile phone, and short message service media. Through a web survey, we asked respondents to identify (1) for each of the five media (2) up to five of their most frequent communication partners, (3) the partner's social role (including colleagues, family, friends), and (4) their own employment category. Individual-level and network-level analyses were used to compare variations in communication relationships and configurations of relationships among social roles overall, within each medium, and for different employment categories, and to identify configurations of relationships across media. IM, SMS, and mobile phone are distinctive media for students, mobile phone for homeworkers, and email for organizational workers. Moreover, mobile phones tend to be used in reinforcing strong social ties, and text-based CMC media tend to be used in expanding relationships with weak ties. Finally, face-to-face (FtF) seems to be a universal medium without significant differences across respondents' employment categories.

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Introduction

This study explores the configurations of relationships in people's everyday communication face-to-face and through four new media. It takes into account the social contexts of both respondents (their employment categories) and their communication partners (their social roles), as well as the closeness of the relationships between them. Further, it analyzes and compares configurations of relationships overall and within these media at both the individual (respondent) and configuration (network) level. The study analyzes responses from a cross-section of Koreans, as new media use is especially important in the Korean context because of high usage levels and diverse and sophisticated new media and services.

The Republic of Korea, with a population of 48.2 million, had the 12th largest economy in the world in 2002 (ITU, 2004), and the 7th highest level of information use (consumption flows of ICTs/time period) and a 98.1% literacy rate in 2003 (Sciadas, 2005). As of 2002, there were 55.2 Internet users per 100 inhabitants; South Korea had the world's highest broadband access (70%); and 68% of the population had mobile phones (compared to 48.9% with landline telephones) (ITU, 2004). By 2003, those figures had increased to 61% Internet, 70.1% mobile phone, and 53.8% landline (Sciadas, 2005). By December 2004, South Korea had the 11th highest Internet penetration rate (63%, 31.6 M of 49.9 M) (Internet World Statistics, 2006). According to the National Internet Development Agency of Korea (2005), young people's access to wireless Internet services is growing especially fast compared to other generations. As of September 2005, more than 80% of middle school (83.6%) and high school (89.3%) students used wireless Internet. Youths aged 12 to 19 who had their own mobile phones used the Internet 6.7 times per week.

In the case of mobile phone, rapid and extensive adoption was stimulated primarily by the nationwide development and standardization of Code Division Multiple Access (CDMA) and regulated low usage rates (Sciadas, 2005), resulting in "state of the art mobile networks and handsets, the world's most extensive broadband network, [and] 25,000 cybercafés located around the country" (ITU, 2004, p. 6). Mobile phones allow Korean users to purchase goods at coffee shops, convenience stores, and department stores (either in person or online), and to check on missed SMS calls, purchase lottery tickets, and download and read e-books. "To Koreans, their mobile handsets often represent their digital connection to friends, family and the world" (ITU, 2004, p 18).

Literature Review

Contextual Aspects of Media Use

In general, studies of new media use over the past 20 years have shifted from a more technological to a more social context perspective. The media richness model (Daft, Lengel, & Trevino, 1987; Trevino, Lengel, & Daft, 1987) proposed that the use of a certain medium in a communicative activity is influenced by the fit or match

between the medium capacity (richness—presented as objective characteristics of the medium) and the nature of the task (uncertainty/equivocality). Initial results from this approach were supportive and influential (Daft, Lengel, & Trevino, 1987; Trevino, Lengel, & Daft, 1987). However, as computer-mediated communication (CMC) media became widely available, and more people adopted and used email, voice mail, and the Internet, contradictory findings appeared (for example, greater socio-emotional content and relational development in mediated communication, or broader use by top managers than expected; see Rice & Love, 1987; Walther, 1992). Researchers began focusing on the social influences, network contexts, and processes of media uses and perceptions (Fulk, Schmitz, & Steinfield, 1990; Rice, 1993; Trevino, Lengel, & Daft, 1987; Walther, 1992). Others proposed that the characteristics of a medium are defined and appropriated through the social activities for which the medium is used (DeSanctis & Poole, 1994; Orlikowski, Yates, Okamura, & Fujimoto, 1995).

Licoppe and Smoreda (2005) point out that specific conditions of communication—aspects of the medium, purposes, and the participants—influence how one chooses, uses, and perceives different media. For example, because the small screen and keyboards of SMS and wireless email severely limit the length of messages and even the use of full words, typically senders and receivers must already know a lot about each other as well as the message context, implying that these participants are members of an ongoing communication network. Mobile phone use emphasizes dyadic interaction, while PC email allows copying to multiple others and broadcasting to discussion lists, which generally include many people not personally known to the sender (Miyata, 2006). In Japan, for instance, mobile phone emails tend to go to those more socially or physically present than those contacted through PC email (Miyata, 2006; Miyata, Boase, Wellman, & Ikeda, 2005).

Quan-Haase and Wellman's (2006) analysis of media use in a high-tech organization concluded that "CMC, FtF contact, and the telephone serve different communication purposes, often working in synergy and not in competition with one another" (p. 299). For example, instant messaging is a transient medium used to check in without the requirement an immediate response, to set up a face-to-face meeting, to signal one's accessibility, to track the accessibility of others (e.g., whether they are logged on or not) and for chatting and discussing issues, all fostering increased closeness in the workplace. On the other hand, email is used for more detailed information exchange, especially for messages that do not need an immediate response, to maintain records of an interaction, to forward or broadcast messages to others, or for less close relationships.

Multiple Media Use and Communication Network Relationships

To what extent, then, can new media maintain, expand, or decrease existing relationships; how might those relationships differ from more traditional face-to-face (FtF) relationships; and what participant contexts might influence these differences? Some research argues that people can maintain a sense of interconnectedness, even an

intimate community, through media, even if the network members are geographically dispersed (as, e.g., Katz & Rice [2002] and Wellman & Gulia [1999] argue for the Internet). New media may complement current interpersonal and telephone communication or may lead to additional and specialized uses (Johnson-Smaragdi, 2001; Quan-Haase & Wellman, 2006). Further, mediated communication can foster "connected presence" (Licoppe & Smoreda, 2005) or "communicative readiness" (Nardi, 2005), whereby people can manage multiple encounters at the same time and across time, signal ongoing awareness of and relationships with specific others, indicate their availability, and maintain a social context (such as an ongoing "common ground" or "field of connection"). These uses in turn influence how other media choices and uses are interpreted (Nardi, 2005; see also Rice, 1987; Sitkin, Sutcliffe, & Barrios-Choplin, 1992; Wei & Lo, 2006).

For example, maintaining peer relationships is especially important for adolescents and teenagers as they make the transition from childhood to adulthood and from parent-defined to peer-defined self, all the while dealing with insecurity and changing contexts. A recent Pew report found that teenagers tend to use email for communicating with "adults" and institutions and for transmitting lengthy and detailed information to many others, while they use instant messaging for day-to-day conversations with a range of friends (Lenhart, Madden & Hitlin, 2005). Similarly, Boneva, Quinn, Kraut, Kiesler, and Shklovski's (2006) study of 13–18 year-olds found that conversations using instant messaging were more social than FtF visits or phone conversations. Finnish teenagers also use mobile phones to both maintain and extend their social networks (Oksman & Turtianen, 2004).

Moving away to college places great obstacles and costs on maintaining those high school friendships. Cummings, Lee, and Kraut (2006) tracked the communication networks of high school students from the spring of their senior year in high school through the end of their junior year in college. Email and IM seem to guard better against declines in closeness to high school friends after moving to college—possibly because communication frequency is least affected by distance and cost—even though phone communication was the strongest predictor of closeness. However, concerning their new college friends, these students communicated much more via FtF and phone interactions than through email and IM. Baym, Zhang, and Lin's (2004) study of U.S. college students' communication diaries found that most interactions were FtF, followed by phone calls and Internet. Nearly two-thirds of the respondents socialized through all three media, with about one quarter doing so through FtF and phone only, and only a small percentage doing so through Internet alone. A Pew study (2002) reported that primary uses of the Internet by college students include social communication (42% of respondents), entertainment, keeping in touch with their friends easily, and communicating with friends and family.

Some studies of social uses of new media have more specifically looked at relationships between media use and participants' social networks. Boase, Horrigan, Wellman, and Rainie's (2006) nationally-representative survey found that people who kept in contact via email with most of their central relationships also had greater

telephone contact with those people and more FtF contact for non-central relationships. Internet users had more non-central relationships. Further, email users received more support from their relationships, even more so if they used multiple new media (such as instant messaging, mobile phone, PDA, text messaging, or wireless Internet connection). Nardi, Whittaker, and Bradner (2000) found that while IM was used by members of an ongoing work group as a channel to seek and exchange content, it was also used as a coordinating tool for managing accessibility and flow of interactions, apart from the content.

IM is thus generally used to maintain a small network of fellow IM users rather than to connect to new others. For example, Nardi, Whittaker, and Schwarz (2002) found that workplace IM buddy lists contained six friends/family and 16 coworkers, but the users frequently interacted only with four or five of their IM buddies. Schiano, Chen, Ginsberg, Gretarsdottir, Huddleston, and Isaacs (2002) found that teenagers communicated regularly with fewer than five IM buddies, while Grinter and Eldrige (2003) and Ito (2005) found fewer than three regular communication partners for U.K. IM users and Japanese mobile phone users, respectively (cited in Nardi, 2005).

A small set of research focuses on the relationship between multiple media use and network relationship strength. For example, people with stronger ties (formal work ties; close friend or friend) have been found to have more relationships, communicate more frequently, and use more media than do people with weaker ties (Haythornthwaite, 2005; Haythornthwaite & Wellman, 1998). In an online distance learning setting, students with strong ties tended to use email and instant messaging more frequently than those with weak ties (Haythornthwaite, 2000).

Studies from a series of major Japanese projects have compared network aspects across new media. Ishii (2006) compared the use of landline phone, mobile phone, mobile email (text messaging), and PC email by respondents and their reported partners, based on survey data from a representative sample of nearly 1,000 19–69 year old Japanese, involving an average of 5.6 communication relationships per respondent. Ishii found differences in media use by these dyads based on gender, partners' social roles, use of other media, and distance between partners. Miyata's (2006) study compared mobile phone email and mobile phone voice communication from over 1,000 nationally representative Japanese respondents to a two-year panel survey, which also asked about the diversity of social roles in the respondents' personal networks. Mobile emails did not affect one's network diversity but did foster more supportive network ties, while PC emails increased network diversity, especially through more weak ties.

Research Questions

The literature review above shows that different media may be used in similar, overlapping, and different ways, depending on their technical features, users' communication purposes, user and partner characteristics, and social contexts. Different

media may also weaken, support, or expand current networks or foster new ones. This study examines the configuration of communication relationships involving people in different social roles through different media, across respondent employment categories, and at the individual and the network levels of analysis.

We would expect to find meaningful differences across combinations of medium, purposes, and participants (Licoppe & Smoreda, 2005). At a minimum, communication needs and tasks are likely to vary between employed people (whether salaried or professional) and non-employed people (students, homemakers), due to factors such as communicating in different social groups, the transition from home to college, greater or lesser exposure to peer and external groups, and support versus task/project needs. Therefore, we ask the following two general research questions:

Individual Level RQ1: How do the number, diversity, type, and closeness of communication relationships vary across media and by respondent's employment category?

Network Level RQ2: How do configurations of relationships vary across media across employment categories? In particular, how do configurations of relationships in new media compare to those in FtF communication, overall and across employment categories?

Method

National Web-Based Survey and Network Generator

A telecommunication company, SK telecom, sponsored this study as a part of a media user project through the Korean Society for Journalism and Communication Studies. The data for the present study have not been analyzed or reported on before. During the web survey development, 10 communication researchers in Korea peer-reviewed the questions, adding, subtracting, and revising questions. A survey company then took over the survey questionnaires, conducted a brief pilot survey, revised some questions, and implemented the survey. Although this survey was conducted via the web, it was designed to represent the Korean adult population as broadly as possible. The commercial company maintains a large master survey pool developed and maintained over time, providing small gifts for people who respond to their advertisements for participation, for registration to the master pool, and for participation in each survey.

Registrants provide demographic information and information about their media ownership and use. The company uses the demographic information to create a proportional stratified sampling frame by gender and age categories, appropriate for the specific survey topic (such as email and mobile phone users). The entire master pool is solicited by email, and the survey stays open until each category is filled, closing down each category when it reaches its criterion sample size. Typically, this takes one week to 10 days. The survey program also evaluates responses and rejects surveys with skipped questions and random or invariant responses. A total of 1,507 people responded to the present survey. As the survey collection ended when the stratified categories were filled, there is no "response rate" to report. We collected information

on the respondents' *employment category*, their *media* use, up to five people in up to 15 *social roles* they communicate with through each of those media, and the *closeness* of those relationships, as a limited set of social contexts influencing media use.

The web survey asked respondents to indicate their gender and age (for descriptive purposes only) and to check their *employment category* from a list of 11 occupations: Administrator/management, IT technician or professional, salaried, sales/service, simple technician or laborer, agricultural/fishery, housework, middle or high school student, college student, no occupation, and other. (The survey considered a person as "salaried" if (a) s/he gets paid regularly (by month) and (b) if his/her company size is over 100 employees and his/her position's rank is lower than a managerial position, or (c) if his/her company size is under 100 employees and his/her position's rank is lower than a mid-level managerial position. It does not include government office workers; religion, art, athletic field workers; employees in political and non-governmental political organizations; self-employed, free-lance workers; doctors or nurses; lawyers or accountants; salespersons (at stores or door-to-door); paid-by-day workers; or others such as farmers, fisherman, students, professors, teachers, or military personnel.) Because of very low frequencies for some of the categories, they were grouped into six categories: salaried, homemaker, middle-/high-school student, college student, IT professional, and others. The "other" category, with 468 respondents, was not included in the analyses, to maintain a consistent sample across the analyses that did and did not include employment categories. Thus we used the sample with the five general employment categories throughout.

This sample of 1,039 respondents consisted of 44% males and 56% females, distributed across the following age ranges: 13–19 (29.8%), 20–29 (27.9%), 30–39 (27.7%), and 40–49 (14.5%), and distributed across the following employment categories: salaried (27.3%), home worker (23.5%), middle/high school student (14.6%), college student (22.9%), and technical/professional (11.6%).

On a separate set of web pages for each of *five different media* (face-to-face—FtF; email—EM; instant messenger—IM; mobile phone—MP; and short messaging service—SMS), each respondent identified a maximum of five communication partners with whom s/he communicates most frequently. The respondent listed each communication partner by number (i.e., "person 3") and identified that partner distinctively across the media. That is, if a partner was identified in one medium but also appeared as a partner in the list for another medium, the respondent would mark the partner as the same person ("person 3"). This approach is midway between an ego network (respondents list the others with whom they have contacts, with no attempt or ability to assess links among those contacts) and a system network (respondents indicate contacts on a roster of a bounded system of actors).

Here, we used what Marsden (1990) refers to as a role relation name generator. For each person indicated, respondents checked the *social role* (spouse, children, parent, sibling, other relative, elementary/middle/high school friend, college friend, girlfriend/boyfriend/lover, other types of friend, work colleague, work boss/manager, work subordinate, other work related, teacher/professor, or online only). These

social roles are fairly similar across General Social Survey (GSS)-type surveys (see Hashimoto, Ishii, Nakamura, Korenaga, Tsuji, & Mori, 2000; Van der Gaag, 2005). We avoided some possible problems of name-generator approaches (a brief review is available from the authors) by using the general referent of "who you most frequently communicate with" (through each medium) and separately asking for an indication of the *closeness* of each communication relationship (from 1 = not close to 5 = extremely close), which Marsden and Campbell (1984) concluded was the best single item indicator of relationship strength.

Identifying Configurations of Relations by Medium, Employment Category, and Social Role

Typically, in the GSS network surveys, respondents are asked to estimate the presence and strength of ties among the few named alters or social roles (Burt, 1984; Marsden, 1987; Ruan, 1998). One can then compute network measures among those few estimated others and analyze and report the distributions of those measures, along with associations of those measures with individual-level variables, across the entire sample. However, we adopted a different approach, in order to reflect a broader social level analysis, to compare configurations across media, and to increase the number and possible diversity of relationships within and across media.

Analyses

Analyses involved both the traditional respondent-by-variable dataset (individual level) and the social role matrices for each medium (network level).

For *individual-level analyses*, we used repeated-measures ANOVA to test for differences in amount, closeness, and overlap in social roles across employment categories (salaried, homemaker, middle/high school student, college student, and information-related technicians) and media. We performed 5x5 repeated-measures ANOVA with mean value of closeness for each medium as the within-groups factor and employment category as the between-groups factor.

For *network-level analyses*, we used all respondents' answers about their communication relationships to create a matrix for each medium. (For these and other network analyses we used Ucinet 6.0; Borgatti, Everett & Freeman, 2002.) This matrix can be called G(k), where k represents the specific medium. Each of the 1,039 rows (i) is a different respondent, and each of the 15 columns indicates a different social role (j). The value in cell (i,j) indicates the number of mentions of communication with that social role (j) the respondent (i) reported for that specific medium. For example, survey participant 232's communication partners through FtF include 1 spouse (we would hope no more than 1!), 2 work colleagues, and 2 work bosses/managers (for the maximum of five relationships).

Each of those five media matrices was then converted into a matrix Ak. Matrix Ak = Gk*Gk'. Gk is the original 1,039 respondent $\times$ 15 social roles matrix for medium k, and Gk' is Gk transposed. Gk is then matrix-multiplied by Gk'. The resulting matrix Ak is a 15 $\times$ 15 social role by social role matrix, aggregated

across the 1,039 respondents, for medium *k*. Note that these values are *not* the frequency of communication between those social roles; rather, they indicate the frequency with which each pair of these social roles exists in the overall configuration of social roles for each medium, across the entire sample.

As an example, consider the A*k* matrix where *k* is FtF. A value on the *diagonal* (*j,j*) indicates the number of times the respondents overall identified that social role *j* as a communication partner (ranging from a low of 10 teacher/professor communication partners, to 263 spouse communication partners, to a high of 420 middle/high school friend communication partners) for the FtF medium. An *off-diagonal* (*i,j*) value indicates the number of times any two social roles (*i* and *j*) were *both* mentioned by any respondent. For example, 263 respondents reported communicating FtF with a spouse (*diagonal value* for the spouse social role), whereas 65 reported communicating with a spouse and with children, 28 with a spouse and with a college friend, and only two with a spouse and with someone only online (*off-diagonal* values).

We then used Ucinet 6.0 to transform those A*k* frequency matrices into correlation matrices. The correlation between any two social roles in a particular medium matrix indicates the extent to which those two social roles have similar patterns of frequencies to all other social roles in the A*k* matrix. Just as two variables are correlated in traditional analysis, here two columns are correlated. The correlations between each two columns are placed in the respective cell of a new matrix, and that new correlation matrix is used as input for subsequent analysis. Netdraw (a module of Ucinet 6.0) was used to display the results of multi-dimensional scaling of the correlation matrices visually, showing how the social roles are more or less "close" to each other in each medium. The configuration of these relationships within media can thus be described and compared both visually and statistically.

To compute the correlation (extent of similarity) between pairs of the matrices and the statistical significance of those correlations, we used the Quadratic Assignment Procedure (QAP) in Ucinet 6.0. This permutes (by default, 2,500 times) the rows and columns of one of the pairs of matrices and computes the correlation between the two matrices for each permutation. This is done by converting all the non-diagonal values from one matrix into a single column of values, and the same for the other matrix, and then the two columns are correlated as two variables are typically correlated. The program then creates a distribution of all those 2,500 correlations and determines where along that distribution of possible correlations the empirical correlation between the actual two matrices lies. This nonparametric approach to assessing statistical significance is required because the rows and columns of network matrices are not independent, unlike the traditional assumption underlying survey data and parametric statistics. In order to assess how the social configurations in the four new media were uniquely associated with the FtF social configuration, the multiple regression quadratic assignment procedure (MRQAP) with semi-partialing (Krackhardt, 1988) was applied to compute the overall R^2 and each new media matrix's partial beta coefficients. This uses the same approach as QAP but controls for interdependence among the explanatory matrices.

Results

Individual Level: Mean Relationships by Medium and Employment Category

The mean number of communication partners for FtF was 3.6 (s.d. 1.4); for Email, 2.9 (1.6); for Instant Messenger, 2.6 (1.9); for Mobile Phone, 3.5 (1.5); and for SMS 3.1 (1.7). There were significant differences (means table not included) in the number of communication partners across employment categories for all media except FtF ($F(4,1034) = 2.7$, n.s.). For email ($F(4,1034) = 16.2$, $p < .001$), a post hoc test revealed a significantly higher number of relationships for worker (salaried and tech professionals, M = 3.3 for each) than for the other employment categories, especially middle/high school students (M = 2.3). For instant messenger ($F(4,1034) = 36.9$, $p < .001$), the home worker category has significantly fewer relationships (M = 1.4) than the other groups (especially college students, M = 3.2). For mobile phone ($F(4,1034) = 10.1$, $p < .001$) and SMS ($F(4,1034) = 3.6$, $p < .01$), middle/high school students have fewer relationships than all other groups (M = 2.8 for each).

Individual Level: Number, Unique and Duplicate Relationships by Medium and Employment Category

Next we focus on comparisons of communication with social roles across employment categories (see Tables 1a and 1b). *Total* relationships across all media (max 25) is the number of communication partners identified across all five media. *Unique* relationships across all media (max 25) is the number of unique communication partners identified across all five media. *Duplicated* relationships across all media = the number of communication partners who are the same people across at least two media. *Unique social roles* across all media (max 15) is the number of unique social roles (out of 15 kinds: spouse, children, parents, etc.) across all five media. For example, if a person reports 2 children, 1 sibling, 2 college friends, 1 work boss, and 2 work colleagues across all the media, and the same college friend is mentioned for both FtF and email, then there are 8 total relationships, 7 unique relationships, 1 duplicated relationship, and 5 unique social roles.

Overall, the number of *unique relationships* varied by employment category ($F(4, 1034) = 40.5$, $p < .001$). Post-hoc analysis showed that significant mean differences (from lowest to highest) were found for: middle/high student (2.7), college student (3.52), homeworker and tech professionals (4.16 and 4.25), and tech professionals and salaried (4.25 and 4.67). However, more work-related partners were found in both FtF and in email ($F(4, 1034) = 82.9$, $p < .001$; $F(4, 1034) = 109.9$, $p < .001$, respectively), with more in FtF than email ($t(1038) = 3.6$, $p < .001$).

There was an overall difference in the number of *duplicated relationships* in FtF and email among the employment categories ($F(4, 1034) = 6.3$, $p < .001$). However, a post-hoc test revealed that the differences were mainly between middle/high school student and working categories (we would not expect young students to have many communication relationships with organizational workers). The other two

Table 1a-b Mean overall and worker relationships and social roles, across media and for FtF and email

a. Total, unique, and duplicate communication relationships and unique social roles, across all media

Respondent Employment Category	N	Total Relationships across All Media (max 25)		Unique Relationships across All Media (max 25)		Duplicated Relationships across All media		Unique Social Roles across All Media (max 15)	
		M	s.d.	M	s.d.	M	s.d.	M	s.d.
Salaried	284	16.8	6.2	8.9	3.8	7.94	4.44	4.67	1.86
Homeworker	244	14.5	5.3	7.6	3.2	7.00	3.69	4.16	1.53
Mid/high school student	152	14.6	6.2	8.3	3.8	6.28	4.37	2.70	1.45
College student	238	16.2	6.2	8.0	3.7	8.21	4.41	3.52	1.63
Technical/ professional	121	15.9	6.5	8.2	4.2	7.67	4.53	4.25	1.79
Total	1039	15.7	6.1	8.2	3.7	7.51	4.31	3.95	1.79

b. FtF and email relationships with workers and social roles

Respondent Employment Category	N	Worker Relationships in FtF		Worker Relationships in Email		Worker Relationships in Both FtF and Email		Number of Social Roles in Both FtF and Email	
		M	s.d.	M	s.d.	M	s.d.	M	s.d.
Salaried	284	1.59	1.63	1.30	1.51	.44	.91	1.28	1.37
Homeworker	244	.25	.73	.20	.54	.04	.24	1.13	1.19
Mid/high school student	152	.02	.18	.02	.14	0	0	.86	1.35
College student	238	.24	.74	.12	.46	.03	.22	1.03	1.26
Technical/ professional	121	1.31	1.59	1.23	1.55	.37	.80	1.37	1.34
Total	1039	.70	1.30	.58	1.16	.18	.60	1.14	1.31

employment categories (college student and home worker) were not significantly different from the working categories. More specifically, there was a significant difference in the number of *duplicated work-related communication relationships* in FtF and email ($F(4, 1034) = 29.8$, $p < .001$). Based on a post-hoc comparison, the two work categories differed from the three non-work categories.

Individual Level: Comparison of Social Roles and Employment Category Overall and by Medium

Table 2 provides descriptive statistics for the number of relationships by social role, employment category, and overall and for each medium. Aggregating across media,

the largest number of relationships are with friends, then family, then work, and then online. More specifically, the largest number is for students communicating with their friends, through FtF, IM, SMS, and mobile phone. Homeworkers have the largest number of family relationships, primarily through mobile phone and FtF. Naturally, salaried and tech professionals have the greatest number of work relationships, primarily through FtF and email.

Individual Level: Relational Closeness by Medium and Employment Category

Table 3 provides the means for closeness of relations for each of the employment categories within, and the total for, each of the five media. Since the assumption of sphericity was violated, multivariate test results were used in the interpretation. Table 4 provides the overall ANOVA statistics. There was a significant *medium* (within-subject) effect ($F(4, 873) = 123.5$, $p < .001$; $Eta^2 = .36$): Instant messaging is used for communicating with weak relations, mobile phone for strong ones. There was a significant *employment category* (between-subject) effect ($F(4, 876) = 10.3$, $p < .001$, $Eta^2 = .05$) on closeness. Homeworkers had lower overall closeness with their partners compared to all other employment categories, due primarily to the low closeness through instant messaging. There was also a significant *interaction* effect—that is, medium by employment category ($F(16, 2667.7) = 13.7$, $p < .001$).

Email differs significantly from all other media in its interaction with respondent employment category. Students use email to communicate with less close others in comparison to other employment categories, especially homeworker, salaried, and tech professionals, with the latter two categories reporting the highest closeness.

Network Level: Descriptive Analysis of Configurations of Relationships by Medium

Overall, we would like to know how similar the five media are in terms of how they are used to support communication with each of the social roles. First, quadratic assignment was used to compute the Pearson correlation between each pair of media. These were all highly intercorrelated, from .57 between mobile phone and IM to .90 between mobile phone and FtF. These correlations were then entered into a 5×5 (medium by medium) matrix (ignoring the diagonals), which was submitted to Ucinet's multidimensional (MDS) and hierarchical procedures.

The Pearson correlation is the correlation between each pair of matrices; higher values mean the patterns of communicating with the 15 social roles in each of the compared medium matrices are more similar and thus more strongly clustered. The thickness of the line between each medium matrix is proportional to the strength of the correlation. Media are considered grouped together at each given correlation level if their correlation is as strong as the listed correlation. The strongest cluster includes FF and MP; the next closest cluster includes first EM and SM, and then IM.

Figure 1 shows that the configurations of relationships among the social roles in FtF and mobile phone communication are quite similar, and therefore those two media are tightly clustered in the multi-dimensional scaling (MDS) representation. Email and SMS are also tightly but separately clustered, and IM is less tightly

Table 2 Mean relationships by social role, employment category, and medium

Social Role (grouped)	Respondent Employment Category	All		FtF		Email		Instant Messenger		Mobile Phone		SMS	
		M	s.d.	M	s.d.	M	s.d.	M	s.d.	M	s.d.	M	s.d.
Family	Salaried	1.67	1.59	.77	.99	.48	.78	.29	.58	1.14	1.22	.65	.82
	Home worker	2.89	1.69	1.45	1.31	1.17	1.18	.41	.88	1.97	1.29	1.18	1.07
	Middle/high	1.18	1.44	.59	.98	.34	.71	.16	.58	.66	.98	.23	.48
	College	1.19	1.31	.65	1.02	.29	.72	.15	.51	.71	.98	.27	.60
	Tech/ prof	1.69	1.64	.93	1.08	.75	1.01	.33	.68	1.22	1.23	.78	.91
	Mean	1.78	1.67	.89	1.13	.61	.96	.27	.66	1.18	1.25	.64	.89
Friends	Salaried	3.59	2.63	1.25	1.41	1.39	1.42	1.50	1.49	1.57	1.43	1.78	1.55
	Home worker	3.37	2.57	1.51	1.39	1.37	1.26	.79	1.31	1.33	1.22	1.39	1.26
	Middle/high	6.59	3.55	2.96	1.62	1.67	1.68	2.74	1.78	2.08	1.77	2.39	1.88
	College	5.98	3.09	2.59	1.60	1.94	1.58	2.81	1.64	2.64	1.46	2.95	1.54
	Tech/ prof	3.31	2.94	1.24	1.47	1.19	1.37	1.29	1.55	1.40	1.51	1.40	1.56
	Mean	4.49	3.21	1.87	1.64	1.53	1.48	1.79	1.74	1.81	1.54	2.00	1.66
Work	Salaried	3.29	2.94	1.59	1.63	1.30	1.51	.93	1.30	.88	1.25	.58	.95
	Home worker	.68	1.33	.25	.73	.20	.54	.13	.54	.18	.52	.22	.63
	Middle/high	.05	.27	.02	.18	.02	.14	.01	.08	.01	.11	.02	.18
	College	.44	1.13	.24	.74	.12	.46	.11	.44	.11	.45	.10	.39
	Tech/ prof	2.94	2.94	1.31	1.59	1.23	1.55	.75	1.14	.91	1.30	.64	1.12
	Mean	1.51	2.43	.70	1.30	.58	1.16	.40	.94	.42	.94	.31	.77
Online	Salaried	.27	.97	.09	.57	.11	.56	.14	.61	.09	.54	.11	.56
	Home worker	.19	.96	.03	.21	.11	.47	.08	.46	.04	.25	.05	.26
	Middle/high	.27	.67	.01	.08	.11	.42	.13	.45	.05	.24	.09	.33
	College	.19	.63	.03	.17	.07	.30	.09	.37	.02	.14	.04	.19
	Tech/ prof	.16	.62	.01	.09	.07	.31	.09	.52	.06	.32	.07	.28
	Mean	.22	.82	.04	.33	.10	.44	.11	.49	.05	.35	.07	.37

Table 3 Mean closeness of communication relationships by medium and employment category

Respondent Employment Category	N	FtF		Email		Instant Messenger		Mobile Phone		SMS	
		M	s.d.	M	s.d.	M	s.d.	M	s.d.	M	s.d.
Salaried	262	4.41	.64	4.23	.86	3.69	1.65	4.61	.56	4.56	.54
Homeworker	210	4.60	.49	4.44	.76	2.13	2.27	4.70	.44	4.56	.54
Middle/high student	97	4.57	.62	4.16	1.21	3.64	1.76	4.64	.52	4.55	.58
College student	206	4.65	.47	4.13	1.07	4.13	1.27	4.69	.44	4.57	.49
Technical/ professional	106	4.54	.50	4.45	.65	3.44	1.89	4.63	.52	4.60	.50
Total	881	4.54	.55	4.27	.92	3.38	1.93	4.66	.50	4.57	.53

Note: Closeness was measured as 1 = not close to 5 = extremely close.

Table 4a-b Summary ANOVA tables for differences in mean closeness

a. Repeated measure ANOVA table, within-subjects effect (medium and interaction)

Effect	Wilks' Lambda	df	F
Medium	.639	4.0	123.5 ***
Medium * employment interaction	.786	16.0	13.7 ***

b. Repeated measure ANOVA table, between-subjects effect (employment)

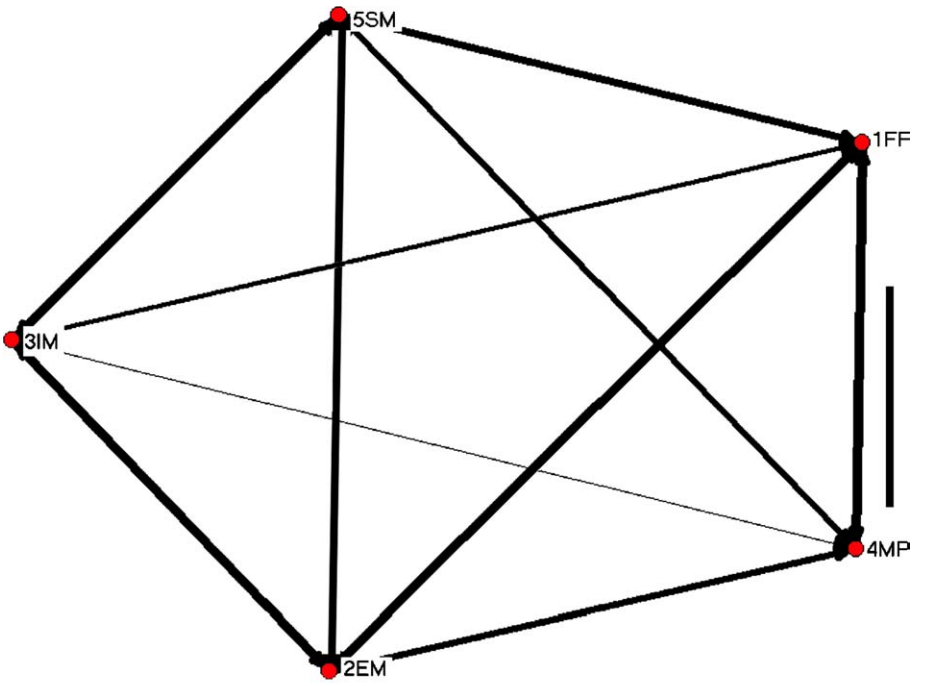
Source	SS	df	MS	F
Intercept	69442.6	1	69442.6	43191.7
Employment	66.5	4	16.6	10.3 ***
Error	1408.4	876	1.6	

Notes: As we used multivariate tests (instead of a within Subject test) because of the sphericity problem, the two table formats are not the same.
*** $p < .001$

clustered with email and SMS while being least similar to FtF and especially mobile phone. Thus, these five media are not interchangeable, although some are quite similar to others. However, these comparisons are visual and not statistical.

Network Level: Statistical Analysis of Configurations of Relationships by Medium

The first column in Table 5 provides the overall test explaining the FtF configuration by the other four media configurations, using MRQAP. The mobile phone configuration provides the strongest association with the FtF configuration (beta = .69, $p < .001$; adjusted $R^2 = .65$ ($p < .001$). Indeed, this swamps the effects of all other media such as email, instant messaging, and SMS (betas for email, messenger, and SMS were .51, .12, and −.30, respectively, all n.s.), largely due to the strong



Pearson Correlation	F F	M P	I M	E M	S M
.90	X	X	.	.	.
.89	X	X	.	X	X
.87	X	X	X	X	X
.74	X	X X	X	X	X

Figure 1 Multidimensional scaling of the five media configurations of relationships, with hierarchical clustering showing clusters at each cutoff
Note: FF = face to face; EM = email; IM = instant messenger; MP = mobile phone; SM = SMS

intercorrelation among the media pairs noted above, so that there is little variance remaining after the strongest association is removed.

Network Level: Descriptive Analysis of Configurations of Relations by Medium and Employment Category

Figures 2, 3 and 4 show multidimensional scaling of configurations of the social roles based on the correlations among them, as derived from the A*k* matrix (the frequency of co-mention of the 15 social roles for the *k* medium—here, FtF, email, and IM). Due to space limitations, we selected the three most different from each other, based on the overall multidimensional scaling and clustering in Figure 1 (the figures for mobile phone and SMS are available from the authors). Line thickness is proportional to the *similarity* (correlation) between each pair of relations.

Table 5 Multiple QAP regressions explaining the FtF configuration of relationships from configurations of other media relationships, overall and by employment category

Employment Category						
Medium	Overall	Salaried	Home worker	Middle/high school student	College student	Technical/ professional
Email	.51	.63 *	−.01	.25	.13	.56 **
Instant Messenger	.12	.07	−.09	.24	.25	−.11
Mobile Phone	.69 **	.49 *	.68 *	.76 ***	.89 **	.41 *
SMS	−.30	−.32	.37	−.20	−.24	.06
Adj R^2	.65 ***	.70 ***	.90 ***	.88 ***	.96 ***	.78 ***

Notes: Values for each explanatory medium matrix are standardized beta coefficients *p < .05; **p < .01; ***p < .005

For FtF, relations involving spouse and children are most central and mediate between other relatives and work relations. Within work relations, co-worker and boss relations are most similar. Relations among school and friends and one's professor are quite distinct from the family/work relations. Note that the configuration of relationships in FtF is quite differentiated, with school relations on one side, family relations in the middle (with spouse and children central), and work relations on the other side.

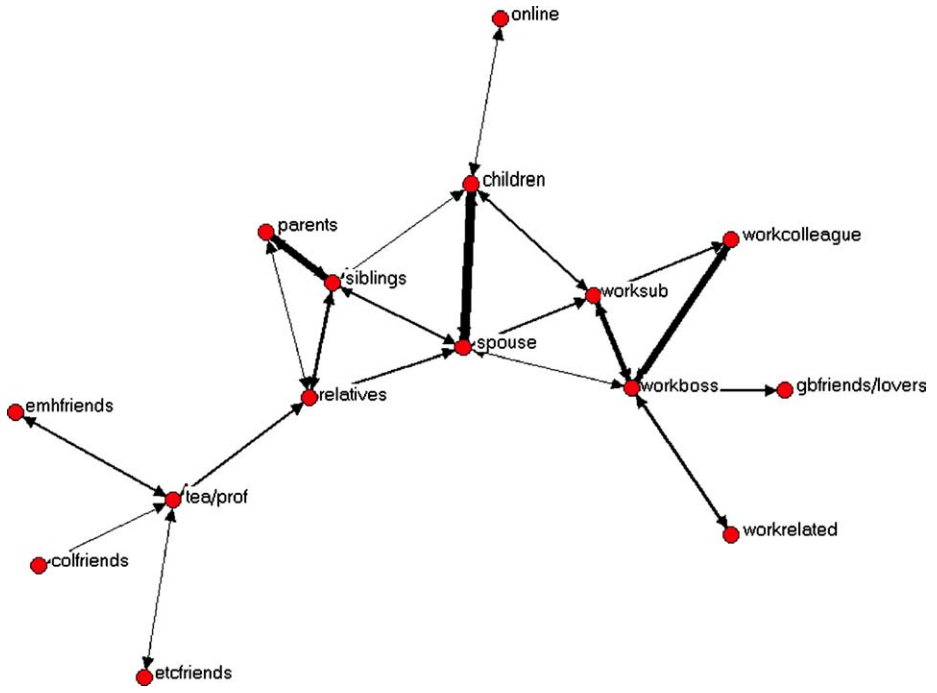


Figure 2 Configuration of FtF relationships

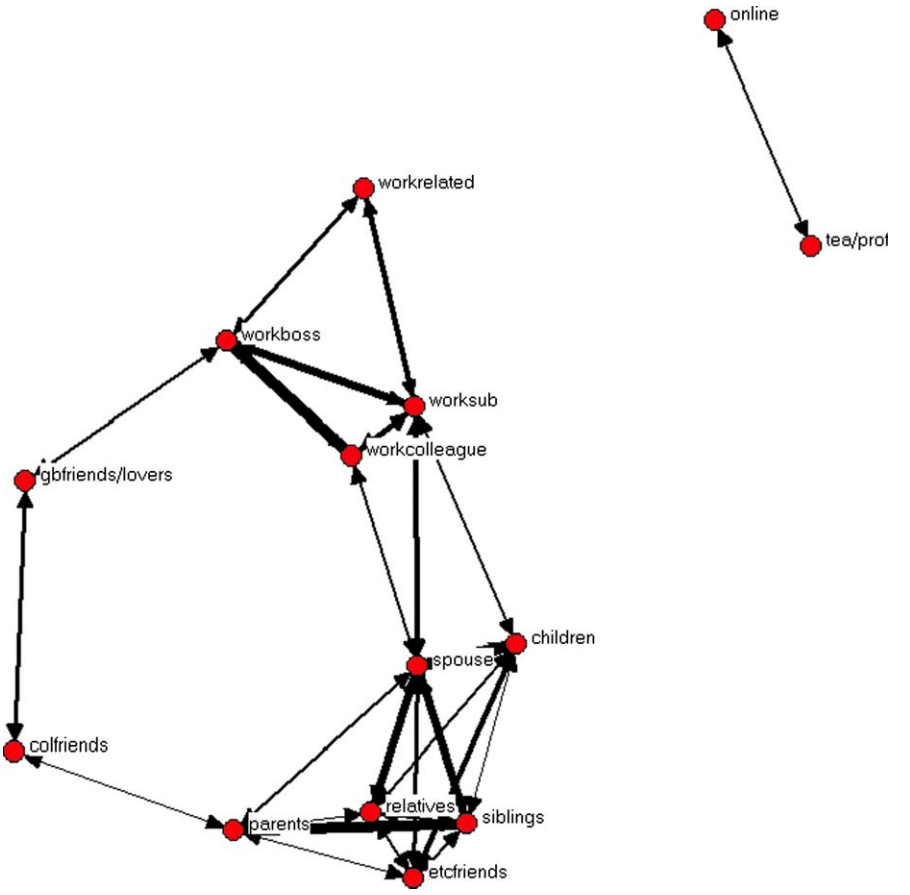


Figure 3 Configuration of email relationships

Email apparently allows for denser interrelations among workers, but it also does so among relatives, presumably because of its ability to overcome distance and time constraints (due to its asynchroneity, unlike the mobile phone) on communicating with them. Online and teacher/professor relations become a completely distinct social arena, presumably representing the educational communication domain.

Instant messaging seems predominantly to involve children, spouse, siblings, and parents, and more centrally but less frequently, relatives and other friends—i.e., it is a family medium. There are also shared relations involving workers, but they are somewhat less separated from the family network than in FtF or especially in email. Note that while the configuration of one's communication with a spouse and with one's work boss is somewhat similar in FtF and in IM, there is no such similarity in the email medium.

The configuration of relations among the social roles through the mobile phone (not shown) are much denser than in the other media, except for the clearly distinct

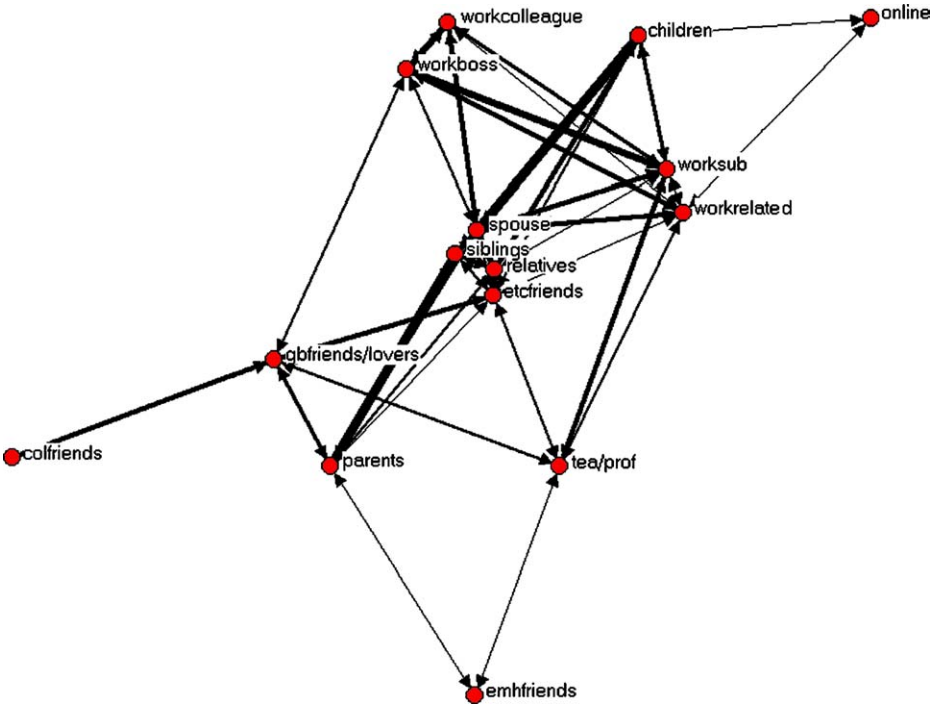


Figure 4 Configuration of instant messenger relationships

dyad involving college friends and girl/boy friends and lovers. Although still closely related through the spouse, the work subnetwork and the family subnetwork are distinct, unlike in IM. Mobile phone relations also have stronger relations (greater similarities/correlations) within each of those subnetworks than in the FtF network. Siblings, children, and parents are at the center of the SMS network (not shown), indicating that this medium is used to coordinate the activities and whereabouts of family members. There are also strong relations between spouse and work subordinates, indicating that people are trying to manage aspects of both their work and family life.

Network Level: Statistical Analysis of Configurations of Relations by Medium and Employment Category

To test for differences in configurations across media by the respondents' employment categories, we separated the original five data matrices into 25 matrices, one for each medium (5) by employment category (5) combination. Then for each employment category, we tested the influences of the new media configurations on the FtF configuration, as we did above. Not surprisingly, the remaining columns in Table 5 show that the similarity between mobile phone and FtF relations was strong and significant for all employment categories. Students report the most similar patterns of relations with people in the various social roles between FtF and mobile phone communication.

However, homemakers' relations through email and instant messenger are essentially completely independent of their FtF relations. Homemakers may use these CMC media to keep in touch with social roles whom they cannot frequently meet in person—old friends, relatives, etc. For both salaried and technical/professional users, the greatest similarity in configurations occurs between email and FtF, although their mobile phone configuration is also similar to their FtF configuration of relationships. Unlike the younger generations (middle/high school and college students), for these organizational workers email is a medium frequently used in the maintenance of the same kinds of relationships managed through FtF. This may be so for several reasons. First, organizational workers are old enough to have experienced email when it was introduced earlier, so that they feel comfortable using email (rather than using other media). Second, in workplaces, email is a crucial medium supporting work tasks with fellow employees (Rice & Webster, 2002).

Summary and Discussion

Limitations

The present results are clearly provisional and non-generalizable. First, social network analysis is typically applied to the members of a closed group or organization. Since the data were obtained from a public online survey, complete networks could not be obtained. Instead, we used the common approach of collecting ego network data and specific social roles (e.g., homemaker, salaried worker) but transformed these 2-mode matrices (respondents by social roles) into 1-mode matrices (social role by social role) for each medium, and then analyzed those matrices for each employment category. Thus, even though there was no complete system-wide network roster (impossible for a random survey), our approach of using specific social roles in the network analyses allowed us to identify and examine the patterns of social relations through various media.

Second, although the survey was carefully designed, it was a public web-based survey, so there is no known sampling frame, response rate, or sample generalizability. However, it applied a quite rigorous sampling design for web surveys and did generate a reasonable distribution of the employment categories representative of new media users in Korea.

Number, Unique, and Duplicate Relations by Medium and Employment Category

Overall, the media with the largest number of reported partners were FtF and mobile phone, with IM having the fewest. Employment categories differed significantly in the number of reported relations across all the new media, albeit not for FtF. This by itself reveals a difference in social configurations of FtF compared to new media—that is, people in different employment categories use the new media to support slightly different numbers of relations, unlike in FtF, which seems to be a sort of universal channel. In particular, workers had more relations in email, college students had more relations in IM, and middle/high school students had fewer relations in both mobile phone and SMS.

Concerning unique and overlapping relations (i.e., a specific partner—not general social role—identified in two or more media), middle/high school students had the fewest unique relations, while workers had the most. That is, young students managed a more general configuration of relationships through multiple media, while workers seem to manage somewhat different sets of relationships through each medium. However, people working outside the home seem to complement their FtF relations with specific partners through email, especially with other work-related people. This might motivate further research on the social influence of communication technologies, in the sense that the nature or characteristics of communication technologies are significantly defined through, and through use with, significant others (Licoppe & Smoreda, 2005).

Relational Closeness by Medium and Employment Category

The mobile phone supports communication with the closest relationships (not FtF, even though it supports the most relationships) and IM with the least close relationships. It is probably not easy to avoid having conversations with weak relations in FtF communication settings, but the mobile phone can be used to communicate with, and maintain, only close relations. One implication is that recent Korean mobile services such as "bus-ting (bus meeting)," which is heavily invested in by the three big telecommunication companies in Korea (KTF, KT, and SKT), might not be successful for a while. In this service, telecommunication companies send the phone numbers of registered users to each other when more than one user gets on the same bus, as indicated by a phone number sensor on the bus and transmitted to the phone service. The criterion for the match is common hobbies and interests, previously entered through the mobile phone by the user and stored in the company's database. The three companies (who otherwise compete with each other) collaboratively offer the service, perhaps fearing that the service would not be popular or profitable enough as competing services. From the perspective of this study, this means that the separately-supported networks would not represent each user's full mobile phone network. Considering that, as found in this study, one of the major roles in mobile phone use is reinforcing existing social networks, mobile services separated from users' existing social network are unlikely to succeed.

While the mobile phone is used as a narrowing-down medium (to communicate with people with strong ties), IM tends to be used as an expanding medium. For example, students and young adults tend to use IM as a group-talking tool, in which they often invite and are invited to talk with persons who may be involved with the group but not strongly with the individual.

Homeworkers overall had the fewest close relations across the media. However, there was a medium by occupation interaction: Homeworker relations through email, as well as IT technical workers' and professionals' relations through email, involved the closest partners. Since homeworkers' social movement may be somewhat limited (if they are responsible for raising children or taking care of elderly family members, as is common in Korea), their email communication partners

might be people with whom they would not be able to communicate easily via FtF. It also makes sense that IT workers are comfortable using email to keep in touch and manage their projects with close partners.

Configurations of Relationships by Medium

The configurations of relations in FtF and mobile phone are very similar, constituting a cluster separate from the other three media (IM, email, and SMS). Moreover, the mobile phone relations are the sole unique predictor of the FtF relations (although all the media configurations are significantly interrelated at the bivariate level). Thus, at least in Korean society today, these two channels represent similar social uses; mobile phone and FtF communication seem to support and reinforce the same network of relationships.

Similarly, for each of the five employment categories—and especially for students—the mobile phone configurations of relationships were significant predictors of the FtF configuration. For organizational workers, the configuration of relationships through email also was a significant predicter of the configuration of social relations in FtF. IM, email (except for workers), and SMS relationships, *after controlling for mobile phone relations* (which are otherwise significantly similar), are independent from FtF relations, as indicated by the cross-medium cluster analysis.

Configuration of Relationships by Medium and Employment Category

Multidimensional scaling of communication with the 15 different social roles (grouped as family/relatives, friends, work-related, teacher/professor, and online) for each medium showed some variation in the social configurations. In FtF, spouse and children were most central, with friends and fellow students quite distant. Email seems to foster greater similarity among workers and among relatives but isolates online and teacher relations. IM seems to be a family medium, with some simultaneous management of work relations. The mobile phone seems to integrate all the social roles (while distinguishing between work and family subnetworks), save for college friends and boy/girl friends. Finally, SMS seems to foster relations among the nuclear family, again with some management of work relations (especially subordinates).

Overall, FtF seems to be the common medium for the three major employment categories, while each category has it own distinctive set of complementary media: IM, SMS, and mobile for students, mobile for homeworkers, and email for organizational workers. The mobile phone in Korea is used as sort of a multiplexing device for maintaining everyday relationships. Also, as friends appear in almost every medium, friendship seems to be an important element of Koreans' social lives (at least for those in their teens to their 40s). A rather clear divide seems to exist between the use of email by older people and the use of mobile phone (and IM and SMS) by younger people. Further, the social environment of working in an organization is obviously a supportive context for using email to communicate with others. Homemakers intentionally used CMC media (email and messenger) to communicate with

people who may not readily appear in their FtF communication. Thus we believe that exploring the configurations of relationships involving the social contexts of users of FtF and new media and their communication partners has provided some insight into the complementary, as well as the unique uses and implications, of new media.

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About the Authors

Hyo Kim is an assistant professor in the Department of Media at Ajou University. His research interests include communication technology (CMC and mobile), organizational and science communication, and social network analysis.
Address: Sanhag-won Ajou University, San 5 Woncheon-dong Yeongtong-gu, Suwon, Korea (South) 433–749

Gwang-Jae Kim is a Ph.D. candidate at Sogang University in Korea. His research interests include social acceptance and diffusion of information technologies and new media (including Digital Multimedia Broadcasting, IPTV, and Wireless Broadband.
Address: Gabriel-gwan 1 Shinsu-dong Mapo-gu, Seoul, Korea (South) 121–742

Han Woo Park is an assistant professor at YeungNam University. He conducts research on various computer-mediated communication issues, focusing on the use of new digital technologies in extending social networks, and the role of communication in scientific, technical, and innovative activities.
Address: 214–1 Dae-dong Gyeongsan-si Gyeongangbuk-do, Koea (South) 712–749

Ronald E. Rice is Arthur N. Rupe Chair in the Social Effects of Mass Communication in the Department of Communication, and Co-Director of the Carsey-Wolf Center for Film, Television and New Media, at University of California, Santa Barbara. He has conducted research and published widely in communication science, public communication campaigns, computer-mediated communication systems, methodology, organizational and management theory, information systems, information science and bibliometrics, social uses and effects of the Internet, and social networks.
Address: 5844 Ellison Hall University of California Santa Barbara, CA 93106–4020 USA