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ARTICLE

Untangling the technology cluster: mobile telephony, internet use and the location of social ties

RADHAMANY SOORYAMOORTHY
University of KwaZulu-Natal, South Africa

B. PAIGE MILLER
Louisiana State University, USA

WESLEY SHRUM
Louisiana State University, USA

Abstract

Among the communication technologies introduced in the developing world during the past century, none has grown more rapidly than mobile telephony. Yet the impact of mobile phone use on social relationships has received limited systematic study. This article examines the factors associated with mobile phone usage in the south Indian state of Kerala and the social structural consequences of such usage, particularly the composition and location of the social ties maintained through mobile technologies. Bivariate analysis of mobile phone usage and network composition shows that frequent users have fewer local ties and more external ties than non-frequent users. However, these effects are due largely to the association of email and mobile phone use. The article shows that internet use increases, while mobile phone use decreases the geographical diversity of social ties. The implication is that mobile telephony and internet technologies may have different consequences for the globalization process.

Key words
cellphone • email • ICTs • India • internet • Kerala • mobile phone • social networks

INTRODUCTION

A central problem in studies of new media and society concerns multiplexed social interaction, the ways in which new technologies impact the social relationships of their users. This article addresses this issue in the context of Kerala, a state in southwestern India, through face-to-face surveys of professionals and staff members at two academic colleges and a large software company. While our specific interest at the time of the study was the relationship between mobile phone use[1] and the nature of social ties, we recognized that email already had become an important means of communication in Kerala, at least for our highly educated population of respondents. Any examination of mobile phone use in a developing context would need to take account of this other medium. Indeed, we found that respondents often could be characterized as users of multiple communications media: mobile phones were becoming a part of their 'technology cluster' involving computers, connectivity, internet and email use.

While multiple technologies often are used to maintain social ties, the impact of mobile phones on the structure of respondents' social networks proved to be markedly different from that of email. The analysis below shows that these new information and communication technologies (ICTs) are not associated with the relational structure but significantly associated with the locational structure of social networks. The implication is that mobile telephony decreases, while email use increases the geographical range of social ties, implying different consequences for the globalization process.

Although the role of ICTs in the globalization process has received a great deal of attention and there are many systematic analyses of these technologies in the developed world, little is known about their use in developing areas. Specifically, this article addresses the role of mobile phones and email in social networks and their implications for the role of ICTs in the globalization process. Because ICTs are expected by many within the development community to aid less developed countries and integrate them into global structures, the impact of such technologies on the social networks of their individual users is a crucial area of study.

THEORETICAL BACKGROUND

New patterns of social relationships have emerged with the transformation of technospace. Licoppe (2004) provides an account of the 'connected' management of relationships in which the physical absence of a person is rendered presence by the multiplication of mediated communication gestures.

The new literature on mobile telephony suggests that, unlike other ICTs such as the internet and email, rapid adoption of the mobile phone is just beginning as a serious academic interest (Atkin, 1993; Cohen and Lemish, 2003; Özcan and Koşak, 2003; Rogers, 2003).[2] Much of the available empirical research on the topic of mobile telephony focuses on the characteristics of technology users and the factors determining adoption versus non-adoption (Leung and Wei, 1999; Rogers, 2003).

Within a single communication technology such as the mobile phone, there is great variation in the degree and forms of use. Reid and Reid (2004) find two types of mobile users – 'texters' and 'talkers' – who vary in personality and use of mobiles. Texters were more likely to be lonely and socially anxious, with difficulties in traditional face-to-face communication that could result in smaller social networks. Texting affords a distinctive medium of personal contact for maintaining existing relationships and developing new relationships within a closely knit group of 'textmates'. Technologically oriented individuals do not use technologies in isolation but utilize a cluster of technologies to enrich their communication repertoire. The notion of a technology cluster is consistent with Haythornthwaite's (2001) approach to multiplexed social interaction, which is employed in this article: multiple types of interactions are accomplished through the variety of media available for communication, providing a more revealing picture of social interaction. Using data from their 2000 study of mobile phone and internet use, Rice and Katz (2003) report similar adoption patterns for the two technologies. This finding highlights the complementarity of technologies in which users, compared to non-users, tend to adopt other innovations with broadly consistent functions. On the one hand, in the context of communications technologies, considerable evidence exists for 'media multiplexity': the more contact by one medium, the more contact by others (Boase et al. 2006; Haythornthwaite and Wellman, 1998). On the other hand, Dimmick et al. (2000) argue that the emergence of a new medium of communication may lead to the exclusion, replacement or displacement of old media, when new media take over some of the roles played by the old media. The replacement of landlines by mobile phones is one instance of this process, but there has been a general interest among analysts in the replacement hypothesis since the internet became popular (Boase et al., 2006).

This crucial work provides fundamental insight into the process of adoption of new ICTs, but leaves open the question of whether new technologies have similar impacts on social interaction and social networks. Put another way, technological complementarity in Dimmick's sense refers to an association of usage: one technology is complementary to another when a population of potential adopters tends to use both rather than simply one or

neither. However, there is also another aspect of 'complementarity': one technology is complementary to another when it serves a related function, as forks and spoons work together in eating different types of food. In this regard, the ways in which mobile phones and the internet are reordering the social relations of the people who use them is a relatively unexplored area, particularly since similar adoption behaviour does not necessarily go hand-in-hand with similar consequences. The question of whether mobile phones and email have similar effects on the social networks of their users has not been addressed yet in the literature. For example, Baym et al. (2004) argue that patterns of interpersonal media use are heavily dependent on geographical location and, to a lesser extent, on the closeness of the relationship. The internet is used to form meaningful new relationships and to extend existing social networks (Baym et al., 2004; Thurlow and McKay, 2003). Oksman and Turtiainen (2004) report a similar finding for prolific mobile phone users: not only are mobile phones used to maintain existing social networks, they are also meaningful in the establishment of new relationships. Chen et al. (2002) report that telephones were used for most local relationships, while long-distance relationships were maintained by email. However, regardless of distance, email was used more with friends than relatives. In general, the findings of these studies agree that communication technologies transform and rearrange the relations between domestic and public spaces (see also Morley, 2002).

The objective of the current analysis is threefold. First, it seeks to understand one dimension of the relationship between technologies: is mobile phone use associated with ICTs such as computers, the internet and email? Do they complement each other, in the sense that the same people tend to utilize these other technologies, or substitute for each other, in the sense that regular users of cellphones are less likely to use other means of communication? Second, it examines whether characteristics of the social networks are associated with more frequent communication by mobile phone and email. Finally, it analyses the types and location of social relationships as a function of mobile phone and email use, as well as factors such as age, gender and status.

METHOD

Since the cellphone first arrived in India in 1995, the rate of adoption has been exponential with an average annual growth of 80 percent, as mobile phones began to exceed the number of landlines in the country. In Kerala the mobile phone has lured millions to the fold of regular subscribers, with a recent figure of 2.3 million connections (5.2% of total mobile phone connections in India) for a population of about 31.8 million people (3.2% of the Indian population) (*The Hindu*, 2005).

The present study's respondents were sampled from three institutions – two academic institutions and one software company – in the capital city of Thiruvananthapuram. The academic institutions are located within a radius of six to 15 kilometres from the centre of the city, while the software firm is located at a recent enterprise development site. The response rate was 88 percent for the software company, 84 percent for the technical academic institution and 63 percent for the general academic institution. Both professionals and non-professionals (including administrative staff) made up the sample of 610 respondents: 123 (20.2%) from the software organization, 385 (63.1%) from the technical academic institution and 102 (16.7%) from the general academic institution. Owing to the structural and empirical similarities of teaching institutions, the technical and academic institutions are combined as 'public sector' in the analysis below, while the software business is labelled as 'private sector'. The sectoral distinction is important as a control in the multivariate analysis, since software professionals have generally higher levels of ICT use.

Five main variables measure mobile phone use in addition to the mere presence or absence: frequency of mobile phone use; number of calls made in a day; number of calls received in a day; duration of the call; and a dichotomous variable measuring daily mobile phone use. Similar measures were used for computer and internet use. Since different operationalizations of technology use are highly correlated, the analysis is focused on two specific measures of ICTs: frequency of mobile phone use and frequency of email use. However, the distinction between daily and non-daily use proved particularly illuminating in the analysis.

Social relationships of respondents were measured through a social network module that asked the respondent to 'name the people who are most important to you' (maximum of 12 names). By late 2002, the time of the survey, the distinction between landline and cellphone had become extremely important in Kerala, so the study distinguished between these means of communication on the network section. The interviewer wrote down the first names or initials of each person, following the listing with a series of questions about each person. The study asked about the type of relation, location, frequency of contact and means of contact.

Relational and locational structure were operationalized by counting the number of ties reported by the respondent in any particular tie category. For example, kinship relations as measured by the number of family members reported as among the respondent's 'most important' ties. Unlike the type of social relationship and the location of the tie, a relationship may be maintained by more than one means of communication. That is, a reported tie might be categorized as a 'friend' located in 'India outside Kerala' who is contacted 'face-to-face' as well as by 'email' and 'mobile phone'. Finally,

measures of media diversity and locational diversity of the respondent's networks were calculated by a count of the number of communications media (averaged across all relationships) or distinct geographical locations in the reported network.

Table 1 presents the background characteristics of the respondents. The average age of the respondents is 36, with males comprising about two-thirds of the sample. Three-quarters were married at the time of the survey and those that were married had an average of 1.52 children (the prevailing norm in Kerala is to have fewer children than in other parts of India). Close to 70 percent are professionals such as engineers, professors or lecturers, with the remaining 30 percent from the cadres of administrative, technical and support staff. Slightly more than half have a master's degree or better, while one in eight possess a doctoral degree. Since these respondents are employed by academic colleges and software firms, their average income is relatively high (monthly income between 10,000 and 15,000 rupees (about $200 to $300 at the time of the survey). Nearly half reported a spouse employed in a regular permanent job in the public sector.

RESULTS

Table 2 presents basic data on mobile phone ownership and usage patterns. About one-third of the respondents have their own mobile phones, but there is a clear sectoral disparity between the private and public respondents; this difference appears throughout much of the table. Of the full sample, 42 percent have never used a mobile phone, while one-quarter had used one before but never owned it. Here the division between the private and public respondents tends to be sharp: nearly all of the private sector respondents had used a mobile phone, contrasting with only half of public sector respondents.

• Table 1 Respondent profile

VARIABLE	FULL SAMPLE	N
1	**2**	**3**
1. Male	63%	610
2. Age	36.5	610
3. Single	25.1%	610
4. Number of children	1.52	458
5. Professional	69.7%	610
6. Possession of master's degree	51.8%	610
7. Monthly income	3.33[a]	610
8. Spouse permanently employed in public sector	45.0%	458

[a]1 less than Rs, 5000; 6 = 25,000 and above

At the time of our survey, many of the users were still relative novices – slightly more than one-third had owned such a phone for more than two years.

For the present analysis this article is most interested in the frequency of use, that is, the degree to which the mobile phone has become important in extending or maintaining social relationships. Unsurprisingly, the most prolific

• Table 2 Mobile phone use by sector

MOBILE PHONE VARIABLES	PRIVATE	PUBLIC	FULL SAMPLE	N
1	2	3	4	5
1. Own a mobile phone (%)***	60.2	22.2	29.8	610
2. *Category of mobile phone use* (%)***				609
a. Never used	4.1	51.4	41.9	
b. Used but never owned	29.3	24.3	25.3	
c. Used and owned in the past	6.5	2.7	3.4	
d. Use and own now	60.2	21.6	29.4	
3. *How long owned a mobile phone* (%)**				179
a. Less than a month ago	–	5.7	3.4	
b. Less than six months ago	29.7	12.4	19.6	
c. Less than one year ago	5.4	9.5	7.8	
d. Between one and two years	31.1	33.3	32.4	
e. Between two and three years	23.0	24.8	24.0	
f. Above three years	10.8	14.3	12.8	
4. *How often use mobile phone* (%)***				596
a. Everyday	70.9	20.9	30.7	
b. Several times a week	5.1	5.8	5.7	
c. Once/twice a week	6.8	7.7	7.6	
d. Once/twice a month	8.5	4.2	5.0	
e. Less than once a month	8.5	61.4	51.0	
5. *Calls made in a day* (%)***				306
a. Two or less	45.1	71.5	61.8	
b. Three to 10	46.9	27.5	34.6	
c. More than 10	8.0	1.0	3.6	
6. *Calls received in a day* (%)***				302
a. Two or less	31.5	56.0	47.0	
b. Three to 10	57.7	38.2	45.4	
c. More than 10	10.8	5.8	7.6	
7. *Duration of a call* (%)***				349
a. Less than a minute	7.9	45.1	33.0	
b. Between two and five minutes	69.3	53.2	58.5	
c. Between six and 10 minutes	17.5	1.7	6.9	
d. More than 10 minutes	5.3	–	1.7	

Results of Chi-square test. ***, **, * significant at the .01, .05 and .1 levels respectively.

users of mobile phones are the private sector employees, 71 percent of whom use one daily, against only 21 percent of the public sector respondents. This difference remains constant for dimensions of use that pertain only to mobile phone users, such as calls made and received. Note that the sample is reduced by half when non-users are eliminated and calls received in India are not charged to the owner of the phone, unlike the USA. The last dimension, intensity of mobile phone use, is the duration of a typical call made or received by the respondents. Most calls last fewer than five minutes. Consistent with other dimensions of use, private sector respondents spend more time on their mobile phones than public sector respondents (Chi-square tests show that sectoral differences are significant for all Table 2 variables).

The first question is whether the use of the mobile phone is associated with access to and use of other ICTs such as landlines, computers, the internet and email. That is, do they complement the communication needs of the respondents, in the direct sense that those who use mobile phones also tend to use other means of communication? Or does mobile phone use substitute for other technologies, in the sense that regular users are less likely to use them? Table 3 shows that mobile phone use is associated significantly with computer and internet access. While daily users and non-daily users have equal access to landlines, they differ significantly in their use of other ICTs. Daily mobile users are significantly more likely to have a computer at home (59.3%, compared to 38.3%) and at work (90.2%, compared to 78.5%) than non-daily users. Interestingly, daily users tended to acquire their home computers earlier but their work computers later than the non-daily users, reflecting their personal technological orientations rather than their work opportunities. Still, daily users are significantly more likely to be connected to the internet at work than non-daily users (92.7% compared to 81.3%).[3] This finding is specified further in the third set of factors (web and email). While these are highly correlated – and the difference is sometimes confused in the minds of some of the respondents – daily mobile phone users were more likely to browse the web, use email and to do so approximately two years earlier than non-daily users. In short, the data on the computer, internet access and web use support the notion of a close relationship between daily mobile use and other ICTs, representing a pattern in which mobile phone users tend to adopt other technologies with broadly similar functions.

The second question is whether social network characteristics are associated with the use of particular communications technologies. Since the focus is the relationship between mobile telephony and the internet, first the differences between daily and non-daily users in the number of personal relationships maintained by these communication technologies are examined. As shown in the first panel of Table 4, the difference between the daily and

• Table 3 Access to and use of ICTs by mobile phone users

Other ICT access	Daily mobile users	Non-daily mobile users	N
1	2	3	5
1. *Access to landline (%)*			596
a. At home only	1.1	.2	
b. At work only	12.6	12.1	
c. Both home and work	86.3	87.4	
2. *Computer*			
a. Year first knew computer [a]	1987.42	1986.68	596
b. Computer at home (%)*** [b]	59.3	38.3	589
c. Year home computer acquired *** [b]	1998.48	1999.42	266
d. Computer at work (%)*** [a]	90.2	78.5	596
e. Year work computer available** [b]	1996.24	1995.04	489
f. Internet at home (%) [a]	71.6	66.2	266
g. Internet at work (%)*** [a]	92.7	81.3	491
3. *Web and email*			
a. Ever browsed web (%)*** [a]	89.6	52.3	596
b. Year first knew web*** [b]	1996.61	1998.03	596
c. Year first used web*** [b]	1997.63	1999.06	380
d. Ever used email (%)*** [a]	89.6	55.7	596
e. Year first knew email*** [b]	1995.91	1997.08	596
f. Year first used email*** [b]	1997.48	1998.99	394

Results of Chi-square test (a) and independent *t*-test (b); ***, **, * significant at the .01, .05 and .1 levels respectively.

non-daily users of both mobile phones and email is statistically significant for the majority of the measures of communication structure. Rows 1 to 5 of Table 4 represent the number of reported relationships that involve a particular type of communication (face-to-face, letter, landline, mobile, email). Of course, many relationships involve more than one type of communication and it is not uncommon for a relationship to involve several.

Table 4 shows that frequent users of both technologies have larger mobile phone and email networks but smaller face-to-face and landline networks. The difference for the size of the social network maintained by letters is significant for mobiles but not email – letters are by far the least frequent means of communication among close personal associates. We would be surprised only if there were fewer email contacts maintained by daily email users. What may be more important about Table 4 is that daily mobile users also report more social relationships that are maintained by email, and daily email users also report more relations maintained by mobile phone. The

• Table 4 Mobile use and means of social interaction

No.	Network variables (no. of reported network ties)	Daily mobile use	Non-daily mobile use	Daily email use	Non-daily email use
1	**2**	**3**	**4**	**5**	**6**
1.	Size of face-to-face network	5.65*** (2.96)	7.32 (2.69)	5.51*** (2.98)	6.95 (2.18)
2.	Size of letter network	.202*** (.57)	.38 (.97)	.316 (.88)	.309 (.88)
3.	Size of landline network	4.91*** (3.2)	6.84 (2.89)	4.70*** (3.44)	6.86 (2.88)
4.	Size of mobile phone network	3.73*** (2.8)	.45 (1.2)	2.93*** (2.97)	1.27 (2.17)
5.	Size of email network	3.22*** (2.30)	1.34 (2.12)	4.75*** (2.90)	1.73 (1.77)
6.	Average number of communication means used in relationships	1.96*** (.55)	1.76 (.43)	1.96*** (.55)	1.82 (.49)

Results of independent *t*-test; ***, **, * significant at the .01, .05 and .1 levels respectively.

differences are larger for the size of the networks maintained by their associated technologies. Still, Table 4 implies that those who make frequent use of mobile phones and email tend to develop networks that are technologically mediated.

Table 4 also shows that non-daily users have significantly larger face-to-face and landline networks. Non-daily mobile users report a face-to-face network size of 7.32 compared to 5.65 for daily users and a landline network of 6.84, compared to 4.91 for daily users. The latter is, of course, unsurprising. The properties of mobile telephony made it a more direct substitute for wired telephony than for internet communication in south India at the time of the survey, although the introduction of voice over internet protocol (VOIP) has changed that. For non-daily email users, face-to-face network size is 6.95 compared to 5.51 for daily email users, and landline network size is 6.86 compared to 4.70 for daily users. The last finding in Table 4 is that frequent use of mobile and email technology is associated with more diverse means of communication. The diversity was measured by a simple count of the number of communications media for each relationship, averaged across all relationships. Since email and mobile users tend not to reject other media of communication, they maintain relationships using more technologies – 1.96 compared to 1.76 for mobile phones users and 1.96 compared to 1.82 for email users.

We have seen that the use of these two focal communications technology (mobile phone and email) is associated with social network characteristics: frequent users have larger mobile and email networks but smaller face-to-face and landline networks. However, what kind of relationships are they, and where are they located? Using the same distinction between daily and non-daily users for both mobile phone and email technologies, Table 5 presents the results for five types of relationships, seven categories of proximity and one general measure of diversity. Row 6, panel 1 indicates that no significant difference exists between daily and non-daily users of either mobile phone or email in terms of the size of their networks (non-daily users report slightly more ties, but the difference is not statistically significant).

There are two important findings in the first panel of Table 5. First, rows 1 and 2 indicate that daily mobile and email users report significantly larger friendship but smaller family networks ($p<.01$). Work networks are approximately the same, regardless of the level of use of email of mobiles. These networks are smaller for frequent email users, while no significant difference exists between daily and non-daily mobile users in the size of this network.

The second panel in Table 5 pertains to the location of the relationships. The second important finding is that daily mobile and email users report significantly larger external but smaller local networks ($p<.01$). Rows 1 to 7 describe the location of ties in broadly (although not strictly) increasing zones. The nearest zone – that is, the most 'local' social context – is the capital city of Thiruvananthapuram. Daily mobile and email users have significantly fewer contacts within this geographical area than non-daily users (row 1). This difference in network size was reported also for hometown networks (mobile phone only), for other towns and rural districts (email only). However, these networks are more difficult to interpret in terms of geographic proximity, since we do not know the specific location in Kerala. Rows 5 (outside Kerala but within India) and 6 (outside India) are straightforward measures of social ties that occur outside the state. They have been combined additively as a measure of external (non-local) relationships in row 7. Regardless of the measure used, daily mobile and email users have more external contacts (contacts outside Kerala) than non-daily users.

The final row of Table 5 employs a measure of relational diversity. Diversity is a simple additive sum of the number of different locational categories for the respondent's social ties, ranging from one, if the respondent's ties are all in one place, to six, if the respondent has ties in all of the locational categories provided. The additive nature of the measure makes it relatively easy to interpret: the higher the number, the more diverse the respondent's network in terms of the locations where social relationships are maintained. Row 8 shows that frequent email users have the most diverse ties (2.83 locations),

• Table 5 Mobile use and network structure

No.	Network variables	Daily mobile use	Non-daily mobile use	Daily email use	Non-daily email use
1	**2**	**3**	**4**	**5**	**6**
I	*Type of relationship*				
1	Size of family network	3.09★★★ (1.77)	3.70 (1.88)	3.06★★★ (1.80)	3.86 (1.89)
2	Size of friendship network	2.98★★ (2.24)	2.51 (2.11)	3.24★★★ (2.19)	2.62 (2.17)
3	Size of work network	2.57 (2.04)	2.72 (1.82)	2.64 (2.11)	2.51 (1.78)
4	Total network size	9.02 (1.99)	9.29 (1.91)	9.24 (2.02)	9.44 (1.82)
II	*Location of relation*				
1	Size of capital city network	5.60★★★ (2.55)	6.40 (2.56)	5.30★★★ (2.41)	6.05 (2.41)
2	Size of hometown network	.47★★ (1.17)	.71 (1.65)	.795 (1.37)	.567 (1.42)
3	Size of network in other towns	1.07 (1.63)	1.01 (1.61)	.807★★★ (1.25)	1.37 (1.84)
4	Size of network in other rural districts	.21 (.82)	.28 (.84)	.111★★★ (.49)	.341 (.99)
5	Size of network outside Kerala but in India	.98★★★ (1.36)	.49 (1.03)	1.32★★★ (1.58)	.562 (1.01)
6	Size of foreign network	.70★★★ (1.25)	.397 (.77)	.906★★★ (1.29)	.558 (.89)
7	Size of external network	1.68★★★ (1.89)	.886 (1.38)	2.22★★★ (1.99)	1.12 (1.42)
8	Diversity of relationship locations	2.51★★ (.95)	2.34 (1.00)	2.83★★ (.88)	2.59 (.98)

★ The dependent variable 'external network' is the sum of 'Outside Kerala in India' and 'Foreign', such that the mean differences shown in row 7 are not independent of the results in rows 5 and 6.

significantly more than non-daily users (2.59). Similarly, frequent mobile phone users have more diverse ties (2.51) than infrequent users (2.34). In sum, the last panel of Table 5 reveals an inverse relationship between the daily use of email and mobile phones and contact proximity, with daily users reporting more distant contacts but fewer local contacts, as well as more diverse networks in terms of location.

We have seen that frequent users tend to develop networks mediated by mobile phones and email, but have fewer face-to-face ties than non-frequent users (Table 4), and that the social networks of frequent users are larger in terms of friends and external ties, but smaller in terms of family and local ties

(Table 5). Yet these findings still leave the key question hanging. Since mobile phone use is associated with other computer-mediated technologies such as email (Table 3), is frequent mobile use associated with network structure, independent of factors such as level of email use and age? That is, do mobile owners have larger friendship networks, or does it simply appear so because they are also frequent email users, or younger? While the present data is cross-sectional and it is not possible to make an argument for causality, multivariate analysis allows us to examine whether network size and mobile phone use are associated, controlling for both email use and other variables.

Table 6 shows the results of regressing network size, as defined by the dimensions in Table 5, on the frequency of email and mobile use. The models were estimated with controls for six variables:

- age;
- gender;
- level of education;
- marital status;
- professional status; and
- sector (given the importance of the latter to the usage variables in Table 2).

Table 6 gives standardized beta coefficients for 11 models of network structure, as defined by the dimensions in the column headings. The first three models describe the size of family, friendship and work networks, while the remainder describe the size of the network in various locations from local to global.

Turning attention first to the control factors, it is possible to note that age and professional status have no impact on network size for any model. Gender is relatively unimportant, except for the size of the family and work networks. Women and married respondents have larger family networks than men or unmarried singles, as expected in the Indian context. Women also have smaller work networks and smaller networks outside Kerala but in India. Higher education is not generally important, a fact attributable to the generally high level of education in Kerala. Possession of a master's or PhD degree has a positive association only on the size of the network in the capital city and, to a lesser extent, on the size of one's network in another town. Unmarried singles, as noted, have smaller family networks, but they have larger friendship networks. Singles also have slightly smaller work and international networks. The key finding in Table 6 is that neither mobile phone nor email use are associated with the relational structure of the network – that is, neither are related to any of the main social tie types – but both are associated with the locational structure of the network. Examination of rows 7 and 8 shows that none of the standardized beta coefficients

• Table 6 Regression of social network structure on mobile telephony and email use

Background factors and technology usage variables	Family networks	Friends networks	Work networks	Capital City	Home district	Other town	Rural district	India	Foreign	External network★	Locational diversity
1	2	3	4	5	6	7	8	9	10	11	12
1. Age	−.009	−.120	−.064	−.018	−.052	−.060	−.023	−.116	.082	−.038	−.076
2. Gender (1 = male, 0 = female)	−.181★★★	.066	.104★	−.014	−.012	.044	−.033	.098★	−.034	.053	−.013
3. Education (1= masters/ M.Phil/ Ph.D, 0 = other)	.066	−.085	.061	.150★★	−.067	−.109★	.030	−.027	−.017	−.031	−.079
4. Professional (1= professional, 0=non-professional)	.040	−.072	−.062	−.049	.015	−.004	−.035	.005	−.055	−.030	.014
5. Sector (1= private, 0= public)	.052	.191★★	.044	.249★★★	−.059	.005	.160★	.007	.070	.048	.165★
6. Marital status (1= single, 0 = married)	−.256★★★	.301★★★	−.133★	−.030	.093	−.055	.008	.114	−.136★	.002	−.040
7. Frequency of mobile phone use	−.056	.010	−.039	−.026	−.155★★★	.053	.035	−.001	−.024	−.015	−.174★★★

8. Frequency of email use	−.011	.065	.123	.127	−.020	−.251***	−.019	.161**	.347***	.334***	.260***
$R^{2=}$	.162	.152	.029	.081	.048	.055	.029	.125	.060	.110	.059

$N = 582$, ***, **, * indicate significant at the .01, .05, .1 levels respectively.

* Note that the dependent variable 'external network' is the sum of 'India' and 'Foreign', such that the positive effect of email is not independent of the results presented in columns 9 and 10.

indicating technology use is significant when gender and marital status are held constant. Thus, there is no evidence that email or mobile use is related to the size of family, friendship, or work networks. Columns 5 to 11 show that the frequency of mobile phone use has no association with any dependent variable except the size of the home district network. While this is difficult to interpret, it should be noted that it is the opposite of what was expected – much of the literature on ICT for development assumes that a primary use of mobiles is to keep in touch with remote areas.

On the other hand, email use is associated with the location of one's network ties, particularly the indicators of external contacts in columns 9 to 11. Apart from gender (which has a marginally positive effect on social ties in India outside Kerala) and marital status (which has a small impact on international contacts), no factor other than the frequency of email use is significantly associated with external ties. For the combined measure of external ties, email use is the single significant predictor in a model that explains 11 percent of the variance in network size. The positive beta coefficient indicates that controlling for age, gender, education and marital status, those that use email more often report more social ties outside the state of Kerala, both within India and internationally, while mobile phone use has no impact.

This difference between the impact of email and mobile phone is indicated most clearly by the measure of locational diversity in column 12, when the coefficients for email and mobile phone use are compared. The relationship between email use and locational diversity is positive, consistent with the bivariate positive association in Table 5. However, the relationship between mobile phone use and locational diversity is now negative: greater use of mobile phones is associated with less diversity in the location of one's social ties. Compare the negative coefficient in Table 6 to the last row of Table 5, the positive bivariate impact of mobile phone use on locational diversity is spurious due to its association with email use and other factors. When these factors are controlled for, mobile phone use is associated with less diversity in the locations where social ties are maintained.[4]

DISCUSSION AND CONCLUSION

This article has examined the factors associated with mobile phone and email usage in the south Indian state of Kerala. Its interest in this issue derived from earlier studies of scientists and researchers there, as well as studies of similar populations in Ghana and Kenya, where the strikingly rapid diffusion of mobile telephony has been observed, compared with the relatively slower diffusion of the internet. Particularly, it sought to understand the composition and location of the social ties maintained through internet and mobile technologies.

The empirical findings of this study may be summarized as follows.

1 Mobile phone use in Kerala is associated with a cluster of technologies that includes computers, email and the web.
2 Frequent mobile and email users tend to maintain networks that are technologically mediated, more so than the networks of non-frequent users. However, there is no difference in the overall size of their reported social networks: they simply report more friends and fewer family members within the pool of their significant relationships.
3 Frequent mobile and email users report larger external, but smaller local networks.
4 Neither mobile phone nor email use are associated with differences in the types of relations (family, workmates, friends) in their network, but both mobile phone and email use are associated with the locational structure of the network.
5 Email use is the sole predictor of external network ties and the best predictor of geographical diversity in social relationships.
6 Mobile phone use is negatively associated with geographical diversity: those who use mobile phones frequently have fewer social relations outside the state.

Prior studies of ICTs in the developing world have examined adoption patterns for mobile phones and email, but not their consequences for the development of social relations. Classical diffusion theory postulates that the 'technology cluster' is a significant predictor for the adoption of innovations. It was found that frequent mobile phones users are 'technologically oriented' – they also tend to use the internet more and have greater access to computers at home and work. This finding suggests one type of technological complementarity for mobile phones and internet use. However, there are three possibilities here: successful adoption of mobile phones encouraged users to get connected to the internet; internet experience encouraged users to try other means of communication; or institutional differences between the public and private organizations facilitate the use of both new media.

What is the most likely explanation? This study does not believe that this is a case of technological determinism. However, we can exclude the first possibility (mobile phone use facilitates internet use), owing to earlier diffusion of the internet in Kerala. Experience of the internet generally precedes experience of mobiles for individuals who came of age before or during the mid-1990s. Indeed, mobile telephony was quite undeveloped when most of these respondents already were using the internet. Accepting that each medium has its distinctive advantages and that the boundaries between them are becoming decreasingly clear, these technologies have tended to cluster in the hands of adopters who prefer technological options

in communicating with their social network. This is unsurprising and tends to confirm the popular conceptions of a 'techie' – the private sector respondents were predominantly from software firms – as well as scholarly analyses of the adoption of innovations (Quan-Haase and Wellman, 2006). The most likely explanation is rooted in the institutional difference between these respondents and the educators interviewed in the public sector. The software engineers were more likely to have connected computers at work, use mobiles for project work involving long hours (although the phones themselves are a personal choice and not required by the employer) and, indeed, can afford it owing to higher salaries. They became relatively early adopters of mobile phones, which became central to their work.

However, when technologies are viewed only in terms of their adoption characteristics, crucial social dimensions are neglected. Whether these technologies, primarily meant for communication purposes, have similar or different influences on social interaction, is another question. With a sample drawn from three public and private work settings, this study examined the association of mobile phone and email use with the characteristics of social relationships: what kinds of people are viewed as most important to south Indians and where are they located? While it was found that avid mobile and email users had more friends and fewer family ties, this association results from other factors such as youth and gender. When background variables are controlled, mobile phone and email use prove to be unrelated to the relational structure (work, friendship, or kinship ties), but significantly related to the locational structure of social networks.

The most notable finding involves the different associations of mobile phone and email use with the geographic diversity of social ties. Of course, avid mobile users do have geographically diverse networks, but not because they use mobile phones. The appearance of diversity results from the association with email use: the same people tend to use both mobile phones and email. This state of affairs yields the 'hyperconnected network' that Quan-Haase and Wellman (2006) found in their study of a high-tech company, where participants were intensively 'glocalized', in the sense of constraint-free communication combining both local and global connectivity. However, when we controlled for email use, the results were quite different than the positive bivariate association of daily mobile use and diversity would suggest. Email use is the sole factor that predicts non-local tie, conceptualized in this study as important social relationships in other parts of India as well as internationally. In other words, regular email users establish and maintain more global contacts. What was unexpected was the inverse association of mobile use and geographic diversity: social networks of frequent mobile phone users are more limited geographically.

Mobile telephony involves remote, synchronous communication. It is more difficult to establish new social relationships with people in distant places via

synchronous than asynchronous communication, which is the primary reason that mobile telephony does not facilitate the establishment of new international ties, while email encourages such ties. In business, the 'cold call' to prospective clients is one of the most difficult and costly types of sales approach, for the reason that phone calls from strangers are viewed with suspicion. In this respect, we would qualify Oksman and Turtiainen's (2004) view that mobile phone use is important in the establishment of new relationships. Contrasting with their study of Finnish teenagers, in the south Indian context it is quite difficult to imagine new social ties being established by mobile phone. This difficulty is increased for calls across international boundaries involving differences in culture and language. To the extent that mobile phone use requires the expenditure of time, energy and resources, it may reduce international ties, which is what this study believes is evidenced in Table 6.

New communications technologies redistribute opportunities for interactions and construct a common space for experiences which can contribute towards a transformation of interpersonal relations and sociability (Licoppe, 2004). A recent report by the Pew Internet & American Life Project based on 2004–5 data shows that, controlling for marital status and education, mobile and landline phone use are associated with smaller networks, while email use is associated with larger networks (Boase et al., 2006). The present findings suggest that mobile phones are not transforming the social space of developing world users in the same way as email. The qualitative interviews suggest that such statements need qualification. ICTs are not equivalent with respect to their social network characteristics. For the relatively high-status respondents, email and mobile phones are used in complementary ways to maintain social relations that are geographically distinct. One way of looking at this distinction is to see mobile phones as providing access to a proximate zone, while the internet provides access to distant zones. This 'proximate zone' suggests that there is a geographical component to Ling's 'bounded solidarity' (Ling, 2004) and, perhaps, Licoppe's (2004) 'connected presence'. Since regular access to the internet continues to elude the world's poorest populations, while mobile phones are being purchased at rapid rates across socioeconomic lines, further work must attend directly to the impact of mobile phone use on poorer, less-educated individuals. To the extent that there is a trade-off between mobile and email use owing to scarce resources, the networks fostered by telecommunications technology will tend to be local rather than international in character. Policies and programmes designed to provide connectedness in developing areas must take seriously the notion that new media need not have consistent effects on the interpersonal networks of their users.

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Notes

1 Mobile phones, cellular telephony, mobile telephony, mobile phones and mobile technology are synonymously used in this article. The 'user' denotes the user of mobile phones or the internet.
2 For example, an examination of the articles published in *New Media & Society* since its inception in 1999, reveals about one article per year focusing on mobile telephony.
3 This finding is most likely due to external (institutional) factors and not necessarily any personal preference for internet connection.
4 Standard tests for multicollinearity show that the correlation between email and mobile phone use is not an issue. In Table 6, the variance inflation factors never exceed 4, well below the conventional level of 10.

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RADHAMANY SOORYAMOORTHY is an associate professor of sociology at the University of KwaZulu-Natal, South Africa. Currently, he is studying science and scientific collaboration in South Africa.
Address: Department of Sociology, University of KwaZulu-Natal, Howard College Campus, Durban 4041, South Africa. [email: sooryamoorthyr@ukzn.ac.za]

B. PAIGE MILLER is a graduate student at Louisiana State University.

WESLEY SHRUM is Professor of Sociology at Louisiana State University and Secretary of the Society for Social Studies of Science. Since 1994 he has studied scientific communication in developing areas, with a focus on Kenya, Ghana and Kerala.