Are mobile phones changing social networks? A longitudinal study of core networks in Kerala

Antony Palackal
Loyola College of Social Science, Trivandrum, India

Paul Nyaga Mbatia
University of Nairobi, Kenya

Dan-Bright Dzorgbo
University of Ghana

Ricardo B. Duque
University of Vienna, Austria

Marcus Antonius Ynalvez
Texas A&M International University, USA

Wesley M. Shrum
Louisiana State University, USA

Abstract

Mobile telephony has diffused more rapidly than any Indian technology in recent memory, yet systematic studies of its impact are rare, focusing on technological rather than social change. We employ network surveys of separate groups of Kerala residents in 2002 and again in 2007 to examine recent shifts in mobile usage patterns and social relationships. Results show (1) near saturation of mobiles among both the professionals

Corresponding author:
Dr Antony Palackal, Post Graduate Department of Sociology, Loyola College of Social Sciences, Trivandrum, Kerala, India
Email: antonypalackal@yahoo.com

and nonprofessionals sampled, (2) a decrease in the number of social linkages across tie types and physical locations, and (3) a shift towards friends and family but away from work relationships in the core networks of Malayalis. We interpret these findings as support for the bounded solidarity thesis of remote communication that emphasizes social insulation and network closure as mobiles shield individuals from their wider surroundings.

Introduction

While the internet monopolized scholarly attention during the 1990s, the rapid diffusion of mobile phones in the early 2000s instigated a parallel shift in scholarly work on new information and communication technologies. Yet understanding of these new media has been hampered by the absence of the longitudinal studies that are required to document change in behavior. Jonathan Donner's (2008) comprehensive review of over 200 recent studies of mobile telephony in the developing world reveals no survey of the social impacts of mobile phones conducted over more than one time period. In short, while there is much speculation and many case studies of mobile telephony, systematic scholarly studies of social change are few, if any. In the absence of longitudinal data, it is difficult to proffer evidence-based claims regarding social change.

We focus on the southwestern Indian state of Kerala between 2002 and 2007, arguably the main period for the exponential diffusion of mobiles throughout India. Our study was designed to measure changes in technology use and its association with social network patterns. In particular, we focus on *core networks* – relatively strong, ego-centered relationships – their size, type, and geographical dispersion (the location of the tie). The idea of core networks (or core ties or linkages) is that the social environment centered on an individual social actor is a relatively small but important subset of their entire set of past and current social ties. The importance of such relations for the individual in terms of information, support, resources, and opportunities means that they can more easily be remembered – and measured – than the full network. This is one reason why the properties of the core network can be reproduced with various questions and are not highly sensitive to specific question wording. We also present data on usage patterns among both professionals and non-professionals: the former group representing a relatively homogenous sample from the two selected years. The most striking finding is the decline in the number of core social connections together with a shift towards family and friends and away from work relations. We interpret this finding as support for the bounded solidarity thesis of mobile social ties.

Mobile telephony and social relations

Even as scholars struggled to evolve a comprehensive understanding of the internet, the literature on mobile telephony has burgeoned into an interdisciplinary study of mobile technology as it interacts with the social order ((   )r, 2005; Castells et al., 2007). Yet

characterizations of the effects of mobile technology have often been abstract and nonspecific. Castells and associates summarized a vast amount of work on 'mobile network society' with the proposition that it represents an *enhancement* of the social structure by new, wireless communication technologies (2007: 6). The enhancements that provide the evidence for this claim are largely based on characteristics of the technology: micro-coordination of schedules made possible by the ability to communicate while moving; establishment of new businesses that provide mobile technology; use of new surveillance capabilities embedded in cell phones equipped with GIS; cultural innovations (sex, entertainment, news feeds); the potential for rapid political mobilization. Yet if enhancement of social structure is *simply* the continuation of old practices through new means, or the introduction of a new resource that will differentially accrue to those with pre-existing advantages, mobile technology does not portend any major shift.

We argue that the potential for major social structural change with new ICTs is related to their potential for the establishment and maintenance of social ties. This will have consequences for the characteristics of the social networks that result. Our empirical contribution is to an emerging scholarly discourse that seeks evidence of changes in social relationships – specifically, in core networks – in locations where technology reduces dependence on co-location. The literature on new media and social relations allows for two distinct emphases, one stressing the dominant uses of a device while the other stresses new or unique practices associated with adoption. In the first instance, the association of a device with its primary or typical functions produces a view of new media integrated into existing social structures that are unyielding or difficult to change in fundamental ways.[1] The second approach highlights novel practices such as the formation of special interest groups crossing national boundaries or the circumvention of gender boundaries for women (Palackal et al., 2006). We note that the two approaches are not as inconsistent as they might first appear: conventional use reinforces conventional structures, while new practices allow us to envision nascent social patterns that are still uncommon.

While India has been the subject of many examinations of mobile telephony (Donner, 2008), several studies have particular relevance for Kerala. Abraham's (2006) economic investigation of Indian fisher communities suggests that mobile telephones helped producers and buyers more efficiently respond to supply and demand fluctuations. Echoing this rational-choice argument, Jenson's (2007) examination of traditional fishers in Kerala offered clear evidence that the use of mobile phones could actually produce better market prices and less wasted catch.

In a recent study of Kerala, Sooryamoorthy et al. (2008) showed that new information and communication technologies (ICTs) were not associated with the relational structure but significantly associated with the locational structure of social networks. They examined the joint effects of email and mobile phone use on social network patterns. A bivariate analysis showed that daily users of mobile phones had fewer local ties but more ties outside Kerala than non-daily users. However, these effects were largely due to the fact that mobile users in the early 2000s also tended to be heavy users of the internet and email. When the effects of internet use were controlled, mobile phone use decreased the geographical diversity of social ties. This surprising finding implied the diffusion of mobile telephony had complex effects and perhaps different consequences for social networking its advocates imagined.

One way to approach this complexity is through the 'bounded solidarity' thesis that derives from a line of theorizing linking changes in spatiotemporal interactions to the strengthening of individual identity and close social ties through talking, texting, and flashing – a relational configuration that Christian Licoppe (2004) has called 'connected presence'. His account stresses the management of relationships through mediated communication in which physical absence is rendered presence. The distinction between co-presence and co-location is crucial to our argument here. Predictions of ubiquitous connectivity (everyone is accessible to everyone else) have generally been misguided because of the conflation of these two concepts (Zhao and Elesh, 2008). While co-location implies that social actors are in spatial proximity, co-presence refers to the condition of reciprocal orientation that is related to the potential for social interaction, the possibility of connected presence that is precisely what mobile technology yields.

Leopoldina Fortunati (2000) views mobiles as offering the possibility of choice in sociality that often leads us to distance ourselves from strangers or acquaintances, moving public spaces to the background in favor of an itinerant or nomadic intimacy.[2] Hans Geser (2005) calls the pattern one of regressive social insulation, as highly traditionalistic relationships are perpetuated rather than modern, fleeting and dispersed ties. The cell phone allows individuals to remain within the fixed field of the familiar and shield themselves from potentially threatening and novel situations and interaction partners. In short, cell phones facilitate network closure and a focus on known relationships. They allow microsocial systems to exist in the absence of spatial separation and thereby empower primary bonds (Gergen, 2002: 237).

A high density of communication with a closed circle of ties predicts a deepening of established relationships rather than new communicative partners (Ling, 2008). Following Ling, we employ the term 'bounded solidarity' for the view that mobile communication creates cohesion within the sphere of the familiar (2008). This framework draws from the micro-sociological extensions of classical work by Durkheim (1893) on the foundations of social solidarity in collective life. First proposed by Erving Goffman (1967) in his work on interactions in everyday life, this work was recently extended by Randall Collins (2004) to a theory of interaction rituals, focusing on situations of co-presence[3] in which participants achieve a common focus and generate emotional energy through the micro-coordination of gestures. Ling departs from Collins in viewing forms of remote contact, and mobile communication in particular, as creating and enabling precisely those conditions of mutual focus and entrainment that contribute to cohesion. While disturbing situations of physical interaction, mobile technology strengthens the bonds of family and friends, producing bounded solidarity.

Collectively, the theorists who have contributed to the current discussion of bounded solidarity have developed the notion that mobiles shield individuals from their physical surroundings and promote a kind of social insulation while allowing anytime/anywhere contact with preferred associates. Changes in interpersonal relations are discussed but without stating testable hypotheses. Bounded solidarity focuses on strong ties – not weak ties – and suggests that there will be a reduction in ties, a focus on family and friends, and a spatial narrowing of social connections.[4] To put it simply, mobile technology tends towards closure rather than opening of networks.

The central question of this article is whether the widespread adoption of mobile phones affects the structure of core networks, defined in terms of the size and

distribution of alters in different social categories and locations. The characteristics of mobile interaction described by the bounded solidarity perspective principally impact core social networks. *Core networks* must be distinguished from comprehensive or total networks, the total set of past and present social relations attributable to a single individual. These total networks contain a much larger number of peripheral ties (weak ties, acquaintances). For each individual (ego), a small number of others (alters) are especially significant or important. This set of alters constitutes the respondent's core network. Bounded solidarity implies that to the extent remote communications technology becomes integrated into the social fabric, core social networks should decrease in size, become more centered on friends and family, more local in orientation.

The bounded solidarity thesis has both micro and collective aspects, which may be called usage or network effects respectively. At the level of micro-sociology, people use new ICTs to interact with their associates at varying levels of intensity. Users may talk and text many times each day, or they may just keep a mobile phone for travel emergencies and use it rarely. Such usage effects (different outcomes depending on the frequency with which the device is used) were reported by Sooryamoorthy and colleagues in Kerala at an early point in the diffusion of mobiles (2008). At the collective level, degrees of *aggregate* usage of ICTs yield a network effect: that is, a change in the value of a good resulting from a change in the number of individuals using the same kind of good. Positive network effects occur when a technology such as the telephone has low value when there are few owners, but increasing value as more and more individuals begin using the device, thus becoming accessible to others. Either usage, network diffusion, or both could impact core networks: (1) individuals must interact with technology in specific ways in order to achieve the kind of connected presence that would affect network closure; (2) significant numbers of individuals must be connected not just for a system to have economic viability, but so that most people in the system may interact with each other in principle. Relative saturation (that is, complete diffusion) of a technology within a locale or user population removes the constraints that limit microsociological effects.

Our interest in core networks and bounded solidarity requires us to examine both usage effects and network effects. A usage effect would be indicated by a positive association between the frequency of use of mobile phones and the characteristics of the core network (smaller, larger percentage of family and friends, more local in orientation). Usage effects may occur relatively early in diffusion trajectory of a technology and are indicated directly by correlations or regression coefficients. Usage effects may be indicated in a cross-sectional analysis since longitudinal data are not required: those who make extensive use of mobiles should have smaller networks according to the bounded solidarity thesis. But network effects are only observable over time, *after* the widespread adoption of mobile phones. We hypothesize that social networks should decrease in size, center more on friends and family, and become more local in orientation. Longitudinal data is required to demonstrate network effects.

Context of Kerala

Our study location, Kerala, gains special significance for its unique developmental trajectory, often termed the 'Kerala Model' (Oommen, 1999 & 2). This generally refers to the high achievements of Malayalees on social indicators of development

without impressive economic growth. The most obvious component of the Kerala Model is the set of statistical quality of life indicators such as education that locate Kerala closer to high-income developed countries than to other low-income areas. Malayalees (the people of Kerala) are also known for their high levels of political consciousness and activism. Paradoxically, these positive indicators are accompanied by low economic growth and incomes, chronic unemployment, dependence on outside remittances, a stagnant economy that is ill-suited to compete in world markets, and a budget deficit that is often described as out of control. The poor economic growth coupled with backwardness and landlessness of a sizable population in the state contradicts its well-publicized achievements (Franke and Chasin, 2002).

Kerala witnessed a rapid increase in the diffusion of the mobile since the dawn of the new millennium. By the end of our study in 2007, there were almost ten million mobile customers in Kerala, contributing to nearly 15 percent of the total mobile phone connections in India. This means that one in every three Malayalees has mobile connectivity. The most revolutionary aspect of the use of mobile phones in the state is the increase in the air time of the telephone calls. Mobile service providers enjoyed a leap in their growth rate ranging from 70 to 142 percent with a corresponding growth in income. Six mobile service providers earned more than 210 million rupees in the financial year 2006–2007. Overall Kerala, with little more than three percent of the population of the Indian subcontinent, has the highest proportion of mobile usage in the country (Malayala Manorama, Business Magazine April 8, 2007).

When mobile telephony is discussed in relation to the developing world, scholars emphasize that the importance of widespread diffusion is in providing *connectivity* rather than *mobility*. The literature focuses on the penetration of mobiles, their use as a shared and stationary family phone, and the substitution of travel costs versus usage costs for small entrepreneurs (Donner, 2006). However, in Kerala, owing to the large number of Malayalis who work in the Middle East and the importance of remittances to the local economy, the level of fixed line connectivity throughout Kerala has been relatively high and even those who did not have household telephones could readily access ISD/ITD kiosks to pay for a single call. For the population of interest in this paper, most had access to a landline before the 2002 study.

Data and methods

The survey instrument was administered by research assistants at Loyola College of Social Sciences in both 2002 ($N = 610$) and 2007 ($N = 297$). We sought to include both professional and informal sectors, implementing a selective sampling procedure based on location. We conducted face-to-face interviews with all individuals within a given area or institution, including both professionals (teachers, clerks, administrators, lecturers, ICT experts, lawyers) and non-professionals in each year. The first author travelled with the interviewers to the location (e.g. teacher training colleges, engineering colleges, IT companies, informal market) and introduced the team to the authorities and officers. The informal market comprised of small and medium-sized businesses such as stationeries, groceries, fish, meat, vegetables, fruits, and shoe malls. We also included enterprises such as leather works, electricals, automobile spare parts and

Table 1. Respondent Characteristics

	2002		2007		Full Sample	
		N		N		N
Professional (%)	69.70	610	45.80	297	62.00	907
Gender (% male)	63.00	610	65.90	296	64.00	906
Age (years)	36.53	610	34.49	294	35.87	904
Marital Status (% married)	74.80	610	72.70	297	74.00	907
Children (number)	1.14	610	0.98	297	1.09	907
Education (% BA or higher)	79.80	610	71.80	294	77.00	904
Education (% MA or higher)	51.80	610	31.30	294	45.00	904
Mean monthly income (Rupees)	13,073.00	610	12,725.00	259	12,969.00	869

workshops, computer accessories, pharmaceuticals, photocopying and DTP centers, as well as telephone and internet kiosks. The major difference between 2002 and 2007 was in the inclusion of this informal, small business sector. Different groups of individuals were interviewed in each wave. In 2007, owing to widespread interest in the use of mobile phones in the informal sector, we made a special effort to interview small shopkeepers and business operators. The sample was stratified on this dimension, such that half of the 2007 sample consists of micro-entrepreneurs. We also sought to ensure gender balance in the sample, though no precise quota was specified.

The questionnaire took our research assistants an average of one hour to complete. We included items on the respondent's core network and its composition, ownership and use of mobile phones, perceptions of use of mobile phones; access and use of computers and the internet, and socio-demographic data. From these themes, the study generated about 200 variables. Our main interest is testing the bounded solidarity notion in the usage and social network variables. In the first part of the questionnaire, Kerala respondents were requested to enumerate up to eleven names of people that were important to them. In a tabular form, for each person named, the respondents specified (1) the type of relationship (family, friend, work, romantic, other); (2) the location of the contact; (3) the frequency of communication; (4) means of communication used (face to face, land line, fax, letter, email or mobile phone). More than one means of communication was allowed.

Table 1 shows the general characteristics of our sample. While the average education of the entire sample is near diploma level, this is primarily due to the bimodal distribution of education for professionals and small businesspersons in Kerala.

Results

Saturation

Our first (2002) Trivandrum survey was conducted to determine the extent to which mobile phones were diffusing among Malayali professionals. While some of our respondents (fewer than 5%) had heard of mobiles in the 1980s, most learned about mobile phones in the 1990s: more than half were familiar with the technology by 1997. Dramatic

increases occurred in the late 1990s such that almost everyone had at least heard of the new gadgets by the turn of the millennium.

Comparing 2002 and 2007, mobile phone use in Kerala is now pervasive among the user groups we studied. In 2002, less than 33 percent of our respondents had owned and used a mobile phone (one quarter had used a mobile owned by someone else), while 42 percent had never used one. By 2007 only one percent of the sample had never used a mobile, and 96 percent *currently owned and used* one.[5] Indeed, our group of authors has not been able to identify any other technology where such a dramatic change occurred in the short span of five years: from one-third of the population to virtual saturation. As new users adopt the technology, average experience increases. Although religion and caste are important categories in the making of the demographic composition and social structure of Kerala and in the socio-cultural and political lives of Malayalis, the extensive adoption of mobiles among both professional and informal sectors showed no significant variation in terms of religion and caste. Thus the sharp increase in the diffusion of mobiles in Kerala is regarded as a widespread phenomenon cutting across differences such as religion, caste, education and income.

How extensively do professionals and small businesses in Kerala use mobile phones? In 2002, less than one third of the sample used their phones daily.[6] By 2007, usage patterns had changed more than we anticipated: so much so that our 2002 categories no longer served to represent the range of frequencies actually encountered.[7] In the pilot phase we shifted our question because very few used their mobile less than once a day (2% in the 2007 sample). One quarter of the sample in 2007 reported using their mobiles more than 15 times daily[8] and over 60 percent used them more than six times daily. Considering only the professionals in our sample, the percentage using a mobile phone daily increased from 38 percent to *over 99 percent* while the percentage making three or more calls per day increased from 25 percent (n=425) to 82 percent (n=136) between 2002 and 2007. The average duration of calls also increased over this period, with the falling costs of airtime.[9]

The mobile network pattern in Kerala

Malayalis, regardless of their social status, typically use more than one means to communicate with their associates. Most important are traditional face-to-face interaction, email, and mobile telephony, including both voice and text messaging. Table 2 presents the values for network size and average frequency of interaction within the core network of our Malayali respondents for 2007. Network size is a simple count of the number of relationships, out of 11 possible. Other measures are constructed by counting the number of relations that reported to employ a particular means of contact. We calculated interaction frequencies (1) by summing and then averaging the reported frequency of interaction for all nominated relations regardless of means, then (2) summing and then averaging the reported frequency of interaction separately for (a) face-to-face, (b) mobile phone, and (c) email communication.[10] Table 2 shows the striking impact of communication via cell phones relative not just to email but to face-to-face interaction. The average size of core networks in our Kerala sample is 5.5. Our respondents report communicating with members of their core network several times each week. The

Table 2. Frequency of Co-Located, Email, and Mobile Interaction (2007)

	N	Mean	SD
Size of core network	297	5.48	1.80
Size of face-to-face network	297	1.96	2.22
Size of mobile network	297	4.40	2.20
Size of email network	297	0.56	1.41
Frequency of contact with core network members	297	1.74	0.63
Frequency of contact face to face	175	1.46	0.65
Frequency of contact by mobile	283	1.72	0.66
Frequency of contact by email	59	2.16	1.02

Frequency codes: 1 = Daily, 2 = Few times in a week, 3 = Once or twice a week, 4 = Once or twice a month, 5 = Less often. Higher values represent less frequent communication.

average number of relationships involving mobile phones (over four) is more than those involving face-to-face interaction (about two), and much higher than those involving email communication (less than one). Yet the frequency of interaction for those (fewer) relationships maintained by mobile technology is less than with face-to-face relationships. Face-to-face ties are reported to involve almost daily interaction, while mobile relationships are closer to several times per week. Both types of ties exceed internet relationships in both number and frequency. The message of the table is that for this sample of respondents *mobile relations are more common but less frequent than face-to-face relationships* and both are clearly dominant over email as a means of keeping in touch with core relations.

To what extent have relationships shifted from face-to-face to mobile means of interaction? For this, we require a comparison of the percentage of relationships that were reported to involve each specific means of interaction. From 2002 through 2007 the shift from face-to-face and email to mobile interaction is both striking and statistically significant. In 2002, respondents reported almost three quarters (74%) of their core network relationships were maintained through face-to-face means, followed by email (21%) and mobile phones (16%). But by 2007 mobile communication represented a primary means of keeping in touch[11] for *81% of all core network ties*. It is important to emphasize that respondents were not forced to choose a single means of contact. They could indicate multiple means of interaction for each tie and reported an average of 1.7 types of contact. Yet in the five-year period, the percentage of the core network maintained regularly through face-to-face interaction dropped from three-quarters to just over one-third (35%), while the proportion maintained through email dropped from one fifth to only 9%.[12]

Core Network Change

Bounded solidarity predicts a decrease in size, greater emphasis on friends and family, and narrowing of orientation to local (as against remote) ties. First we examine the size of core networks during the time period in questions. Table 3 exhibits the change over time between 2002 and 2007 in the average number of core network ties, as well as their

Table 3. Change in Network Size[a]

	Year	Full Sample		Professionals	
		Mean	SD	Mean	SD
Size of core network (total)	2002	9.20 ***	1.95	9.02 ***	2.03
	2007	5.48	1.80	5.32	1.92
Size of family network	2002	3.51 ***	1.87	3.49 ***	1.85
	2007	2.12	1.47	2.36	1.54
Size of friendship network	2002	2.64 *	2.16	2.61 ***	2.13
	2007	2.28	1.79	2.04	1.37
Size of work network	2002	2.69 ***	1.92	2.55 ***	1.90
	2007	0.96	1.33	0.76	1.14
Relational Diversity[b]	2002	2.83 ***	0.61	2.83 ***	0.62
	2007	2.33	0.79	2.38	0.77
Size of network in Trivandrum	2002	6.15 ***	2.59	5.78 ***	2.43
	2007	4.23	2.05	3.65	1.96
Size of network in Kerala	2002	8.06 ***	2.26	7.68 ***	2.30
	2007	5.10	1.85	4.87	1.89
Size of external network in India outside Kerala	2002	0.64 ***	1.16	0.76 **	1.25
	2007	0.30	0.75	0.37	0.70
Size of foreign network (outside India)[c]	2002	0.50 ***	0.95	0.58 ***	1.03
	2007	0.07	0.32	0.07	0.36
Locational diversity[d]	2002	2.40 ns	0.99	2.54 ns	0.97
	2007	2.27	1.01	2.38	0.99

[a] Full sample means are based on $N = 610$ (2002) and $N = 297$ (2007). Means for professionals are based on $N = 425$ (2002) and $N = 136$ (2007).
[b] Relational diversity is a count of the number of different types of relationships in the respondent's core network (e.g., friends, work, family).
[d] Locational diversity is a count of the number of different spatial locations (Trivandrum, Kerala, India outside Kerala, etc.) in which the respondent's core network is located.
*$p < .05$; **$p < .01$; ***$p < .001$ (two-tailed tests).

distribution by type and location. The most striking finding is that the size of core networks has clearly declined, for all types of relationships. *T*-tests for mean differences (independent samples) show that all differences are statistically significant except one: locational diversity has not changed during this time period. For the network as a whole, the number of reported relationships is lower by nearly four persons, from 9.2 to 5.48, that is, a 40% shrinkage in the size of the core network. This general decline is reproduced for all types of relationships, including family, friendship, and work and has resulted in an overall decline in the diversity of relationship types as well. What about the location of these social ties? We distinguish between (1) local ties in Trivandrum (the capital metropolitan area), (2) ties within Kerala (the southwestern state of India, speaking Malayalam), (3) ties within India (but excluding Kerala), and (4) international ties, that is, those outside India itself. In each case, the number of reported relationships has declined, with the largest reductions for the state of Kerala itself.[13] In the second panel (right side) of the table, we replicate this analysis for the professionals in the sample only, since the small businesspersons were not sampled in 2002. The results are similar, with some of the differences slightly larger than for the sample as a whole.

Table 4. Change in Network Size[a]

	Year	Full Sample		Professionals	
		%	SD	%	SD
Percentage of family members in core network	2002	38% ns	0.19	39% **	0.19
	2007	40%	0.26	44%	0.23
Percentage of friends in core network	2002	29% ***	0.22	29% ***	0.22
	2007	41%	0.28	39%	0.24
Percentage of workmates in core network	2002	29% ***	0.20	28% ***	0.20
	2007	17%	0.23	14%	0.20
Percentage of core network in Trivandrum	2002	67% ***	0.25	64% *	0.24
	2007	78%	0.28	71%	0.29
Percentage of core network in Kerala	2002	88% ***	0.17	85% ***	0.18
	2007	93%	0.14	92%	0.14
Percentage of network in India (excluding Kerala)	2002	7% ns	0.13	9% ns	0.14
	2007	5%	0.12	7%	0.13
Percentage of network outside India	2002	5% ***	0.10	6% ***	0.10
	2007	1%	0.05	1%	0.05

[a] Full sample means are based on $N = 610$ (2002) and $N = 197$ (2007). Means for professionals are based on $N = 425$ (2002) and $N = 136$ (2007).
*$p < .05$; **$p < .01$; ***$p < .001$ (two-tailed tests).

Table 4 shows change in these same types of relationships, now calculated as proportions. This allows us to examine the idea that no matter what the size of the respondent's core network, *relationships are becoming more concentrated among friends and family* in the local area. As in Table 3, we present the analysis for both the full sample and for professionals only, which are similar but for one difference. The first part of the table shows that for both the full sample and for professionals, the percentage of friends has increased, while the percentage of workmates has decreased. For professionals, the proportion of kin in the core network has increased from 39 percent to 44 percent. This difference is significant at the .01 level but it is not significant for that sample as a whole, where the proportion has only increased from 38 percent to 40 percent. For the full sample, a reduction in work ties of 12 percent is equivalent to the increase in friendship ties.

Turning to the locational distribution of ties, Table 4 shows that the percentage of the core network located in the capital (Trivandrum) – representing by far the largest proportion of the network – increases from 67 percent to 78 percent for the entire sample and from 64 percent to 71 percent for professionals. While there is no change in the proportion of relationships within India as a whole, the shift to local ties occurs owing to the reduction in the proportion of foreign contacts, about 5 percent for both professionals and the full sample. Summing the contacts within India (outside Kerala) and outside India, we see a reduction of 7 percent in external ties for the average core network of the respondents in our sample. While the shift in the relational distribution is more complex, both the distribution of ties by friends and workmates, and the distribution of ties in and outside of Kerala, offer support for the thesis of bounded solidarity.

Table 5. Regression of Core Network Size on Selected Dimensions[a]

	Full (1)	Family (2)	Friend (3)	Work (4)	Diversity (5)	Local (6)	Kerala (7)	India (8)	Foreign (9)	Diversity (10)
Survey (0 = 2002; 1 = 2007)	−0.66 ***	−0.25 ***	−0.12 **	−0.43 ***	−0.33 ***	−0.34 ***	−0.52 ***	−0.14 **	−0.26 ***	−0.05
Professional Status (0 = No; 1 = Yes)	−0.16 ***	−0.01	−0.08	−0.11 *	0.01	−0.19 ***	−0.17 ***	0.04	−0.005	0.04
Frequency of Mobile Use	−0.03	−0.09	−0.02	0.04	0.01	−0.04	−0.06	0.02	0.08	0.02
Frequency of Email Use	0.06	0.02	0.02	0.05	−0.03	−0.05	−0.12 ***	0.24 ***	0.23 ***	0.11 **
Monthly Income (Rupees)	−0.05	−0.004	−0.03	−0.03	−0.04	−0.12 *	−0.08 *	0.05	0.03	0.01
Education	−0.09 *	−0.04	−0.01	−0.03	−0.03	−0.08	−0.09 *	0.04	−0.02	−0.08
Gender (0 = Female, 1 = Male)	0.02	−0.16 ***	0.07 *	0.09 **	0.06	0.03	0.03	0.02	−0.04	−0.06
Marital Status (0 = Unmarried, 1 = Married)	0.02	0.21 ***	−0.24 ***	0.08 *	−0.01	0.06	0.03	−0.11 **	0.09 *	0.01
Age (years)	−0.06	0.02	−0.14 **	0.02	−0.05	0.05	−0.02	−0.05	−0.04	−0.16 **
R-square (R^2)	0.46	0.2	0.13	0.19	0.11	0.2	0.35	0.15	0.12	0.08
degrees of freedom (df)	867	867	867	867	867	867	867	867	867	867

[a]Ordinary least squares regression for total number of contacts mentioned by respondent. Cell values represent standardized regression coefficients.

*$p < .05$; **$p < .01$; ***$p < .001$ (two-tailed tests).

Table 5 supplements these bivariate findings with a multivariate analysis of the network change. It may be that the apparent change in network size is due to the somewhat different sample, or a change in the use of communications technology. We examine the joint effects of year, ICT use, and social factors on the size of core networks broken down by location and type of tie. Each column represents the results of regressing network size on nine dimensions, with cell values representing standardized regression coefficients. Rather than presenting separate results for the professionals in the sample, we control for professional status of respondents using a dummy variable in row 2 of the table. This analysis allows us to address the issue of whether the network effect of mobile phones is due to widespread adoption or level of use. A usage effect would be indicated by a statistically significant association between frequency of mobile use and network size, while a diffusion effect would be supported by a general decline regardless of level of use.

Table 5 shows that the decline in network size is quite general across nearly all measures of relational type and location. The size of these effects is indicated by the magnitude of the beta coefficients. Not only is the effect of year negative (smaller networks in 2007 than in 2002) and statistically significant in all models except one, but the year coefficient is the largest in nearly all of these models.[14] Our best measure of mobile technology use, the number of outgoing calls made,[15] is not associated with the overall size of core networks, or the size of the network in any category.

The first columns of Table 5 exhibit the factors associated with the overall size of the core network and the size of the core network involving particular types of relations (family, friendship, work). For these types of ties, the only factors that predict network size are gender (males have smaller family networks but larger friendship and work networks) and marital status (marrieds have larger family and work networks but smaller friendship networks than singles). Education and professional status also have a significant, negative association with total size of the core network (less education and status are associated with larger networks overall). Column five reports a model of the 'diversity' of relational types, where one represents only a single type of tie (that is, all 'family').[16] The negative coefficient of year indicates that controlling for the technology use patterns and social characteristics of respondents, the diversity of tie types actually decreased from 2002 to 2007.

The remaining columns display effects estimates for the *location* of reported ties. We asked our respondents to tell us whether their core contacts were in the Trivandrum area (the capital of Kerala, where all of the interviews occurred), within the State of Kerala as a whole, within India outside Kerala, and international (outside India). The first row of Table 5 again shows networks became smaller from 2002 through 2007, as indicated by the negative coefficient of year. This occurs for both local and external ties, and for ties within India (outside of Kerala) and international ties (outside of India). There are small negative effects of income (for local and Kerala ties) and education (Kerala ties). For the bounded solidarity argument, it is significant that the frequency of mobile phone use is not associated with network size, while email use is clearly associated with the location of ties. Frequent use of email is characteristic of those who report fewer Kerala ties but *more* external ties, both within India and outside the country. We note that diversity in the location of the core network does not decrease over time, as this is the only model in Table 5 where the effect of year is not significant. However, email use does appear to have a positive impact on diversity of locations.

Table 6. Regression of Core Network Composition on Selected Dimensions[a]

	Pct Family (1)	Pct Friends (2)	Pct Work (3)	Pct Local (4)	Pct Kerala (5)	Pct India (6)	Pct Foreign (7)
Survey year (0 = 2002; 1 = 2007)	0.15 **	0.17 ***	−0.29 ***	0.17 ***	0.15 **	0.06	−0.23 ***
Professional Status (0 = No; 1 = Yes)	0.07	0.002	−0.08	−0.08	−0.03	0.06	−0.03
Frequency of Mobile Use	−0.09	−0.03	0.09	−0.05	−0.05	0.02	0.08
Frequency of Email Use	0.02	−0.03	0.03	−0.10 **	−0.33 ***	0.24 ***	0.24 ***
Monthly Income (Rupees)	0.004	−0.004	−0.01	−0.12 **	−0.07	0.07 *	0.03
Education	−0.003	0.04	−0.02	−0.004	−0.03	0.06	−0.03
Gender (0 = Female, 1 = Male)	−0.20 ***	0.07 *	0.08 *	0.04	−0.03	0.002	−0.05
Marital Status (0 = Unmarried, 1 = Married)	0.22 ***	−0.25 ***	0.07	0.08	0.03	−0.13 **	0.08
Age (years)	0.07	−0.16 ***	0.08	0.07	0.05	−0.02	−0.02
R-square (R^2)	0.14	0.17	0.09	0.11	0.19	0.14	0.11
degrees freedom (df)	867	867	867	867	867	867	867

[a]Ordinary least squares regression for total number of contacts mentioned by respondent. Cell values represent standardized regression coefficients.
*$p < .05$; **$p < .01$; ***$p < .001$ (two-tailed tests).

The last table exhibits models for the same types of relationships, now calculated as proportions. Again, we control for social characteristics that may affect network configurations. Not surprisingly, gender and marital status are associated with the type of tie (more family ties for women and married respondents; more friendship ties for men and unmarried respondents).

However, our main interest is to confirm the bivariate changes that were observed in Table 4 from 2002 to 2007. Now that ICT usage and social dimensions are controlled, the increase in the proportion of family ties is statistically significant. The first row of Table 6 shows that kinship and friendship ties increase as a proportion of the core network, while ties with workmates decrease. With regard to location (columns 4–7), local ties and ties within Kerala increase, ties within India remain relatively constant, and external (foreign) ties decrease significantly. The degree of mobile use is not associated with any shift in any categories, while email use is associated with changes in the location, but not the type of relationship. Daily use of email is associated with a decrease in the proportion of ties in the capital area and within Kerala, but an *increase* in the proportion of ties within and outside India – that is, more distant relationships.

Discussion

If the introduction of mobile communication technology is nothing more than the augmentation of pre-existing practices then no major shift in social structure is to be expected. If, on the other hand, mobile technologies change the nature and distribution of social connections, then their widespread diffusion may have significant consequences for the development of social structure. One technological affordance of cell phones allows communication between distant social actors, but this does not distinguish them from conventional landlines. What has changed is the potential for anywhere/anytime interaction with others who also possess such a device. We summarize the empirical findings on core networks before examining their implications for the thesis of bounded solidarity.

(1) Core personal networks are significantly smaller in 2007 than in 2002, by about 40 percent.
(2) *The decline in the size of core networks is pervasive* across all relational types and is associated with an overall decline in the diversity of relationships (family, friends, and work).
(3) The *decline is observable for all locations*: locally, within Kerala, within India, and internationally. The largest contraction is within the state of Kerala.
(4) Controlling for ICT use and social factors, the proportion of family and friends in the core network increases, while the proportion of work ties decreases.
(5) Controlling for ICT use and social factors, the proportion of local ties increases, while ties within India remain relatively constant. International ties decrease significantly.
(6) Mobile social relations are less frequent but more common than face-to-face relations, while email is comparatively rare.
(7) Controlling for both ICT use and social factors, frequent email usage is associated with a decrease in the proportion of local ties and an increase in the proportion of ties within and outside India.

The first three findings reveal something significant happening amid the close personal networks of south Indians within the past five years (2002–2007). A general contraction or shrinkage has occurred across all types of relationships and across all locations where ties are typically maintained.[17] Our sample consists of professionals and small businesspersons, and cannot be generalized to all Malayalis, all Indians – certainly not to any such entity as the Global South. That said, the contraction is both large and at odds with the notion that new communication technology expands the social circle of users. It is consistent with the thesis of bounded solidarity, interpreted as the notion that mobiles shield individuals from their wider surroundings, promoting social insulation and network closure.

We attribute the observed changes to the widespread diffusion of mobile communication technology. A rapid shift in the average size of social networks is more likely to be due to technological change than to social changes (such as urbanization or the shift from extended to nuclear families) owing to the speed of adoption of new technology. Since methods of communication are central to the frequency and intensity of human interaction, and since strong ties are likely to be affected by new communication opportunities – regardless of their overall number or distribution – we believe the most likely explanation for the rapid reduction in core network size is to be found in the technological shift that has occurred during this same period of time.

Bounded solidarity, the thesis that mobile technology produces an increased emphasis on close family and friendship relations, could be produced by either a usage effect or a network effect. Our data provides no support for the idea that the decline in core networks is due to a usage effect: those who use mobiles more often do *not* have substantially smaller networks than those who use them less. The effect of mobile phone diffusion is more likely to be due to a network effect, that is, a change in the aggregate level of 'reachability' throughout the region. Network effects (sometimes referred to as network externalities) are a change in the value of a good that derives from a change in the number of others who consume the same kind of good. With communication technologies such as phones and faxes, the effect is usually viewed as positive value or opportunity (the item has more value as the number of owners increases).

The change in the south Indian context documented here is striking, if not stunning. When we first entered the field in the fall of 2002, fewer than one-third of our respondents owned a mobile phone as compared to 96 percent in 2007. It is difficult to think of a technological shift that has happened so quickly. Within a mere five years, most Malayalis now keep in touch with their strong ties through a combination of face-to-face and mobile technology. The percentage of the core network interacting through the use of mobiles increased from 16 percent in 2002 to 81 percent in 2007, while reported contact through both face to face and email declined. Mobile ownership is no longer a status symbol but an essential device, connecting individuals to virtually the entire population of Malayalis with whom they might wish to communicate.[18] As mobile phones have diffused throughout Kerala, the question is no longer whether someone is connected via a cell phone, but what their number is.

Saturation within the locale – at least in terms of the population of users examined here – removes many of the constraints that can limit microsociological effects. Together with the mobile network pattern (more common but less frequent ties), changes in the interpersonal relations of south Indians might be anticipated, but the argument from

bounded solidarity renders the general expectation specific while yielding concrete hypotheses. As it applies to core social networks, the bounded solidarity thesis suggests that there will be a core network contraction, a focus on family and friends, and a narrowing, rather than expansion of social connections. In short, mobile technology tends towards closure rather than opening of networks. Our interpretation builds on Fortunati (2000), Geser (2005), Licoppe and Ling (2008), who emphasize the role of mobile technologies in extending relational co-presence beyond ordinary physical (co-located) proximity. By locating bounded solidarity in the interaction framework developed by Goffman (1967) and Collins (2004), Ling provides the essential mechanism for the role of mobile telephony in the ritual interactions through which social cohesion is produced, creating our sense of the social (2008). What seems to be the 'small talk' of everyday life is opportunities to produce mutual focus and emotional energy that outlives the immediate context. The mobile telephone is a 'tool of the intimate sphere' (Ling, 2008: 159) that rejuvenates and recharges this energy, strengthening the bonds of solidarity between family and friends.

Though Ling furnishes a theoretical foundation in interaction ritual theory, his overall evaluation of the mobile connectivity is positive, emphasizing the deepening and enrichment of social bonds. Geser, on the other hand, casts a skeptical light on a technological practice that makes it easy for social actors who find themselves physically proximate to strangers in dense urban settings to accomplish interactive egress by contacting their intimates:

> the cell phone works as an 'antievolutionary' device by promoting the retrogression to more simple, 'pre-modern' patterns of social life. (Geser 2005: 25)

Our own view is tentative, partly because we have experienced the power and beauty of mobile communication in our own collaborative work. But we find no reason to doubt results that seem to implicate new communications technology in the contraction of core networks, and one that has occurred much more rapidly than that in the US. If core networks shrink, becoming local in orientation and more focused on family and friends, we do not see this as a positive development. The increasing interdependence – and associated problems – that characterizes the modern era requires solutions based on interpersonal understandings and relationships that go beyond the narrow confines of restricted circles to incorporate more, not fewer, core connections.

Mobile technology does not exist in isolation, but as part of a variety of communication technologies that include the internet. The rapid diffusion and excitement over mobiles may be contrasted with the relatively slower rate of diffusion of internet connectivity, and email communication provides reason for optimism, at least where the location of ties is concerned. The effect of the internet is to decrease the proportion of local ties and increase the proportion of ties within and outside India – that is, widening the locational sphere. Since the spread of wireless communication is unprecedentedly rapid, two issues are crucial. The first is the need for longitudinal studies, without which we cannot know what difference mobile telephony makes to human social relations. The second is the trajectory of these shifts. Social change is not simple or constant, and temporary phenomena cannot be disentangled from long-term trends without periodic evaluation.

Acknowledgments

Notes

1. Both the telephone (Fischer, 1994) and the internet (Hampton and Wellman, 2002) were used more to maintain existing relationships than to create new social relations.
2. Early studies showed usage of mobiles was highest among individuals who were maintaining contacts with family (Fortunati, 2002: 56). Such patterns led to the 'localistic' theory that mobile phones were primarily used to strengthen pre-existing intimate relationships rather than enlarging social circles.
3. The concept of 'co-presence' is now ambiguous in its reference. While Ling (2008) uses it to refer to physically proximate interactions, Zhao and Elesh (2008) also make a convincing case for reserving the term 'co-location' for participants in physical proximity and using the term 'co-presence' to include remote interactions.
4. We note that these phenomena are not causally independent. A focus on family and friends should lead to a spatial contraction, given that, on average, friends and kin are located in the same geographical areas.
5. We note the interesting category of 'former' users constitutes almost 3 percent of the sample. This group deserves further research.
6. We include nonusers, since frequency of use implies that nonusers use the technology less than daily.
7. As sociologists of science and technology who studied the internet, we were simply unprepared for the pace of change and did not allow for sufficient categories in our 2002 question formulation. Our highest category in 2002 was 'daily' mobile phone use.
8. Our variable 'daily use' includes both verbal and text communications.
9. Whether or not we include nonusers of mobiles in 2002 (almost an empty category in 2007), the number of calls made and received, as well as the average call duration increased significantly in 2007. We note that a similar study in Kenya over the same period of time showed a nearly identical duration of calls in 2002 and 2007, indicating that for African users the dramatic increase in the use of mobiles is due to other activities (such as text messages) rather than the use of the phone for conversational purposes.
10. For F2F, mobile, and email means of interaction, we present averages without zero values, in order to account for the fact that only a subset of all relationships use a particular means of communication – though in principle each relationship can involve multiple means.
11. The questionnaire was constructed to allow information about all means of contact. While the survey item also offered a choice of fax, letter, and landline communication, these represented a very small proportion of interactions and they are disregarded here. The question remains, is it really the case that a respondent could maintain a relationship exclusively through mobile communication without any face-to-face contact? We think not and we know from qualitative information that respondents frequently skipped over means of contact survey that were less common or less significant to them.
12. There was also a decrease in the average number of means of interaction (mobile, F2F, email, letter, landline, fax), which dropped from 1.8 in 2002 to 1.6 in 2007 ($p > .001$).
13. This is unsurprising, since these relationships constitute the bulk of the core networks for most respondents. We also measured ties within Trivandrum, which were reduced from 5.78 to 1.88. However, in 2007 we changed the question wording slightly to clarify the difference

between [] town and corporation. While this does not change the general result, the clearest measure examines Kerala as a whole.

14. In predicting the size of friendship networks, marital status has a greater impact.

15. We measured calls made, calls received, frequency of use, and a variety of other factors, but the largest bivariate correlations were generally found for outgoing calls. Since these are paid by the caller they are the best indicator of interest in and use of mobile technology.

16. In addition to family, work, and friendship ties we asked about romantic and 'other' ties, although these were very rare and we did not attempt to model them separately. Therefore, the diversity measure ranges from one to five, if all types of tie were mentioned.

17. The economy of 'discount tariffs' may have a significant role in declining core networks. Kerala has one of the cheapest mobile tariffs in the world with ever changing schemes and packages of discounts especially for the family circle, which has filliped the wide diffusion of the cell phone across all sectors. Hence, mobile phones exhibited an extremely high growth rate even in rural parts of Kerala.

18. We emphasize that our population of users did not include the 'poorest of the poor' and was limited to a group of small entrepreneurs, teachers, and professionals within the capital area.

References

Abraham R (2006) Mobile phones and economic development: Evidence from the fishing industry in India. In: *International Conference on Information and Communications Technologies and Development*. Institute of Electrical and Electronic Engineers (US).

Castells M, Fernandez-Ardevol M, Qiu JL and Sey A (2007) *Mobile Communication and Society: A Global Perspective.* Cambridge, MA: MIT Press.

Collins R (2004) *Interaction Ritual Chains.* Princeton, NJ: Princeton University Press.

Donner J (2006) The use of mobile phones by microentrepreneurs in Kigali, Rwanda: Changes to social and business networks. *Information Technologies and International Development* 3(2): 3–19.

Donner J (2008) Research approaches to mobile use in the developing world: A review of the literature. *The Information Society* 24(3): 140–159.

Durkheim E (1893) *The Division of Labour in Society.* New York: Free Press.

Fischer C (1994) *America Calling: A Social History of the Telephone to 1940.* Berkeley, CA: University of California Press.

Fortunati L (2000) *The Mobile Phone: New Social Categories and Relations.* Trieste, Italy: University of Trieste.

Fortunati L (2002) Italy: Stereotypes, true and false. In: Katz JE and Aakhus M (eds) *Perpetual Contact: Mobile Communication, Private Talk, Public Performance*. Cambridge, UK: Cambridge University Press.

te RW and Chasin BH (2000) *Is the Kerala Model Sustainable? Lessons from the Past, Prospects for the Future.* London: Zed Books.

Gergen K (2002) *The Challenge of Absent Presence.* Cambridge, UK: Cambridge University Press.

H (2002) *Is the Cell Phone Undermining the Social Order? Understanding Mobile Technology from a Sociological Perspective.* Bielefeld: Transcript Verlag.

Goffman E (1967) *Interaction Ritual: Essays on Face-to-Face Behavior.* New York: Anchor Books.

Hampton KN and Wellman B (2002) *The Not So Global Village of Netville*. Oxford: Blackwell.

Jenson R (2007) The digital provide: Information (technology), market performance, and welfare in the South Indian fisheries sector. *The Quarterly Journal of Economics* CXXII(3): 879–924.

Licoppe C (2004) Connected presence: The emergence of a new repertoire for managing social relationships in a changing communication technoscape. *Environment and Planning: Society and Space* 22(1): 135–156.

Ling R (2008) *New Tech, New Ties: How Mobile Communication is Reshaping Social Cohesion.* Cambridge, MA: MIT Press.

Oommen MA (1999) *Kerala's Development Experience: Volume I & II.* New Delhi: Concept Publishing.

Palackal Antony, Anderson MBP, Miller BP and Shrum W (2006) Internet equalizer: Gender stratification and normative circumvention in science. *Indian Journal of Gender Studies* 14(2): 231–257.

Putnam RD (1995) Bowling alone: America's declining social capital. *Journal of Democracy* 6(1): 65–78.

Sooryamoorthy R, Miller BP and Shrum W (2008) Untangling the technology cluster: The effects of mobile phone and email use on the location of social ties. *New Media & Society* 10(5): 729–749.

Zhao S and Elesh D (2008) Co-presence as 'Being With': Social contact in on-line public domains. *Information, Communication and Society* 11(4): 565–583.

Antony Palackal PhD teaches in the Post Graduate Department of Sociology in Loyola College of Social Sciences, Trivandrum, Kerala, India.

Paul Nyaga Mbatia PhD is Professor and Head of the Department of Sociology in University of Nairobi, Nairobi, Kenya.

Dan-Bright Dzorgbo PhD is Professor of Sociology in University of Ghana, Accra, Ghana.

Ricardo B. Duque PhD is Professor of Grad[TS: Pls style name to match other authors in list]es of Science, University of Vienna, Austria. Marcus Anton[...]Department of Sociology, Texas A&M International University, Laredo, TX (USA).

Wesley M. Shrum PhD is Professor and Chair, Department of Sociology, Louisiana State University, Baton Rouge, LA (USA).