

Small and Even Smaller Circles: The Size of Mobile Phone-Based Core Social Networks in Scandinavia and South Asia

Rich Ling, Geoff Canright, Johannes Bjelland,
Kent Engø-Monsen, & Pål Roe Sundsøy

Previous research in developed countries has shown that mobile phone users call and text to a relatively small circle of people. Research from the Global South indicates that core network size is often larger than in the developed world since the logistics of daily life require extended informal logistics. This suggests that the core social network, as seen in the use of mobile voice and texting, will be larger in developing countries than in developed countries. This is tested using mobile phone log data from Norway, Malaysia, Thailand and Pakistan. A total of 4000 subscribers and their “one hop” social networks (approx. 80,000 links) were examined. The results show that the core mobile phone-based networks are not larger in developing countries. This indicates that cost, literacy and other cultural issues are significant when considering the question of core network size as seen in the use of mobile telephony.

Keywords: Mobile Com; Cross Cultural Research; Social Network Analysis; South Asia

(Received 17 October 2011; final version received 21 February 2012)

Rich Ling is a Professor at IT University of Copenhagen and also works with the research group in Telenor. He has examined the social consequences of mobile communication. He received his PhD from the University of Colorado and has worked at The University of Michigan. Geoff Canright works as a Research Scientist at the Telenor Group, Research & Future Studies. He has worked on self-organized networks, Web link analysis, and social network analysis—the latter based primarily on mobile phone data. Johannes Bjelland is a Research Scientist in the department of Research and Future Studies in Telenor Group. Current research interests are mainly within data mining and social network analysis. His academic background is MSc in computational Physics from NTNU in Norway and LTH in Sweden. Kent Engø-Monsen is a Research Scientist at the Telenor Group, Research & Future Studies. His interests are focus on social network analysis, network economics and analysis. He has more than 10 years of experience in the research functions of the Telenor Group, and a PhD in computer science from the University of Bergen (2000). Pål Sundsøy is working as a Research Scientist at the Telenor Group, Research & Future Studies. Sundsøys work is aimed at Predictive analysis and research on large-scale social network analysis based on mobile communication data. He is holding a Msc in Physics and Mathematics from NTNU, Norway, and UNSW, Australia. Correspondence to: Rich Ling, ITU, Rued Laenggards vej 7, Copenhagen, Denmark. Email: rili@itu.dk

Introduction

In developed countries, the mobile phone is used to maintain a small core of social relations. It is an instrument of the intimate sphere (Ling, Bertel, & Sundsøy, 2012). In this paper, we are interested in comparing the use of the mobile phone in the core network for a developed country, Norway, and comparing it to the situation in three other countries that are less developed, Malaysia, Thailand and Pakistan.

In general, there is the notion that in less developed countries there is greater reliance on informal contacts when dealing with the exigencies of daily life (Shrum et al., 2011). This would suggest that the core networks of individuals are larger since there is the need for more expansive instrumental interaction. As a society gains a more rationalized commercial sector the need for extensive informal logistics should decline in importance. If the mobile phone is an adequate proxy for the functioning of the core social network, we would expect the network to be larger in developing countries. This is because the mobile phone facilitates the coordination of daily life by giving us a better coordination tool (Ling & Yttri, 2002).

There are, however, barriers to the use of mobile telephony in developing countries. The cost of buying a mobile phone and paying for the subscription are significant obstacles. For the billion or so people who make less than one dollar a day, the cost of a \$30 mobile phone represents a month's work. Further, payment for the subscription is not trivial. Another barrier, in the case of texting, is illiteracy. When users can either not read or write—or in the case that their interlocutors cannot read or write—texting is not a realistic option. Beyond these structural issues it is clear that there are basic cultural differences in these countries. In the case of Norway, the country is affluent with traditions of equality and democratic openness where these values have other dimensions in Malaysia, Thailand and Pakistan. This paper will examine these issues using log data for mobile phone users in these four different countries.

The Rise of Mobile Phones in Developing Countries

The infrastructure for the landline phone proved difficult to deploy in developing countries. It was expensive and difficult to maintain (Castells, Fernandez-Ardevol, Qiu, & Sey, 2007; Maitland, 1984). The mobile phone eliminated many of the more capital intensive problems of the landline telephony system, that is, the “last mile” issue (Green, 2004, p. 103; see also Nduati & Bowman, 2005). As noted by Huber, “Wires are dedicated facilities that (in the last mile, at least) may lie idle most of the time; the radio spectrum, by contrast, is a shared resource” (Huber, 1993). This simple efficiency, that is, the substitution of wireless connectivity to the individual subscriber, as opposed to the more expensive and resource intensive landline connections, meant that it was possible to deploy mobile communication into regions that had languished in the wire-bound landline era. The other development that was essential was the adjustment of payments. The most common landline paradigm was post-payment, that is, payment scheduled on a monthly or quarterly

basis for calls made during the period leading up to the bill. This system is difficult for people who have irregular income. The alternative pre-paid approach, where subscribers buy credit and then use it as the need arises, fits into the situation of impoverished people in developing countries. Thus, the combination of more efficient resource use and subscription systems that fit into the lives of people in developing countries has led to the explosion of mobile phones.

Zhao and Elish note that communication takes place for both instrumental and expressive reasons, typically with elements of both in the same communication session (Zhao & Elish, 2008, p. 572). Writing in 1971, Aronson outlined the more instrumental side of telephony. He describes the efficiency afforded by the device: "Perhaps the most conspicuous of these effects has been the dramatic contraction in the time needed to establish communication, transmit orders and consummate business transactions, what for the sake of brevity, may be called 'transaction time'" (1977, p. 154). He discusses this in the context of formal production in commercial settings. The same efficiencies apply to less formal production in the Global South (Jagun, Heeks, & Whalley, 2008). In addition, Aronson suggests that the telephone has changed the arrangement of the community and affected social interaction by changing the pattern of communication (Aronson, 1977, p. 161).

Social Networks in the Global South

Turning to the question of social networks in the Global south there is limited research. Adams, Madhavan, and Simon (2006) examined the structure of networks for 78 women in Mali, West Africa. They suggest that there were both instrumental and expressive dimensions of the social networks. Women were asked about their social network in relation to obtaining food, loans of different types including money; help with domestic chores, etc. The women reported relying on their networks for material help with food, practical support with domestic chores, child care, etc. advice and finally emotional support (2006, p. 367). About three quarters (76.1%) of the links were associated with material or practical issues. They found that 14.8% of the links were employed for advice and the remaining 9.1% were for emotional support. This distribution suggests that more than 9 of 10 links were associated with some form of instrumental support.

Marin and Wellman (2009) have examined how some impoverished communities, not necessarily in the global south, do not necessarily have the links with which to seek out resources. It is not just having the links, but it is having the correct links and having the ability to call on them that is important. This, in effect, enforces their isolation (Portes, 1998). Faust, Entwisle, Rindfuss, and Sawang (1999) also suggest the centrality of instrumental networks in their analysis of rural Thailand. They look at the geographic dispersion of social networks in Thailand associated with schools, temples and the pooling of tractors. Interestingly, the tractor pooling network is the largest. This would suggest that the social network that is perhaps the most functional is also the largest.

In the developed world there is a different dynamic associated with core social groups. They seem to be becoming more expressive and less instrumental. According to Hampton, Sessions, and Her (2011; see also McPherson, Smith-Lovin, & Brashears, 2006), the size of core networks is declining in the United States; but the use of mobile phones and internet contradicts this tendency, both in terms of the size and diversity of core groups. They go on to assert that information and communication technologies (ICTs) allow for a type of awareness associated with the core network (what Licoppe might call “connected presence” (2004)). Hampton et al. suggest that ICTs have led to a type of specialization within these close ties as seen in the type of support they provide.

The increased accessibility of social ties, through the use of mobile phones and other technologies, combined with the ‘pervasive awareness’ that people have of their network members activities and interests, based on what is broadcast through social media, may allow people to specialize more in the exchange of support within core networks. People may no longer discuss important ‘matters’ (emphasis on the plural), but engage with core network members around very specific issues. The anytime, anywhere connectivity of new communication media, combined with the pervasive awareness of social media may be responsible for a fundamental shift in the structure of community toward more specialized nodes of support. (Hampton et al., 2011, p. 135)

Thus, in the setting of the developed countries, access to ICTs strengthens but does not necessarily enlarge the expressive web of individuals. It allows them to discuss specific types of expressive (and also instrumental) topics with others in their immediate social network. There is also the suggestion that social networks in the Global South have a large instrumental element.

Mobile-Based Social Networks in the Global South

As noted, mobile telephony has become a factor in the social lives of many people in developing countries. According to Donner, users adopt the mobile phone so as to fit into existing social structures. Looking at this in the context of social networks, Shrum et al. (2011) find that the social networks of Kenyans have been increasing in size during the last decade. They base their findings on self-report data of 720 individuals in 2002 ($n = 400$) and 2007 ($n = 320$). They used a “name generator” approach that was similar to that used by McPherson (McPherson et al., 2006) as well as Hampton (Hampton et al., 2011). They assert that the mobile phone is layered on top of existing social networks. Their findings show that the size of core networks had grown significantly in the five-year interval between 2002 and 2007. The size of the total core network had gone from 4.42 persons in 2002 to 7.23 in 2007. Looking at sub-networks, the size of the family network, as well as work and romantic networks, had grown. There was no statistically significant difference between the sizes of the friendship network in the two samples.

In line with the discussion in the previous section, Shrum et al. suggest that, in the Global South, the network of obligations is larger and (percentage wise) has fewer

emotional ties than one might find in the developed countries—where the core networks are smaller and contain a larger percent of expressive ties. They suggest that, in the context of economic resource scarcity, there is a stronger reliance on informal and perhaps irregular social ties. These are not ties from which the individual seeks emotional support; rather they are ties that are associated with problem solving.

In the Global North, among those who do not suffer from acute economic scarcity, problems can be solved by simply purchasing services from formalized commercial outlets. Food comes from the supermarket; repairs are made at an established shop; jobs are governed by contractual relations, etc. When there is resource scarcity these systems are more informal. Shrum et al argue that this system is in transition. They state “communicative shortcuts in a context of resource scarcity strengthen weak ties” (Shrum et al., 2011, p. 622). Hampton and Ling echo this suggestion when they note that social prosperity and new communication devices reduce the need for large core groups (Hampton & Ling, in press).

Jagun, Heeks, and Whalley (2008) describe the impact of the mobile phone on a specific commercial activity, that is, production of Aso Oke Clothing in Nigeria. The production process involves a complex of customers, intermediaries, raw material suppliers, master and secondary weavers, transportation, design development and money transfer. They find, much as suggested by Aronson describing the landline phone, that the mobile phone reduces risks, and saves time and costs (in particular in transport) in the ordering/production process (2008, p. 57). There is the need to develop a bond of trust in the web of interactions, but once that is in place, the mobile phone facilitates the production of orders in a geographically dispersed production network. Indeed they describe a “competitive divide” between producers with and without a mobile phone.

The mobile phone calls saved time and money by substituting for journeys. Time saved per call was typically several hours and, overall, this had meant that the turnaround time between first order and final fulfillment was reduced. (2008, p. 57)

The device facilitates the production process in concrete instrumental ways.

These results suggest that the mobile phone provides an efficient way to maintain existing social relationships and has found a niche in securing the economic situation of users in developing countries (Jensen, 2007). This can be seen the work of Horst and Miller (2005) who describe another type of social networking; the cultivation of sexual partners in Jamaica who somehow play the divide between friendships and paid sex services. According to Horst and Miller, men and women maintain sometimes extensive lists of potential partners in their telephone registers. These names include active sexual partners, older partners and also potential future partners. They report that—particularly for the women—there is often the expectation that providing sexual favors has the implicit expectation of at least temporary economic remuneration. Again, this describes a wide social network that can be mobilized at different times for different needs.

Indirect Indicators of Commercialization

If the economy in a country is characterized by commercial interaction as opposed to informal negotiations, the use of mobile communication will have a larger component of expressive and not instrumental interactions. There are few direct indicators of the degree that an economy is commercialized such that informal channels are needed. Those that exist describe other aspects of a society. Three elements that point in this general direction without really touching directly on the commercialization of a society, are the degree of urbanization, the size of the service industry vs. the agriculture sector and the general level of commercial transparency and accountability (read: corruption).

A greater level of urbanization will indicate a high degree of job specialization, and hence a commercial activity relating to many dimensions of daily life. People living in rural areas often do not have specialized stores or workshops. There is a need to be a jack of all trades, or at least know others who are. This would mean that informal knowledge of people with different skills would be necessary in order to repair items or to secure goods. This is, to be sure, an imprecise measure of commercialization since impoverished people in urban settings also often need informal ways of dealing with daily life.

The second indication of a commercialized economy is the percent of persons engaged in the service sector of a country. According to the CIA World Handbook, this is defined as those who are in “government activities, communications, transportation, finance, and all other private economic activities that do not produce material goods.” Again, this is not a direct measure of the degree to which a country is based on rational economic interactions as opposed to informal bartering. However, the existence of a large formal service economy points in the direction of a diverse commercial sector that is designed to take care of varied needs. If a large portion of the population is engaged in agriculture or basic production, there is a different character to the society.

Finally, we use the degree of transparency that characterizes a country. A large informal economy that is “off the books” suggests that the formal commercial sector is not securely in place. This may include simple “off book” purchases or it can be scaled up to, for example, falsified access to a diverse array of utilities (de Souza e Silva, Sutko, Salis, & de Souza e Silva, 2011).

Factors Limiting the Use of Mobile Communication in Developing Countries

The discussion outlined above would indicate that people living in developing countries would have broader social networks than people living in developed countries. The need to organize complex logistical structures to do tasks that are commercialized in developed countries suggests that use of the mobile phone would simplify logistics, and thus we would expect a large social network to be apparent.

There are clearly other issues that play into the mix. In particular limited economic wherewithal and, in the case of texting, literacy would dampen the use of mobile

communication. When thinking of the cost of mobile communication, many authors have noted that the system affords inexpensive communication (Donner, 2008; Kalba, 2008; Srivastava, 2008). There is a certain price inelasticity that would suggest that the mobile phone is more akin to a necessary service such as food or water. That is, as the relative price of use increases for people with little income, they are still willing to use money to buy telephony service (Agüer, de Silva, & Kan, 2011). That said, the cost of using a mobile phone is a significant issue for people who live at the bottom of the economic pyramid (Agüer et al., 2011). Impoverished people have different strategies when using mobile communication such as the extensive use of pre-paid subscriptions (Kalba, 2008), SIM switching (Fjuk, Furberg, Geirbo, & Helmersen, 2008) the use of missed calls (Donner, 2007; Geirbo, Helmersen, & Engø-Monsen, 2007) and sharing phones (Aker & Mbiti, 2010). The existence of these money-saving strategies indicates that mobile communication has its economic consequences.

Another element that limits the use of texting is literacy. In this case, cost is not an issue. Aker and Mbiti note that, even though the cost of a text message in Niger is about one seventh the price of a call, illiteracy dictates that texting is not used (2010). Simply put, illiteracy is a significant barrier to mobile phone usage (Medhi, Gautama, & Toyama, 2009) and texting in particular. Literate persons are able to quickly absorb, and then forget textual information because they know that it will be available again as needed. An illiterate person needs to memorize the menu structure by rote in order to carry out a function. It also means that illiterate people are not as willing to explore the functions of a mobile phone since they may inadvertently blunder into changing the settings.³ Chipchase describes how illiterate people kept track of phone numbers, by for example using a notebook where numbers for different individuals are on specific pages, in a specific location on the page, or in a particular color (2008). An illiterate user will either have to rely on others to, for example, enter names into the name register, or they will have to use an extended period of time to do it themselves. The questions of economy and literacy would suggest that people in less developed countries are less likely to use mobile communication.

The Socio-Cultural Context

This paper examines the use of mobile telephony in four countries. One country, Norway, is securely located among the more affluent countries in the world. Malaysia and Thailand occupy a middle position and Pakistan ranks low on many development indicators. We do not suggest that these are the only factors available with which to clarify the differences in use of mobile communication. It is clear that there are other deep-seated cultural issues that would also play into the differences in use (Baron & Campbell, 2012; Campbell, 2007; Thomas & Haddon, 2011). These include a whole range of socially transferred symbols, values, beliefs and attitudes. Beyond that it includes their translation into mundane material artifacts social perceptions, behavior. It is clear that culture can apply to spatial communities

Table 1. Imprecise Measures of a Country’s Reliance on a Rational Commercial Sector.

Country	Percentage of urbanized population ¹	Percent in service industry	Transparency and accountability index (10 max) ²
Norway	79	76	8.6
Malaysia	72	51	4.4
Thailand	34	37	3.5
Pakistan	36	36	2.3

(i.e., the culture of Catalonians) and generational boundaries (i.e., teen culture) and gendered boundaries (Baron & Campbell, 2012). Culture can be affected by the broader homogeneity in a country, the degree that a society is hierarchical, the nature of the religious structure, the educational basis of the population, the traditions surrounding gendered interaction and interaction between generations.

Applying culture to mobile communication, it is clear that the technology is being implemented into a cultural context (Shuter & Chattopadhyya, 2011). Taking the case of India Shuter and Chattopadhyya note that texting is cheap and it facilitates interaction. It is also a channel that is outside traditional communication forms. Thus the causal chain is that there is a particular structure in India, that is, poverty and a particular sense of propriety. The adoption of the mobile phone changes the cost of communication while at the same time facilitating the needs of a particular group. Thus the culture (the economic situation and the sense of propriety) results in a particular type of practice. For the purposes of this analysis however, we will concentrate on the interaction between economic wherewithal and mobile phone use. We will look at the general situation of the four target countries below.

Norway

Norway is a rich Scandinavian welfare state. Using the indicators of rationalized commercialization (however imperfect) it is clear that Norway has the most formally structured commercial sector of the four countries considered here (See Tables 1 and 2). There is a large urban population in Norway and a well-developed service sector. In addition there is a very high degree of transparency associated with the economy. Norway is a well-heeled country where people have comfortable personal economies. Based on gas and oil production it has become one of the wealthiest countries in the world. It often tops the list of countries when considering income per capita and other indicators. It is, for example listed as the best country when considering the UN Human Development Index that measures life expectancy, literacy, education and standards of living. Norway has a 2010 GDP/capita of \$54 600.⁵ Income is relatively evenly distributed in Norway. The country has a Gini index of 25.⁶ For every Krone earned by a person in the lowest 10% of the income scale, a person in the top 10% will earn 5.3. The affluence of the country means that the relative cost of using mobile communication is quite low. The cost of sending 1000 texts is approximately 0.1% of the GDP/Capita.

Table 2. Comparison of Countries on Several Social and Economic Variables.

Country	Gini index	Ratio of top and bottom 10%	UN Human devel. index ranking	GNP/capita PPP	Literacy rate (%)	Mobile sub. Per 100 persons ⁴
Norway	25	5.3	1	54,600	100	113
Malaysia	46	19.3	59	14,700	89	121
Thailand	53	26.6	94	8700	93	101
Pakistan	30	6.8	128	2500	50	59

Table 3. Purchase Power Parity Pricing (US\$ Equivalent) for Texts and Mobile Voice Minutes.

	One SMS in USD (PPP) ⁷	Off net voice non-peak/minute in USD (PPP)	On net voice non-peak/minute in USD (PPP)	1000 texts as % of GNP/Cap.	1000 off net minutes as % of GNP/Cap.	1000 on net minutes as % of GNP/Cap.
Norway	0.07 ⁸	0.10	0.10	0.13	0.18	0.18
Malaysia	0.07	0.26	0.20	0.48	1.77	1.36
Thailand	0.18	0.12	0.12	2.07	1.38	1.38
Pakistan	0.07	0.11	0.08	2.8	4.40	3.20

The cost of using the mobile phone is very moderate in Norway. Mobile ownership is nearly universal with 113 subscriptions per 100 persons.⁹ The absolute cost of sending a text is approximately \$0.07. One minute of mobile voice to either and on-net or off-net¹⁰ interlocutor is \$0.10. To put this into a broader perspective, the cost of 1000 texts or 1000 minutes of mobile voice would cost less than 0.2% of the Norwegian GDP/capita (See Table 3). The literacy rate is listed as 100% and the so-called school life expectancy is 17 years. Norway is quite unified linguistically. While there are variations of Norwegian, they are mutually intelligible as are Swedish and Danish. There are small Sami and Finish-speaking groups in the country.

Malaysia

When compared to the other countries considered here, Malaysia has a moderately rationalized economic sector. The data show that 72% of the population lives in the cities and that 51% of the labor force is engaged in the service industry (approximately 13% is engaged in agriculture). Finally it has a moderate score of 4.4 on the index of transparency and accountability.

Malaysia is a middle-income country with an income based on production of primary resources (petroleum, tin, rubber and palm oil). More recently the economy has diversified to include machinery and electronic components. In addition, it has a position in shipping. At \$14 700, the GDP/Capita is about 1,5 times as much as

in Thailand and nearly six times as much as in Pakistan. Norway, in turn, has a GDP/Capita that is nearly four times as large as that of Malaysia.

Malaysia has a relatively large gap in its income distribution with a Gini index of 46. For every Ringgit earned by a person in the lowest 10% of the income scale, a person in the top 10% will earn 19. The cost of using a mobile phone is somewhat complex in Malaysia. The mobile sector in Malaysia is characterized by near universal access (121 subscriptions per 100 persons).¹¹ The pricing for texting is in line with that in Norway and Pakistan but the cost of voice telephony is more expensive than in the other countries. This means that were a person with a median income to pay for 1000 minutes of talking it would represent a significant portion of their income. This is of particular note since there is a large income gap in Malaysia.

The literacy rate for Malaysia is 89% and an average school life expectancy of 13 years. There are several different languages spoken in Malaysia. These include Bahasa Malaysia (official), English, and Chinese in addition to several other languages.

Thailand

Thailand has a less rationalized economy when considering the indicators noted above. The population is markedly more rural and less engaged in the service industry than either Malaysia or Norway. About a third of the population is urbanized and a similar number are engaged in the service industry. The transparency index is at a moderately low 3.5. These numbers point in the direction of a relatively large informal sector to the economy.

Thailand has the most skewed income distribution of the countries considered here. For every baht earned by a person in the lowest 10%, a person in the highest 10% earns 26 baht. Thus, while there is prosperity in the country, it is not evenly distributed.

Thailand has the most expensive pricing of SMS of the four countries considered here. That is, the *relative* (by PPP) cost of texting is the highest of the four countries considered here. Indeed, according to the material shown in Table 3, the relative cost of texting in Thailand is more than double that of the other countries. This also means that 1000 texts would account for a significant portion of the GDP/capita. The cost of voice is more in line with that of Norway and Pakistan. Still, given the relatively low GDP/capita, 1000 minutes of use is a significant economic burden. Literacy is not a barrier to texting in Thailand since approximately 95% of the population is literate with an average school career of 12 years. The data show that 75% of the population is Thai, 14% is Chinese and 11% is listed as other (CIA, 2011). Literacy is somewhat higher for males than for females.

Pakistan

Pakistan has the least formalized economy of the countries considered here. As with Thailand about one-third of the population is urbanized and also about one-third

is in the service economy. About 43% of the people are engaged in agriculture (Norway 3%, Malaysia 13%). At 2.3, Pakistan has the lowest transparency and accountability index. This would suggest the existence of large core networks.

Pakistan has the lowest GDP/capita of the four countries at \$2500. In spite of this, the Gini index of 30 is not far different from that of Norway. For each Rupee earned by a person in the lowest 10% of the population a person in the top 10% will earn only 6.7. This ratio is nearly on parity with Norway. Obviously however, the difference is the size of the pie. The GDP/Capita is 25 times larger in Norway than in Pakistan. In Pakistan the absolute cost of texting and calling is in line with the lowest tier of the other countries. However, the low GDP/capita means that the relative cost of a text is indeed higher than in the other countries. The cost of sending 1000 texts is approximately 2.8% of the GDP/Capita, the largest percentage of the four countries considered here. The country has a much lower literacy rate than the other countries (50%). Thus, there is a literacy barrier when considering texting. In addition, there are a large number of languages used in Pakistan. These include Punjabi (used by 48% of the population), Sindhi 12%, Siraiki (a Punjabi variant) 10% and Pashtu 8%. Urdu is the official language and is spoken by only 8% of the population. About 14% of the population speaks other languages. English is the second official language and it serves as a *lingua franca* among the Pakistani elite.

Research Questions

The foregoing analysis suggests several research questions. The first research question deals with the size of the core network.

RQ 1: The more rational the commercial sector, the less need there is for individuals to engage in instrumental exploitation of their social network and thus the smaller will be the core network.

Since Norway has a transparent and rationalized commercial sector, we would suggest that the core network will be relatively small.¹² The same logic would say that Pakistan would have the largest core networks, given the relatively small service economy and the lack of transparency in the economic system. Malaysia followed by Thailand would fit in between the Norway and Malaysia.

Research questions 2 and 3 contradict, or perhaps modify, research question 1, since they propose that the mobile phone is not a perfect proxy for social networks. They suggest that cost and, in the case of texting, literacy are barriers to the use of mobile telephony.

RQ 2: In those countries where there are large groups with low income, mobile phone use will be low.

Norway has little poverty. Thus there is not an economic barrier to mobile phone use, and there is better reason to suspect that the use of the mobile phone is a proxy for social interaction than in the other countries considered here. In Malaysia the GDP/capita is relatively high, but there is a very poor distribution of income.

This, along with the relatively high cost for mobile voice telephony, might be a hindrance for the use of that service. The low GDP/capita in Thailand and even lower level in Pakistan means that mobile communication use is a large cost. This would indicate low general use of mobile communication in these two countries.

The final research question focuses on the interaction between literacy and the use of texting.

RQ 3: Low rates of literacy would suggest low use of texting.

There is nearly universal literacy in Norway; thus, this should not be a barrier to the use of texting. Malaysia and Thailand both have a relatively high literacy rate, suggesting that this will not be a barrier to the use of texting (though the relatively high cost of texting might be a barrier in Thailand). Pakistan has a very low-literacy rate; this would suggest that there is a low level of texting.

Method

In this paper, we are interested in examining the size of the core social network. Given the access to mobile phone log data we are able to examine this using a specific definition. Rather than using for example the five individuals who “over the last six months—who are the people with whom you discussed matters important to you” such as in the United States-based General Social Survey, our approach is to look at the percent distribution of calls to different links in an individual’s mobile-based social network.

We base the analysis on mobile phone call data records (CDR) for 1000 subscribers and the 20 strongest links in their “one hop” networks for a particular operator in a given country. Thus, there are approximately 80 000 links included in the analysis. These data are anonymized such that it is impossible to know the identities of the individuals. We used the material to examine the social network structure for each of these cases. We are able to identify the—also anonymized—numbers with which each subscriber was in contact. We identify the strongest link and calculate the percent of calls going to that link, the second strongest, the third strongest, and so on. We measure the relationship strength by the total amount of communication over the link. For the SMS-network we rank by number of SMS, while for the voice-network we rank by the total number of minutes over the link that is, your closest relation is the one with whom you communicate the most with.

There is some lag in the time periods covered. In Norway the data covered a three-month period from July to September 2010. In Malaysia it was a three-month period from March to May 2009, In Thailand the data covered a two-month period from February to March n 2011 and finally for Pakistan the data covered a three-month period from March to May 2009. These time points are unfortunately not overlapping. Given the opportunistic nature of the data this constraint was unavoidable.

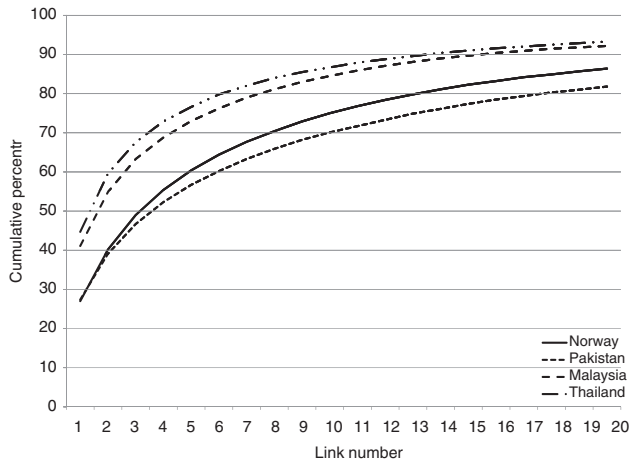


Figure 1 Cumulative Percent of Mobile Voice Calls by Link Number.

These data give us a notion with regards the number of people with whom one is regularly in-touch via mobile voice and texting. It is not the same as their reported social network, nor is it necessarily the same as their face-to-face social network.

Findings

Instrumental Exploitation of the Social Network

The first research question suggested that the more rational the commercial sector in a give country, the less need there is for individuals to engage in instrumental exploitation of their social network. This would, in turn lead to a smaller core network. Thus, we suggested that the smallest core networks (as measured using mobile communication) would be in Norway, followed by Malaysia, Thailand, and finally Pakistan. To investigate this we examined to percent distribution of calls and texts to the 20 most central links.

The material in figures one and two shows that this assertion is not supported by the data. When looking at voice mobile interaction, the ranking (with smallest core networks giving the highest curves, and hence highest ranking) is: Thailand, followed closely by Malaysia, with Norway and Pakistan showing lower, and roughly equal, levels of core network concentration. If we choose the number of links (that is the number of people) who receive 50% of the calls, the numbers are between one and two for Malaysia and Thailand, and between three and four for Norway and Pakistan.

The core groups are even smaller when considering texting (Figure 2). In Norway, between two and three people receive 50% of the texts. In Malaysia it is between one and two persons, and in Pakistan and Thailand it is one person who receives the vast majority of all text messages.

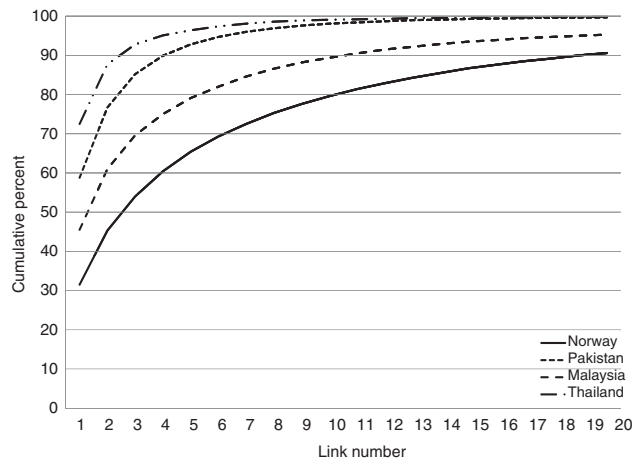


Figure 2 Cumulative Percent of Texts by Link Number.

These findings have two interpretations. One is that, in contrast with the research cite above, the core networks in developing countries are not larger than those in developed countries. Rather they are often smaller. If this is the case in relation to both the mobile networks as well as the face-to-face networks, it would say that there needs to be a basic re-analysis of our understanding of social networks in developing countries. Another, and perhaps more likely, finding is that the nature of the probe is not reliably measuring the true core networks, given differences in the way that the mobile phone is used in the different countries. This means that we need to look at issues that would affect this analysis, that is, the relative cost of use and the role of literacy.

Income and Mobile Phone Use

The second research question suggests that there is a link between economic wherewithal and willingness to use the mobile phone. The assertion is that, in those countries where there are significant impoverished populations, people are more reluctant to use money on mobile telephony. This would suggest that Norway would have the highest use, followed by Malaysia, Thailand and Pakistan.

To examine the relationship between income mobile phone uses, we relied on the cumulative number of (call minutes + texts) sent to a subscriber's top 20 links. The material in Figure 3 indicates that indeed the suggested ordering holds. This is not to say that the relationship is linear. The GDP/capita is far higher in Norway than in Pakistan, but Norwegians only call/text about twice as much as users in Pakistan.

Looking at only the absolute cost of calling (not texting) it is clear that Malaysia and Pakistan have the highest prices. In Malaysia the price of calling is high and while there is a relative high GDP/capita, the income distribution is quite skewed.

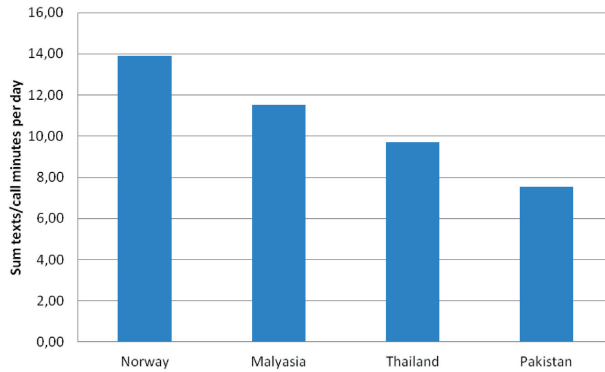


Figure 3 Sum of Texting and Minutes.

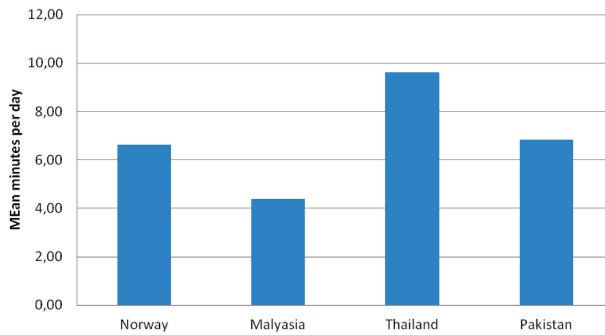


Figure 4 Mean Mobile Voice Minutes per Day.

Thus some sectors of society would be able to afford calls, but not all. The price of calling in Pakistan is in line with that of Thailand and Norway, but the generally low GDP/capita means that calling represents a relatively large percent. Simply using this material we would suggest the ordering as Norway, Thailand, Malaysia and then Pakistan. Interestingly, the material in Figure 4 shows that the ordering places Thailand before Norway. The lower tier of countries is then Pakistan and finally Malaysia. The standing of Malaysia is consistent with the fact (noted above, Table 3) that the relative cost of voice is highest of all four countries in Malaysia. Thus a simple price explanation has some value, but it is not a completely satisfactory solution. Figure 5 shows the extreme difference in texting.

Literacy and Texting

The final analysis was to examine the degree to which rates of literacy would result in low use of texting. Again we suggest that Norway would have the highest use,

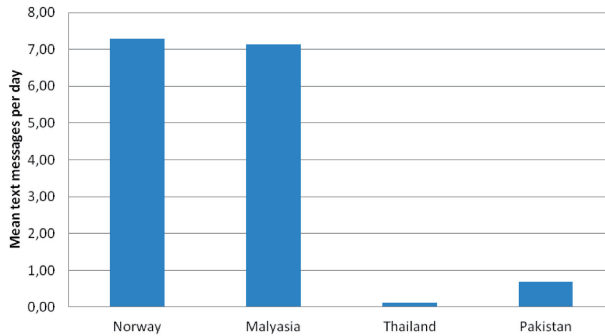


Figure 5 Mean Number of Texts per Day.

followed by Malaysia, Thailand and Pakistan. The data indicate that Norway and Malaysia are about on par when considering texting. Also, Pakistan, and then Thailand, are at a much lower level. Literacy is likely a serious factor in the case of Pakistan, while pricing (Table 3) is in the picture with Thailand.

Summary

The material seems to indicate that it is premature to suggest that the mobile phone is a proxy for all social interaction. The drift of theory regarding instrumental interaction in developing countries indicates that informal relations are important. This line of thought posits that since there is a limited formal economy, informal interactions necessarily fill a large place in the logistics of daily life.

The role of the mobile phone is a new element in this process. As noted above, it has simplified the logistics of arranging daily affairs (Ling & Yttri, 2002). Thus, it is logical to think that the mobile phone will be pressed into this type of service in developing countries where there is truly the need to work out complex coordination.

The data here, however, does not bear this out. There is not the basis to say that the mobile-based social networks are less concentrated in developing countries. Were this the case, we would have expected to see a very flat low curve in Figures 1 and 2 for Pakistan, and in each case the highest (most concentrated) curve for Norway. Instead, we find a complex picture, with Norway having the least concentrated SMS curve (Figure 2), and the second least concentrated voice curve (Figure 1). At the same time, Pakistan has the least concentrated voice core network curve, but one of the most concentrated SMS core networks. This means that either the notion of broad social networks in developing countries is wrong headed, or that the mobile phone CDR data does not capture the full core network.

Given this possibility, we reviewed the relative use of voice and texting in the light of general economic resources in a given country. There is indeed, a mild suggestion that the cost of mobile communication is a factor in mobile phone use. In those

countries where there are significant populations of impoverished persons, mobile communication is more limited in use. There is more irregular contact with other contacts depending on the situation. Otherwise, there are alternative routines and systems for dealing with the needs of daily life. Further, where there is limited literacy, the use of texting becomes spotty. From a network perspective this may mean that there is a not a critical mass of users.

We note that, in the two cases where sms usage is strongly suppressed (Thailand and Pakistan); the effect is to give the most concentrated texting core networks. Put more simply: it seems that, when you don't send many text messages, you tend to concentrate the few that you do send on one or two receivers. This seems to be the case even though the observed sms suppression is apparently due to very different reasons (relative price, and illiteracy) in these two countries.

All this indicates that the mobile phone is not necessarily a completely reliable probe with which to measure social interaction when there are significant barriers to its use. The other major finding, that still stands, is that the mobile phone is an instrument of the closest sphere. In spite of significant economic barriers, users in developing countries used it to maintain contact with a small circle of contacts. As the relative cost of use declines, it is possible that the circle will be enlarged to include others. Further, as economic activities become more formalized in a country or in a social group; we can speculate that the size of the core network would again decline to include more expressive and less instrumental interaction. At the end of the day, however, the result is that mobile communication is limited to a small circle of contacts.

It is clear that this analysis examines the situation using a limited number of cultural indicators. Other dimensions of culture (Hofstede, 2001) such as context (Hall, 1977) and orientation to time (Hall, 1989) would fill out the picture. Clearly there are many dimensions that can be included in the discussion of culture. Taking this a step further we need to think about the causal position of culture when considering mobile phone use. According to McSweeney the notion of national culture can be viewed in a variety of ways ranging all the way from being a "superordinate power in society" to being something that is causal at a far lower order of magnitude (McSweeney, 2002, 92).¹³ It is also possible to think of culture as a special case of path dependence (Page, 2006, 113). That is, the specific development and consumption decisions taken in a country are framed using the particular cultural perceptions of the actors.

Another issue is that telecom systems and the corresponding regulatory bodies are very geographically bound. The regulatory regime (and its cultural baggage) of one country is seldom the same as that of another nor is the organization of the telecom operators and the way that they do business. Even multi-national operators necessarily need to adjust their offering according to the national regulatory situation. In the case of an operator who has bought into a pre-existing system, as is quite common, the nature of the equipment and its placement can affect the coverage, the subscription types, etc. How a particular local culture makes sense of this is, obviously up to the nature of the local culture. In this paper, we have chosen

to look at the impact of income and education on the use of telecom services simply because that is the material that we have available. This is not to say, however, that we have exhausted the possibilities for analysis. This does not negate the relevance of this analysis. It is unique have access to the structure of the mobile-based social network.

Beyond the limited number of cultural indicators, there are several other limitations with the material presented here. First, the data come from a single mobile phone provider in each of the respective countries. Given the nuances of pricing, reputation and marketing efforts, the customers of a single provider do not necessarily reflect the behavior of the entire population in a country. They may be older, more impoverished or more urban than competing providers. Second, there are time lags in the data. We necessarily had to base the analysis on data extractions that did not cover the same time period. This is unfortunate since some of the profiles may have changed for the older data point. Finally, the measurement of socio-demographic and social variables is rough and imprecise. We do not, for example, have income or demographic data for the individual subscribers. Further, the measurement of the informality of the commercial sector is imprecise.

Notes

- [1] Source: for the material in the first two columns of this table is the CIA World Handbook.
- [2] Source: "Corruptions Perceptions Index 2010" by Transparency International. http://www.transparency.org/policy_research/surveys_indices/cpi/2010/results
- [3] Often illiteracy refers to textual not numerical illiteracy (Chipchase, 2008).
- [4] The material is for 2010 in this column comes from the International Telecommunication Union <http://www.itu.int/ITU-D/ict/statistics/>
- [5] This is according to the CIA World Factbook. According to the World Bank the GDP/capita was \$56 894 and according to the International monetary Fund it was \$51 959.
- [6] The lower the number, the more evenly distributed the income in a country. In the United States, for example, the Gini index was 45 in 2010.
- [7] Purchasing Power Parity that is a way of adjusting the purchasing power of money in different countries.
- [8] Unless otherwise noted, the material in this chart comes from data gathered by MobileActive <http://mobileactive.org/mobiledata>
- [9] This is a somewhat misleading statistic since it considers subscriptions per person. It is clear that newborns do not have mobile phones nor do some elderly persons. Some people have more than one subscription. In some cases, people have "retired" subscriptions that are still on the books of the providers. In addition there are subscriptions that are associated with a function, that is, the mobile phone that resides in an ambulance or the subscription that is resident in a particular device.
- [10] On net calls are calls to others using the same operator while off-net calls are to others using an competing operator. Often there are extra charges associated with going from the network of one operator to another.
- [11] Because of multi-SIM use, one person may have several subscriptions.
- [12] Although it is not possible to measure it using the indicators in this paper, the mobile-based interaction is also expected to be more expressive than instrumental.
- [13] His comments are related in particular to the work of Hofstede (2001).

References

- Adams, A. M., Madhavan, S., & Simon, D. (2006). Measuring social networks cross-culturally. *Social Networks*, 28, 363–376.
- Agüer, A., de Silva, H., & Kan, J. (2011). Bottom of the Pyramid expenditure patterns on mobile services in selected emerging Asian countries. *Information Technology and International Development (Mobile Telephony Special Issue)*, 7(3), 19–32.
- Aker, J. C., & Mbiti, I. M. (2010). Mobile phones and economic development in Africa. *Journal of Economic Perspectives*, 24(3), 207–232.
- Aronson, S. J. (1977). The sociology of the telephone. *International Journal of Comparative Sociology*, 12(3), 153–156.
- Baron, N., & Campbell, E. M. (2012). Gender and mobile phones in cross-national context. *Language Sciences*, 34(1), 13–27.
- Campbell, S. (2007). Cross cultural comparison of perceptions and uses of mobile telephony. *New Media and Society*, 9(2), 343–363.
- Castells, M., Fernandez-Ardevol, M., Qiu, J., & Sey, A. (2007). *Mobile communication and society: A global perspective*. Cambridge, MA: MIT.
- Chipchase, J. (2008). Reducing illiteracy as a barrier to mobile communication. In J. Katz (Ed.), *Handbook of mobile communication studies* (pp. 79–89). Cambridge, MA: MIT.
- CIA. (2011). World Factbook. Retrieved September 25, 2012, from <https://www.cia.gov/library/publications/the-world-factbook/index.html>
- de Souza e Silva, A., Sutko, D. M., Salis, F., & de Souza e Silva, C. (2011). Mobile phone appropriation in the favelas of Rio de Janeiro, Brazil. *New Media & Society*, 13(3), 363–374.
- Donner, J. (2007). The rules of beeping: Exchanging messages using missed calls on mobile phones in sub-Saharan Africa. *Journal of Computer Mediated Communication*, 13(1), 1–22.
- Donner, J. (2008). Shrinking fourth world? Mobiles, development and inclusion. In J. Katz (Ed.), *Handbook of mobile communication studies* (pp. 31–42). Cambridge, MA: MIT.
- Faust, K., Entwisle, B., Rindfuss, R. R. J. W. S., & Sawang, Y. (1999). Spatial arrangement of social and economic networks among villages in Nang Rong District, Thailand. *Social Networks*, 21, 311–337.
- Fjuk, A., Furberg, A., Geirbo, H. C., & Helmersen, P. (2008). New artifacts – new practices: Putting mobile literacies into focus. *Digital Kompetanse*, 3, 21–38.
- Geirbo, H. C., Helmersen, P., & Engø-Monsen, K. (2007). *Missed call: Messaging for the masses. A study of missed call signaling behavior in Dhaka. (Internal Telenor R&I publication)*. Fornebu: Telenor R&I.
- Green, P. E. (2004, September). Fiber to the home: The next big broadband thing. *IEEE Communications Magazine*, 42(9), 100–106.
- Hall, E. (1977). *Beyond culture*. New York, NY: Anchor Books.
- Hall, E. (1989). *The dance of life: The other dimension of time*. New York, NY: Anchor.
- Hampton, K., & Ling, R. (in press). Why bigger is not better and less can be more: Core discussion networks and mediated interaction in America, Scandinavia and Eastern Europe.
- Hampton, K., Sessions, L. F., & Her, E. J. (2011). Core networks, social isolation, and new media: How Internet and mobile phone use is related to network size and diversity. *Information, Communication & Society*, 14(1), 130–155.
- Hofstede, G. (2001). *Culture's consequences: Comparing values, behaviors, institutions and organizations across nations*. London: Sage.
- Horst, H. A., & Miller, D. (2005). From kinship to link-up: Cell phones and social networking in Jamaica. *Current Anthropology*, 46(5), 755–778.
- Huber, P. W. (1993). Telecommunications regulation: The beginning of the end. *Issues in Science and Technology: National Academy of Sciences*, 10(1). Retrieved September 25, 2012, from <http://www.freepatentsonline.com/article/Issues-in-Science-Technology/14773691.html>

342 R. Ling et al.

- Jagun, A., Heeks, R., & Whalley, J. (2008). The impact of mobile telephony on developing country micro-enterprise: A Nigerian case study. *Information Technologies and International Development*, 4(4), 47–65.
- Jensen, R. (2007). The digital divide: Information (technology), market performance and welfare in the South Indian fisheries sector. *The Quarterly Journal of Economics*, 122(3), 879–924.
- Kalba, K. (2008). The adoption and diffusion of mobile phones — nearing the Halfway Mark. *International Journal of Communication*, 2, 631–661.
- Licoppe, C. (2004). Connected presence: The emergence of a new repertoire for managing social relationships in a changing communications technoscape. *Environment and Planning: Society and Space*, 22, 135–156.
- Ling, R., Bertel, T., & Sundsøy, P. (2012). The socio-demographics of texting: An analysis of traffic data. *New Media & Society*, 14(2), 280–297.
- Ling, R., & Yttri, B. (2002). Hyper-coordination via mobile phones in Norway. In J. E. Katz & M. Aakhus (Eds.), *Perpetual contact: Mobile communication, private talk, public performance* (pp. 139–169). Cambridge: Cambridge University Press.
- Maitland, D. (1984). *The missing link: Report of the independent commission for world-wide telecommunications development*. Geneva: ITU.
- Marin, A., & Wellman, B. (2009). Social network analysis: An introduction. In P. Carrington & J. Scott (Eds.), *Handbook of social network analysis* (pp. 11–25). London: Sage.
- McPherson, M., Smith-Lovin, L., & Brashears, M. E. (2006). Social isolation in America: Changes in core discussion networks over two decades. *American Sociological Review*, 71, 353–375.
- McSweeney, B. (2002). Hofstede’s model of national cultural differences and their consequences: A triumph of faith - a failure of analysis. *Human Relations*, 55(1), 89–118.
- Medhi, I., Gautama, S. N. N., & Toyama, K. (2009). *A comparison of mobile money-transfer UIs for non-literate and semi-literate users*. Paper presented at the CHI 2009.
- Nduati, C., & Bowman, W. (2005). Working from the sidelines. In F. E. Etta & L. Elder (Eds.), *At the crossroads: ICT policy making in East Africa* (pp. 56–67). Ottawa: International Development Research Centre.
- Page, S. (2006). Path dependence. *Quarterly Journal of Political Science*, 1, 87–115.
- Portes, A. (1998). Social capital: Its origins and applications in modern sociology. *Annual Review of Sociology*, 24, 1–24.
- Shrum, W., Nyaga Mbatia, P., Palackal, A., Dzorgbo, D.-B. S., Duque, R. B., & Ynalvez, M. A. (2011). Mobile phones and core network growth in Kenya: Strengthening weak ties. *Social Science Research*, 40, 614–625.
- Shuter, R., & Chattopadhyaya, S. (2011). Emerging interpersonal norms of text messaging in India and United States. *Journal of Intercultural Communication Research*, 39(2), 123–147.
- Srivastava, L. (2008). The mobile makes its mark. In J. Katz (Ed.), *Handbook of mobile communication studies* (pp. 15–27). Cambridge, MA: MIT.
- Thomas, F., & Haddon, L. (2011). Cultural factors shaping the experience of information and communication technologies. In L. Haddon (Ed.), *The contemporary internet: National and cross-national European studies* (pp. 17–31). Frankfurt: Peter Lang.
- Zhao, S., & Elesh, D. (2008). Copresence as “being with”. *Information, Communication & Society*, 11(4), 565–583.