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Mobile phones and core network growth in Kenya: Strengthening weak ties

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ABSTRACT

In contrast to recent US studies showing a decrease in core network size, our Kenyan data reveals substantial network growth. We attribute this to the diffusion of mobile telephones. Results from pooled survey data from Nairobi professionals and entrepreneurs in 2002 and 2007 as well as qualitative interviews from 2007 to 2009 show virtual saturation in the diffusion of phones during this period, but no direct effect of technology use. What explains this puzzle is a network effect of mobile telephony: increased technological access to existing networks in a context of resource scarcity leads to a strengthening of weak ties and the enhancement of core networks among Kenyans. Video ethnographic data before and after the 2007 post-election unrest supports this interpretation, showing that mobile phones are a crucial resource in managing interpersonal networks for instrumental purposes.

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1. Introduction

The summer of 2006 was notable for widespread press coverage of “Social Isolation in America”, a study that had just appeared in the *American Sociological Review* (2006). Miller McPherson, Lynn Smith-Lovin, and Matthew Brashears examined changes in the size and composition of core networks of Americans over two decades, comparing Peter Marsden’s (1986) original findings from the 1985 General Social Survey with new results from a 2005 replication. The persuasiveness of the findings derived from the methodological elegance of the replication while its power derived from the widespread sense, best crystallized by Putnam (1995), that Americans were withdrawing into smaller social circles and becoming less integrated into the wider social structure. In this essay, we present equally compelling evidence that some urban Kenyans are becoming more integrated owing to the connectivity provided by the diffusion of mobile telephones.¹

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¹ The specific device is typically called a “cell phone” in the US. In the UK and Africa the more common term is “mobile phone” or simply “mobile”.

McPherson and colleagues presented three striking changes in the core network structures of Americans. First, the overall size of discussion networks is smaller, decreasing by almost one third over twenty years. Second, the number of people who reported no discussion partner increased and the modal response of three in 1985 dropped to zero in 2004. Third, network contraction occurred for both kin and non-kin ties, but was more pronounced for the latter. The general implication is a core discussion network for Americans that is “slowly closing in on itself, becoming smaller, more tightly interconnected, more focused on the very strong bonds of the nuclear family” (2006: 371).

McPherson and colleagues did not claim to explain the contraction directly. This point bears on our central finding as well, a finding that goes in the opposite direction. While urban Kenyans are becoming *more* connected owing to mobile phones, frequency of use does not significantly impact network size. We explain this puzzle using qualitative data collected since 2002, including 105 h of videographic research in Nairobi and the Rift Valley during the 2007–2009. Significant social change has occurred through a network effect: the widespread diffusion of new communication technology in a context of resource scarcity.

McPherson et al. indicate a related possibility in two of three proposed explanations: (1) changing interpretation of “important matters” in the name generator; (2) changing interpretation of “discuss” to exclude cell phones and Internet; (3) shifts in the “form and type of connection” (2006: 373), that is, a “demarcation” of smaller core (mainly familial) networks and larger, dispersed networks using new modes of contact. While (1) and (2) are interpretive shifts, perhaps based on historical or cultural change, we emphasize that both (2) and (3) refer to new communications technology. They imply that the underlying network structure may not have changed as much as it appears if, for some reason, respondents either did not consider their Internet and mobile phone links, or did not consider them in the same way. Depending on how one defines personal networks, they may not be shrinking, but transitioning to new forms that are Internet or cell phone based.

The GSS results have since been debated on both methodological and empirical grounds. While the methodological debate goes on (Fischer, 2009), data from phone interviews by the Center for the Digital Future show that friendships have increased from 2002 through 2007 (Wang and Wellman, 2010). The dependent variables in this study are not constructed from name generators but rather ask respondents to report directly on their number of “offline, virtual, and migratory” friends. Recently, the Pew Internet Personal Networks and Community Survey used phone interviews (response rate 22%) to confirm the decrease in the size of core discussion networks (Hampton et al., 2009), but not the increase in “isolation” (having no discussion partner). As in the GSS, respondents were only allowed to mention five names in response to the name generator.

Our central finding—that urban Kenyans are becoming more connected—is based on a replication, with a name generator similar but not identical to that used in the General Social Survey. Our initial interest in the issue of social integration emerged from a research question on the role of new information and communications technologies in the globalization of science.² Along with many other scholars, we had previously focused on the Internet as the most important information technology with the potential to transform developing areas. But by 2002, as sub-Saharan Africa was overwhelmed by the rapid diffusion of the mobile phone, we began to examine this new phenomenon in the context of an urban population.³ Our unpublished 2002 data serves as the baseline for the examination of core network change in Kenya. Overall, the results reveal significant growth in egocentric social networks for most types of tie and most locations. Normal error regression analysis shows that core network size depends on year, education, professional status, and access to email—but not the degree of use of mobile phones. Further, none of our measured variables can account for the large increase, which appears to be quite general among this population. To explain the growth in network size we employ the qualitative method of video ethnography (Shrum et al., 2005). Using over 105 h of videographic data during the period 2007–2009, we argue that the observed phenomenon is a latent function of the rapid adoption of mobiles in an impoverished area that has never experienced a significant level of reliable connectivity. Increases in communication for instrumental purposes strengthen weaker, pre-existing ties, leading to the growth of core networks.

2. Networks and communications technology in developing areas

Jonathan Donner's review of 2008 recent studies on mobile telephony in the developing world distinguishes studies of adoption from studies of impact, as well as those dealing with the relationships between mobile technologies and users (2008). Prior work has shown how cultural, economic, and regulatory dimensions provide a context in which a billion new users tame mobile telephony to correspond with existing social structures and employ its agentive capacities to circumvent social constraints. However, neither Donner's review nor the recent, comprehensive study by Castells and colleagues (2007) identifies any systematic, longitudinal study of mobile phones at the micro level, nor has any study of mobile technologies collected detailed social network data from users. In short, this is the first study to examine the impact of mobile phones on the social networks of any group of Africans at two points in time.

Mobile telephony has diffused more rapidly than any technology in the history of sub-Saharan Africa.⁴ As the developed world achieved almost universal connectivity with near perfect reliability, Africa had neither, remaining a region where phones were scarce and dysfunctional. For Western observers to appreciate this phenomenon, what is crucial is that working landlines

² Since 1994, members of our team have studied communication in the developing world, focusing on the extent to which the introduction of new information and communication technologies affects the integration of scientists and educators into local and international networks (Shrum, 2005).

³ In 2002 the Kenya coordinator of the project met his co-PI at the Nairobi airport for their annual research meeting with the words, “tomorrow we must get you a mobile. . . you can no longer work in Kenya without one”.

⁴ None of the authors have experienced any similar phenomenon in their lifetimes.

were not rare simply in small villages. Even in a major urban area such as Nairobi, telephones were expensive and dysfunctional. Western visitors, ringing a landline persistently, were often surprised to find that it had been switched off for some time. Connections mysteriously disappeared for large areas of the city. Cell phones do allow their users mobility, but the astonishing rate of diffusion in the developing world owes more to the fact that they provide *connectivity*, often for the first time. Now, shortly after their introduction, the number of mobile phones exceeds the number of fixed lines by a substantial margin in many countries (Castells et al., 2007; p. 3, 7).

Our network argument hinges on this fact rather than a “usage” effect in which more frequent use generates social ties. Most scholarship on mobiles in the developing world focuses on the maintenance of pre-existing social relationships (the dominant use perspective) over and above the establishment of new relationships. This perspective focuses on the association of a communication device (telephone, the Internet, mobile) and its primary functions or dominant uses, stressing that new media are integrated into existing social structures that adapt and configure them but are difficult to change in fundamental ways. Scholars often provide a needed antidote to technology innovators who predict widespread or even universal social changes resulting from ICTs. For example, the idea that the telephone would produce new social relationships was simply wrong: the telephone was used to maintain existing relationships rather than to create new kinds of societies or social relations (Fisher, 1994). According to others (Zhao and Elesh, 2008; Hampton and Wellman, 2003) the Internet is the same, reinforcing existing social ties and acting more as local media than global media. The ‘dominant use’ message has been important in dampening the unjustified expectations—and, indeed, unwarranted fears—of enthusiasts and Luddites. Since the impact of technological change is often a function of its penetration (the degree to which it has been adopted by a given population of potential users),⁵ the widespread diffusion of mobiles holds the potential for significant social change. Strangely, there has been little discussion of the possibility that the introduction and widespread use of an innovative technology that makes social interaction possible over distances might actually increase the size of core networks.

Core networks are distinct from comprehensive or complete personal networks. The concept of a close group of associates centered on a particular human actor is a subset of the total number of associates for that individual, which may be in the range of 150–300, including a large number of acquaintances and weak ties (Bernard and Killworth, 1979).⁶ The idea of a core network is also not to be confused with interpersonal electronic networks such as Facebook or MySpace, where members use a designed interface to post information and publicly message a selected subset of the total members on the site. The question of core network size has not been completely neglected. Zhao and Elesh include a conceptual discussion of conditions under which communications technology might increase a person’s social network size, related to the normative conditions under which spatiality is used instrumentally (2008:15). Translated into a developing world context, the idea is that social actors employ technology to overcome spatial constraints that did not exist in the developed areas where mobile phones were first introduced. But we have not been able to identify any longitudinal study of the relationship between the diffusion of mobiles and network size in the developing world.⁷

3. Context and data

An exemplary African showcase during the 1960s and early 1970s, Kenya’s economy stagnated in the 1980s and remained in a state of chronic crisis for two decades. While the country possessed enormous natural resources and basic infrastructure, capital shortfalls combined with mismanagement and corruption have left much of it dilapidated, including major roads near the capital. Our proposed mechanism for social change occurs in the context of extremely poor communication facilities in the years before our first wave. At one research institute we visited three years before our study began, phones had been cut off owing to nonpayment. We were informed that if we needed to get in touch, our best bet would be to call the nearby prison, where a staff member might be willing to cycle the few kilometers with our message.

Kenya is one of the few African countries that maintained a stable political system since independence. In 2002, KANU, the political party that had been in power since independence (1963) and led by President Moi for 24 years, was defeated in national elections by the NARC coalition led by Mwai Kibaki. But even with the new political regime, expected reforms were not implemented and economic growth remained sluggish. In 2007, following the second wave of our study, widespread allegations of election fraud caused an eruption of violence in the Rift Valley, with significant protests and unrest in Nairobi. In this context, before and after the violence, we filmed over one hundred hours of interviews, interactions, and focus groups, allowing us to interpret our main finding.

Quantitative analysis is based on pooled data from surveys conducted in Nairobi, the largest urban area of Kenya, with about three million inhabitants. Since 1994 our project has collected information on the research and educational sectors

⁵ Penetration has been extensively studied, not only by scholars, but also by private consulting firms, NGOs, and multilateral bodies such as the International Telecommunications Union.

⁶ The idea of a complete network needs revision now that the concept of social network has come to refer to a format for interaction on the Internet. High school and university students often boast of social networks consisting of thousands of members, many of whom have interacted no more than once, by accepting a friend request.

⁷ Our primary question is not simply whether there is any correlation between the extent of personal mobile usage and core network size. This hypothesis could be tested with cross-sectional data and does not require trend data. If those who use mobile phones have larger networks than those who do not, or those who use mobiles frequently have larger networks than those who use them rarely, that association should be discernible given measures at any single point in time. Our question, instead, is whether the widespread introduction of mobile phones is associated with the size of the core network, as indicated by social change over time in the number of important persons mentioned. This requires pooled data for at least two points in time.

in Kenya, primarily focusing on the Internet. In 2002, we were quite surprised to observe what appeared to be the rapid diffusion of the mobile phone, among the educated and professionals who were the first to purchase handsets and determined to immediately survey this population in Nairobi, which was our base. The survey instrument was administered by research assistants trained by the Kenyan author, in both 2002 ($N = 400$) and later in 2007 when we conducted the second wave ($N = 320$).⁸ We supplemented these surveys with video ethnography in 2007–2009, which we employed in understanding our quantitative results and in developing our interpretation below (Pink 2007; Shrum et al., 2005).

In the primary surveys we included both modern and informal sectors, implementing a sampling procedure based on location. We sought to interview 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 Kenyan author traveled with the interviewers to the location (e.g., teacher training college; government office building, informal market) and introduced the team to the authorities or security officers. The one difference between 2002 and 2007 was in the primary sectors included. In 2007, owing to widespread interest in the use of mobile phones in the informal sector (locally termed *jua kali*), we made a special effort to interview the small shopkeepers that are so visible and important to the local economy.⁹ The sample was stratified on this dimension, such that half of the 2007 sample consists of micro-entrepreneurs. However, to emphasize the validity of the main finding, we present results separately for the sampled professionals whose social networks may be compared directly. The face-to-face interview, including network, socio-demographic, and technology items took about one hour to complete.

3.1. Measures

We sought to measure *core network structures*, the social environment centered on a particular individual. Our analysis focuses on a subset of significant or strong (“core”) relationships, as elicited by a name generator, following which more detailed questions were asked about each relationship. A respondent’s core network of relatively strong social ties is more memorable than specific interactions, can be reproduced with various questions, and is not highly sensitive to specific question wording (Bailey and Marsden, 1999; Bearman and Parigi, 2004; Bernard et al., 1982; Burt, 1997; Freeman et al., 1987; Kogovsek and Ferligoj, 2005; Ruan, 1998). Our name generator was slightly different than the GSS name generator. The American survey asked about discussions of important matters (“over the last six months—who are the people with whom you discussed matters important to you”).¹⁰ Our Kenyan interviewers simply asked about “the people most important to you, including work and home, and any other contacts you feel are important”. Another difference pertains to the number of allowable responses. The GSS survey allowed a maximum of five names, which is close to our Kenyan average in 2002 and below the average in 2007. Whether or not this is limitation in the US context, African studies would be inaccurate if they adopted this restriction.

We collected information on various aspects of mobile phones, including the date the respondent first heard of mobiles, whether they had access, whether they owned a mobile, their degree of familiarity, the number of outgoing and incoming calls, frequency of use, length of typical call, and average costs of mobiles. The number of outgoing calls proves to have the strongest relationship with network size, as might be expected in a system where the caller (not the recipient) pays for the call. As James and Versteeg have argued, usage data, rather than access or ownership, is a preferable indicator of mobile technology diffusion where the data is available (2007). We also measured access to email, which is sometimes associated with network size (Ynalvez et al., 2005).

In addition to network and mobile communication dimensions we measured a number of standard dimensions that have been associated with social network characteristics in previous studies and serve as control variables in the multivariate analysis below (McPherson et al., 2006; Boase et al., 2006; Wang and Wellman, 2010): gender, income, age, and marital status. We measure education by the possession of a master’s degree, which is not typical of most Kenyans but is common in our subsample of professionals.

Table 1 shows the general characteristics of our sample. The major difference is the larger number of non-professionals in 2007, a function of our design change to systematically include *jua kali*. About three fifths were men (slightly higher in 2007), and about three fourths were married,¹¹ with an average age of 36 and just over two children (2.61 among those who were married). 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. More than one third of our respondents have a B.A. or higher (20.7% have M.A. or Ph.D. in 2007, while 44% finished their education at the level of secondary school or less).

4. Survey results

Our key finding of an increase in network size is both robust and broad, applying not only to the basic set of contacts yielded by our name generator, but nearly every subset of these contacts. Table 2 shows mean values for the size of the core network in 2002 and 2007 for both the full sample and for professionals only. For the full sample, the average size of the core

⁸ All were post-graduate students from the University of Nairobi.

⁹ In the Kenyan context it is common to distinguish between modern (sometimes called “professional”) and informal sectors. The basic distinction involves education and occupation, with the “informal sector” characterized by economic activities that are small, labor intensive, outside of the official revenue and taxation system, and staffed by persons with little or no formal education. The modern sector in this study involves salaried employment in organizations, often as a result of formal training. In Tables 2 and 3 we separate professionals from those in the informal sector, but the results are largely similar for both groups.

¹⁰ The original GSS question was based on a question originally asked by Claude Fischer (1982).

¹¹ Men were more likely to be married than women by a significant margin (83% to 67%).

Table 1
Respondent characteristics.

	2002		2007	
	Mean	<i>n</i>	Mean	<i>n</i>
Professional (%)	77.70	372	50.60	320
Gender (% male)	55.50	393	62.20	320
Age (years)	35.61	393	36.83	317
Marital status (% married)	70.00	395	77.00	319
Children (number)	2.19	307	2.08	318
Education (% B.A or higher)	36.40	398	38.40	320
Median monthly income	16,000.00	364	25,000.00	308

Table 2
Social change in network size^a.

	Year	Full sample		Professionals	
		Mean	SD	Mean	SD
Size of core network (total)	2002	4.42***	1.43	4.52***	1.48
	2007	7.23	1.71	7.18	1.75
Size of family network	2002	1.54***	1.30	1.59***	1.29
	2007	2.68	1.66	2.78	1.62
Size of friendship network	2002	1.64	1.43	1.69	1.43
	2007	1.86	1.64	1.72	1.60
Size of work network	2002	0.95***	1.29	1.00***	1.30
	2007	2.28	1.84	2.16	1.54
Size of romantic network	2002	0.17**	0.45	0.14***	0.45
	2007	0.28	0.46	0.33	0.48
Relational diversity ^b	2002	2.18***	0.80	2.22***	0.76
	2007	2.91	0.81	3.05	0.79
Size of network within Nairobi	2002	3.44***	1.59	3.49***	1.60
	2007	5.47	2.05	5.32	2.02
Size of national network (includes R's hometown or district and other rural districts outside Nairobi)	2002	0.84***	1.06	0.85***	1.02
	2007	1.62	1.60	1.67	1.47
Size of foreign network ^c	2002	0.15	0.46	0.16	0.50
	2007	0.13	0.50	0.19	0.58
Locational diversity ^d	2002	1.70***	0.80	1.75***	0.81
	2007	2.03	0.79	2.15	0.82

^a Full sample means are based on *n* = 396 (2002) and *n* = 320 (2007). Means for Professionals are based on *n* = 288 (2002) and *n* = 162 (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).

^c Foreign network includes ties in Africa outside Kenya and ties outside Africa, generally in the US or Europe.

^d Locational diversity is a count of the number of different spatial locations (Nairobi, outside Africa, etc.) in which the respondent's core network is located.

** *p* < .01.

*** *p* < .001 (two-tailed tests).

network increased from 4.4 to 7.2, an increase of nearly three contacts. Since our sample was selective and in 2007 was stratified by economic sector, the most direct comparison with the 2002 data is the second column, which shows that overall network size increased, though not quite as much, from 4.5 to 7.2. In Table 2, the main findings are consistent, whether we consider the sample as a whole, or professionals only.

After the initial set of contacts was elicited, we asked about the type of relationship with ego and the location of the contact. Table 2 shows that for all but two categories, the average number of reported ties increases from 2002 to 2007. We asked about the relational types generally distinguished in studies of ego-centered networks: family, friend, work, adding “romantic” to capture an important type of relationship that is widely thought to have been facilitated by mobile phones in Africa.¹² For every type of relationship except friendship, the increase over five years is statistically significant. A simple measure of relational diversity, based on a count of the number of different types of tie in the respondent's network, also shows an increase. This indicates that not only has the size of the core network increased, but this increase translates into more diverse contacts.

Locational diversity was measured in a similar fashion using three categories: (1) local (within Nairobi), (2) other town, village, or urban center outside Nairobi, and (3) international (foreign) ties outside Kenya itself.¹³ Again, locational diver-

¹² Romance—the facilitation of dating and physical relationships—is often discussed among Kenyans as one of the main uses of mobile phones, and mentioned in popular songs and videos. While it is a small fraction of the core ties examined here, it is possible that some romantic relationships were classified as “friends” by our respondents.

¹³ We asked about ‘home town’ and ‘other rural district’ but in the analysis we merged these for an indicator of ties ‘outside Nairobi’ because respondents were somewhat unclear about these fine distinctions.

sity—the extent to which respondents have strong ties both locally and outside Nairobi—has increased along with the growth of core networks. But just as there was an exception to the increase in size for relational types, there is also an exception in the location of the contacts. For the full sample, there is a slight decrease in the number of ties outside Kenya, while for the professionals there is a tiny, but statistically insignificant increase.

What factors are associated with the growth of core networks? Table 3 shows OLS regressions of core network size on selected variables for the full sample (Models 1 and 2) and professionals only (Models 3 and 4).¹⁴ Clearly, the strongest predictor of network size (beta coefficient) is year of survey. With 2002 as the baseline category, there is a strong and positive effect for 2007. Education and professional status also have an impact: professionals (Models 1 and 2 only) and those with less than a Master's degree have slightly larger core networks. Age has a negative association with network size, consistent with the original GSS survey that showed older individuals had smaller networks (Marsden, 1986). Neither gender, marital status, number of children, nor monthly income is associated with core network size, controlling for these other factors. Finally, we employ two indicators of the use of new communications technology: whether the respondent has ever used email (Ynavez et al., 2005) and the degree of mobile phone use (number of outgoing calls). The use of email has a positive impact on the size of core networks, particularly among professionals, while the degree of cell phone use does not. However, email use explains a relatively small proportion of the variance in network size, even for professionals, and does not significantly reduce the impact of year.

While the relationship between email access and social networks is important for both sociological theory and public policy, we do not discuss it further for five reasons. Our group has examined the role of email and Internet access for almost 15 years in the research and educational communities of developing areas. Under certain conditions, email is associated with such dimensions as productivity, but access and use do not have any consistent association with social network properties, and certainly not any large impact. Second, the magnitude of the association of email access and core network size is small, about 1/8 of the size of the year effect. Third, the inclusion of a control for email does not significantly reduce the impact of year. Fourth, although “ever used email” has a small association with size in Table 3, “current email use” does not have any association with core network size, which leads us to speculate that the email effect might be in the other direction. Perhaps those with (slightly) larger networks were more eager to try email (ever used email), but their current use of the medium has no impact now that mobile telephony is the dominant medium of contact.

Fifth, and most important, is that email access is far from universal in Kenya, though the technology has been around longer and has been heavily promoted by development agencies since the early 1990s. There has never been widespread demand for the Internet, as compared with mobile telephony. Unlike cell phones, you cannot communicate with most of your friends and neighbors via email. They are simply not online. In sum, email access does not account for the social change that is our focus here, though it does have a small impact on core network size in its own right.

But Table 3 shows even if email use has a small effect, use of mobile phones has *none*. How could it be the case that a technology is responsible for social change, if the use of the technology has no effect at the individual level, at least as measured in this survey? We argue that the effect is structural, specifically a network effect. The *degree* of mobile use by individuals had no impact on network size either in 2002 or 2007, because the effect is due to a change in the social context where phones are employed. “Network effects” are a broad and vigorous category in sociology, but here we use the term to refer to 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 (sometimes called network externalities¹⁵) are often illustrated by the case of the fax machine. Such an instrument is of little value if there are few owners, but high value if there are many, given the increase in the number of potential senders/receivers of faxes. Mobile telephony is characterized by a positive network effect, since the benefits increase with the number of other users.¹⁶

Our 2002 Nairobi survey was conducted with a keen awareness that mobile phones were becoming common among middle income Kenyans and professionals, though they had not penetrated the entire population to the current degree. As our survey results show, while a small minority of our respondents (less than 5%) had heard of the technology in the 1980s, most became familiar with mobiles in the late 1990s (median = 1998). By 2001 almost everyone (98%) had at least heard about these new gadgets. In the first year of the survey we began speaking with early adopters such as teachers and professionals and from 2003 onwards began location filming and interviewing in the Nairobi region. Interviews aside, our footage provides stark evidence of the encroachment of mobile technology into everyday life, as Kenyans are seen walking with phones on the streets and audio increasingly reveals the telltale ringing and beeping from calls and messaging.

Mobile phone use in Kenya is now so pervasive among these user groups that the simple question of diffusion among this urban population no longer holds much interest. In 2002, 38% of our respondents said they had never used a mobile phone,

¹⁴ McPherson et al. (2006) use negative binomial regression owing to the distribution of their count dependent variable. We reran models using this technique with no change to the substantive results, no change in the direction of the coefficients, and only minor changes to the significance levels. However, our network size variable exhibits a distribution very close to normal, as indicated by visual inspection of the distribution and kurtosis and skewness values, such that OLS regression is preferred.

¹⁵ Such network effects are often called network externalities in the economic literature or consumption externalities in the communications network literature, to refer to a state of interdependent demand for a product. However, as Liebowitz and Margolis argue, the language of “externality” is at odds with wider usage, unless the effect is not internalized by the market (1990; 1994). In the case of mobile phones, the owners of the network clearly invest on the basis of such knowledge and there seems little reason to view them as externalities. Metcalfe's Law (value is proportional to the square of the number of users) is often cited in reference to telecommunications networks, but seems to have been formulated based on potential ties rather than value.

¹⁶ There are negative network effects as well, owing to dropped calls when the network has insufficient capacity for the number of users. However, these congestion effects are generally small relative to the benefits that accrue from an increase in the number of users.

Table 3
Regression of core network size on selected dimensions^a.

	All respondents		Professionals only	
	Full model	Reduced model	Full model	Reduced model
Education (0 = less than M.A.; 1 = M.A. or higher)	−0.09**	−0.11**	−0.10*	0.126**
Age at time of survey	−0.15**	−0.08*	−0.12	0.06
Occupational status (0 = nonprofessional; 1 = professional)	0.08*	0.08*	–	–
Email use (0 = never used email; 1 = used email)	0.06	0.08*	0.09*	0.11**
Survey year (0 = 2002; 1 = 2007)	0.69***	0.68***	0.65***	0.64***
Mobile use (number of outgoing calls)	0.00		0.00	
Gender (0 = female; 1 = male)	0.03		0.03	
Marital status (0 = unmarried; 1 = married)	0.00		0.01	
Number of children	0.04		0.02	
Monthly income	0.02		0.01	
R-square (R^2)	0.46	0.46	0.43	0.42
Degrees freedom (df)	(df = 559)	(df = 604)	(df = 405)	(df = 438)

^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).

while 54% currently owned and used a mobile phone. While we acknowledge that ours is not a probability sample of Kenyans, there is little doubt regarding the issue of spread. Two persons were non-users in our 2007 sample, while five had used a mobile phone but were non-users at the time of the survey (primarily for economic reasons). Mobile technology is currently used by 98% of our 2007 sample, a dramatic change in five years. That is, the number of mobile users nearly doubled within the past five years and has nearly reached saturation. Our 2007 finding is supported by a recent study of mobile phone use in Kenya (Bowen, 2010). Countrywide data from 2009, including both urban and rural areas, show that 90% of Kenyans have used a mobile phone within the past year and 93% of those with any formal education had used a mobile within the past week.

As more and more users adopt the technology, the average personal experience of usage increases, provided others do not cease usage. This change should be reflected in the duration of ownership. When we examine the average length of ownership (“How long have you owned a mobile phone?”) nearly 60% of our 2002 users were “novices” in the sense that they had adopted the technology within the past two years. By 2007, even with saturation of the user base, fewer than 10% were novices. At the other end of the spectrum, “experienced users”—that is, those who had used mobiles more than three years—increased from 13% to 77%. Including non-users in the calculation, the percentage of experienced mobile phone users increased from 7% to 74% in less than five years.

5. Qualitative results: how mobiles grew networks

The diffusion of mobile phones between 2002 and 2007 has been dramatic. While we cannot feign surprise at a development all of us experienced, the uptake of mobiles is one of the most extensive and rapid technological changes ever seen in sub-Saharan Africa. What did surprise us was the dramatic increase in the number of important social ties. At the level of everyday interaction an observer will simply witness people using cell phones in multiple contexts. This was striking in 2002, but non-salient by 2007. Even a massive increase of nearly three contacts was not something we noticed through the visual observation of social interaction. Our review of the literature on mobiles in the developing world reveals much discussion of improved connectivity, but nothing that suggests that core networks have grown. Our finding, however, begs for a mechanism for the enhancement of strong ties, one that shifts the boundary between strong and weak social relations. For this we turn to qualitative data on how people used cell phones.

Since 2002 we have used video ethnography as a window on new information and communication technologies in a variety of developing world contexts (Shrum et al., 2005). Video ethnography concerns events as much as interviews, so it better described in terms of hours of footage rather than number of informants or interviewees. From 2007 to 2009, we videotaped 105 h of interviews and interactions, focusing primarily on the same categories of professionals and small businesspersons. In this effort we sought to broaden the sample of urban professionals to cover individuals outside Nairobi. We traveled to a variety of KARI (Kenyan Agricultural Research Institute) organizations and universities from Nairobi through the Rift Valley to Lake Victoria to interview professionals about their use of mobile phones. Many of these individuals had been interviewed previously, as they worked for organizations that had been visited by our project in past years, so they were willing to speak freely and on camera during this sensitive period.

In 2007, some months after our survey data were collected, Kenya shocked the world by disintegrating into violent civil strife after the Presidential election. One possible explanation of core network growth was the temporary increase in network size produced by the election cycle. Perhaps the upcoming elections caused a fluctuation in core networks owing to a perceived need to organize and campaign. But 2002, when our first survey was conducted, was an equally controversial political period, representing the first shift in political power since independence. So both of our data collection periods

occurred just prior to important national elections and were completed before voting commenced. If the increase in the size of Kenyan networks was a spike in an otherwise stable phenomenon, it was not due to the election cycle.

We began interviews in Nairobi, but we developed our interpretation as we traveled to the Rift Valley, where much of the violence occurred. What emerged from these qualitative interviews was virtual consensus on how significant mobiles were both before and after the elections for instrumental reasons. Unlike the US situation, where mobile phones often substituted for remote communication by other means (landlines), Kenyans typically had one means of communication. One who was abroad during approximately the period between our surveys provided a spontaneous observation of the situation “before” and “after”:

- This was a revolution... For a long time we were hearing that Ugandans were using mobiles. Up to and including 2001, when I was going to the US [for graduate work] there were no mobiles on the street. But when I came back, everybody [was using]. In 2001 these things were only owned by the rich... a [hand]set was going for 2,50,000. But now it's a thousand shillings... This mobile phone has really changed things in this country.

Another informant made reference to almost the same time interval:

- It has really made things different. Big, big difference in the way people communicate, relationships, connections... Seriously, very connected than before. For the last I would say 6 or 7 years. I think everybody almost owns a mobile phone of some value. That has really connected the Kenyans in a big way.

By themselves such comments simply confirm what our quantitative data show, that the diffusion of mobile phones is virtually complete among professionals and businesspersons. The important shift was also related to the falling expense of communication:

- Five years ago [2004] the cost of calling was expensive so you would restrict, but these days you can call people, so you don't think even about it. I mean you can call even for less money than writing... Some are doing business. Others are being updated.

Updating was a key theme in both pre- and post-election uses of mobiles. An update refers to direct personal communication about remote events, the importance of which is measured against (1) the lack of information in pre-mobile days, or (2) mass communication such as the widespread text messages that were used to incite violence in the post-election period. Updating is instrumental and often problem-solving in nature: *What is happening there? Where are you? What have you seen?*

Mobile phones provided new means of contact with persons who were already part of an interpersonal network, either substituting for existing means of interaction (face to face) or increasing the number of interactions with the same group of individuals.

- Unlike previous, today people are interacting frequently with mobile phones. That is the most influential gadget that we are using to communicate nowadays with people wherever they are. You find people don't walk a lot. They don't travel. They use mobile phones.

The key to the puzzle is the combination of interpersonal dependence and life challenges that mark the Kenyan context. “You know how exhausting life is, in Nairobi”, said one of our informants in 2003. Landlines at the time were part of the problem, not the solution. But they taught Kenyans what connectivity involved, expensive and dysfunctional as they were:

- Previously, when I was still using Telkom [the government-owned phone company], something which was very important could force me to go to the booth and make a call. And you know now, that one was not possible because how could you inform somebody to come to the telephone booth and wait for you so that you make a call? So we were making calls to the government offices alone. And then you tell that person, go, and then you tell the other person to come to the telephone booth at such and such a time, so to wait. But now, with the mobile phones that I have in my pocket, any time I feel to communicate, so long as I have enough airtime I communicate anytime... because I do business with some people.

The instrument that should have allowed coordinated action (the telephone) itself required coordination to the point that people balked at using them. In the pre-mobile era, the network effect of telephones was small because costs of usage were high and few Kenyans had access. One might be fortunate enough to have a telephone—but the relatives in the village did not, nor did most of one's friends. The importance of a particular communication had to be high to motivate use of landlines. Minor favors were not worth the asking, when actors were not co-present.

Success in the Kenyan context is often a matter of negotiating daily hurdles and assisting others in doing the same:

- We can't say people are at the level to be independent of their children. Because my mother depends on me to some extent and my brothers also, because I'm employed... Mobile phone is making it very easy for us to give the support.

An employee of the Kenya Agricultural Research Institute exemplifies this kind of routine, instrumental use of mobiles:

- Social networking has really increased in this country. . . now you can even organize. . . I can direct you in my home area [outside of Nairobi] to go and look for money. . . and inform immediately... the other day I was going to buy some cows at home and send the money [all laugh]. I sent money through M-Pesa and the old man was going to pick up the money. There was no money. I had to call Safaricom. By the time he got the money he was now in the market. He was telling me 'I've now gotten three of them. This much money.' So I think that has really increased.

The laughter in this interaction occurs because all of those present know the value of such a transaction, how it would have previously been impossible without a "trip to the village" and is now the kind of common occurrence everyone can visualize. Mobile phone access both allowed initiation of the business, and solved the financial problem that occurred when it did not proceed smoothly. It is the "routine nonroutine" of the Kenyan context.

Compared with the core networks of Americans measured by the GSS, our survey respondents identified a much larger number of associates. Of course, the size difference could be due to different name generators, but core networks are not highly sensitive to question wording. Might Kenyans actually have larger core networks than Americans, perhaps because of what is often called their "communal culture"?¹⁷ We believe the answer is "yes", but not because they live in a kind of pre-modern *Gemeinschaft* where everyone knows everyone. Our respondents, after all, live in a large metropolitan area. Their core networks are larger because the problematic nature of daily life in developing areas requires a denser network of inter-personal exchange and favors. The opportunity to expand and accelerate that exchange provides value to mobile technology, which becomes apparent after virtually everyone has access to the technology. The core network of an individual merges seamlessly into wider networks that may be operationalized in a variety of ways (Wellman, 1979; Fischer, 1982; Wellman and Wortley, 1990). To elicit core networks of Kenyans, we did not ask people with whom they "discuss important matters", because it is the wrong question in an African context. Our qualitative interviews repeatedly referred to "updating", "doing business", and other aspects of the micro-coordination of action that strengthens existing relationships. The election period provided an intensification of these routine problems of living.

The concept of "core networks" is closely associated with the concept of "strong ties" (Granovetter, 1973). Unlike McPherson and colleagues (2006), we do not describe ties as "core confidants" of the respondents nor do we characterize these revealed structures as "confidant networks". While confidants (those in whom one confides; trusted persons with whom important matters are discussed) are clearly yielded by the GSS name generator, important matters must also be discussed with people who are not confidants—and certainly with people who are not trusted.¹⁸ The Kenyan election brought this issue to the forefront since in times of normalcy social and instrumental functions are comingled. During the campaign and the election itself mobiles were constantly discussed in terms of coordination. One student who had assisted at the polls observed:

- Everywhere you go you have a notebook and a biro. You have to be called. You will tally: this polling station, I'm down, this polling station I'm high. So I need to tamper with this polling station... Your opponent has just come here and he has poured some alcohol so come quickly and pour some more... People keep you alert of what is happening around.
- Even that MP who came for us, for example, to take us to wherever his constituency is. . . he called that person and said, 'now get for me 500 students, later I'll bring three, four buses. Then we pack them, then we go.

When the post-election violence began amid charges of ballot rigging, Kenyans activated their core networks:

- Personally I had friends who maybe they live in the slum areas they'll, you'll call them because that's where the riots tend to begin, so you'll call them 'what is the situation? Can we go out?' They'll tell you 'yes you can go out' or 'don't go out.' It was very, very useful. Without cell phones [laughs, shakes head]. . . without cell phones [smiles].
- My husband. . . used to come until that particular day when they said they were looking for Kikuyus. . . I would come sometimes and people would call you and alert you, like, don't come now, there are riots or come now or go pick up the children. Our children used to go to school until it got so bad.
- Before I leave home I've been briefed on how the situation is here... You are told, along the road there are some roadblocks. This is how to handle the roadblocks. . . You leave the house knowing you need to be armed with some shillings in your pocket [to get past the roadblocks]. . . the ticket to pass through is a little money to the boys.

There was also general agreement that coordination was also enhanced among the perpetrators of violence:

- The cell phone. . . really enhanced now the violence. Those who were organizing the violence could organize and reach each other easily. . . They were laying blockages and when you passed they could call and tell them there's a certain car that has passed. . . It really enhanced how they were working.

¹⁷ The concept of a "communal culture" among Africans is theoretically problematic but is widely used in the mass media and local conversations. More than one of our interviewees began to discuss "our communal culture" as an interpretation of our main finding, but this is different from the interpretation put forward here and leaves out our central mechanism: communicative shortcuts in a context of resource scarcity strengthen weak ties.

¹⁸ Given the extremely small core networks revealed in the American survey, it is likely that the question was interpreted as referring to trusted persons. We do not claim our name generator is a better measure than the GSS question, but that it is more appropriate in an African context.

- That makes it easier for people to communicate so you can call for reinforcement for people to come and help your fight, so it makes it easier than previously when there were no mobile phones.
- Calls from one end to another, inciting people, particularly in the slums, like Kibera where serious killings on tribal basis were seen.

The primary difference between pre and post-election periods was that communication with core ties now occurred with careful regard to ethnic affiliation. Because the violence was tribal, this often meant the exclusion of friends from opposing ethnic groups.

- What they did was let's say close their phones... they will let's say change the SIM cards. ... Like the friend of mine he changed the SIM card. The personal feeling that I had was that... he now felt scared that I would monitor his movement.

This Kikuyu research technician had been friends with his Kalenjin neighbor since the arrival of the latter's family in the Rift Valley, and had even encouraged the neighbor to acquire a mobile phone. Since Kenyans in this area typically know members of multiple ethnic groups—whether part of their core network or not—it became critical to maintain communicative distance as well as physical distance. One response to the violence was to change phone numbers, at least temporarily. Among our informants, there were many expressions of sorrow or regret:

- Threats. Threatened messages. Even some [members of other ethnic groups], they deleted their mobile numbers from my phone. I could not even get them... I wouldn't like to have your number if you are not communicating to me... Where could I go to? Because my house was torched, was razed down.

The post-election period saw an intensification of the instrumental efforts to manage co-location and communicative availability where social relationships splintered across ethnic lines and core networks were activated for security and updating. Often the purchase of airtime for mobiles was as critical as the purchase of food: what had been a personal choice to of a luxury item in 2002 was a necessity of 2007 with implications for survival.

6. Conclusion

Kenyans might well have stronger connections to family and community than Americans, but neither before nor after the election did they romanticize these connections as sociologists sometimes do in the US. The infrastructure of life is fraught with peril, a state of affairs that obtains apart from any election, a condition marked by the simple invocation, “you know, this is Kenya”. It is a context Africans understand, and to which they adapt using their core networks. This network of strong obligations contains fewer emotional associations than core networks of Americans. We propose that mobile phones are used for both instrumental and expressive purposes, but the instrumental function of mobile connectivity is the primary mechanism for growth in a context of resource scarcity. Kenyan lovers may flash each other,¹⁹ but the chief importance of the mobile for strengthening ties is problem-solving, not social support. In sum, our qualitative data support the contention that the enhancement of core networks is a byproduct of the rapid adoption and widespread use of mobiles for instrumental purposes, strengthening weaker, pre-existing ties. In the sub-Saharan context of resource scarcity, largely dependent on face-to-face communication, a new device provided a previously unknown level of access to existing social ties.

Mobile technology diffused rapidly after 2002, as individuals with higher incomes drove down prices through personal usage, purchased handsets for family members, and lowered the organizational costs of everyday life.²⁰ As the number of mobile users approaches the limit of potential users in the population, Kenyans with large extended networks and a high perceived need to communicate began to communicate more often with potentially important contacts, previously relegated to infrequent visits or chance meetings. The social mechanism proposed here is an outward movement or expansion of the boundary between core and peripheral networks, that is, a strengthening of weak ties. We observed this as an increase in network size, for certain types of tie. Recall that there is no association between the frequency of mobile use and core network size. Simply using one's mobile phone a great deal does not produce a larger network. In 2002 a new adopter of mobile technology could not talk to many of the actors in his/her network because only a minority had mobile phones. It is not the intensity of exposure that makes a difference but the availability of others who also use the technology. In 2007 it was a fair bet that a new adopter could talk to almost anyone.

The network effect we propose for core networks is not inconsistent with an overall increase in the size of egocentric networks, but it is not the same.²¹ The idea that remote communication technology—from conventional mail and landlines through email and cell phones to “social network” technologies such as Facebook—enlarge the sphere of peripheral social

¹⁹ Between 25% and 70% of calls in Africa are flashing, or intentional missed calls (Jonathan Donner, personal communication).

²⁰ The informal economy still dominates everyday life for most Kenyans, who interact with a broad array of actors (both kin and non-kin) to accomplish routine tasks.

²¹ This mechanism is also consistent with McPherson, Smith-Lovin, and Brashear's image of contraction of core networks in the US. If the “discussion partners” yielded by the GSS were framed to include all forms of communication (email, texting, cell), Americans could well have larger extended networks than in the mid-1980s. Neither the American nor the Kenyan study can tell us about the size of extended networks.

ties by facilitating contact over geographical distances is based on two processes. One is the technological capacity, through certain forms of use (sending emails to unknown persons, accepting “friend requests” through shared web protocols), to interact with strangers from a safe social distance, producing pristine social ties. The second is an increase in the frequency of communication, made possible by the construction of a technological system that allows activation of social connections that are dormant (meetings in the distant past) or structural (a rarely met relative). The literature does not coalesce on a single conceptualization of weak ties, but a dynamic account of their functions includes this kind of network expansion. As in a job search, an increase in the overall size of the network is based on fresh action by ego (White, 1992), action that can include the adoption of new technology.²²

Core network enlargement is akin to this second process, at a more intimate level. It does not involve the addition of strangers to one’s network, but changes in frequency or intensity for a subset of links, a strengthening of weak ties. In the specific context of mobile telephony, this shift has been theorized as regressive social insulation (1) at the level of the individual, who retreats to a realm of close relations (Fortunati, 2002), or (2) at the level of the social system, when new technology functions as an anti-evolutionary device, promoting pre-modern, communal patterns. Cell phones unlike the Internet, facilitate network closure rather than paving the way to new relationships. As Geser articulates the theory, they are:

- used to shield oneself from wider surroundings by escaping into the narrower realm of highly familiar, predictable and self-controlled social relationships with close kin or friends (2005: 25)

This could explain the American finding of increased social isolation but does not well describe the Kenyan context, where we have observed an increase in core network size for all but two categories: friendship and international ties.

The stability of international ties is not difficult to explain. Mobile phone charges are still considerable for international calls from Nairobi. Such communication may be conducted by email, even when it entails a trip to an Internet café. Our own work in the South Indian context shows the use of mobiles is best viewed as a medium of local rather than wide-ranging connectivity. But the relative stability of ties with friends—a slight, statistically insignificant increase—is theoretically important. It is the one type of measured tie that has *not* changed over five years otherwise characterized by major increases in kin and occupational components of the core network. If (1) mobile saturation is the reason for the network effect, and (2) mobiles are used largely for instrumental rather than expressive purposes in the Nairobi context, it follows that social organizational issues of family and employment are good reasons for using scarce resources on communication technology, and weaker ties are transformed into stronger ones.

Future research on the strengthening of weak ties through communications technology must examine the question of boundary shifting: *How* are peripheral ties converted into core relations and *which* ties are most likely to change? We have argued that in this context it is a function of the instrumental (task-oriented) use of mobiles rather than their expressive (socio-emotional) use. Mobile telephony changes the Kenyan approach to the challenges of everyday life, which are more significant than those experienced by North Americans. That is what it means, on the micro-interactional level, to live in a “developing” area. Resource scarcity does not simply mean that Africans are poor—it means that transportation is difficult, utilities and residences need constant attention, and kinship demands are commonplace.²³ Africans substitute communication costs for travel costs, trade services, and invest in social relationships that may yield dividends in the future. While cell phones may somehow “reshape social cohesion” by strengthening the bonds between family and friends (Ling, 2008), in sub-Saharan Africa their importance may well lie in the strengthening of weak ties. It is possible that core network growth is a temporary, unsustainable fluctuation but the increase in network size may well be stable, just so long as poor infrastructure and resource scarcity persist in the region.

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²² Network expansion results not only from the action of ego, but from actions by alter, when ego is implicated in events of interest to others (winning a lottery, witnessing a crime).

²³ As an anonymous reviewer suggested, there is an important comparison between our argument and the patterns of network patterns in impoverished US communities where there is high dependence on a core set of kin and friends to cope with resource scarcity. The important difference here is that in the African context, our sample does not consist of poor people but relatively advantaged persons who use new technology for instrumental purposes to strengthen weak ties.

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