Telephone Surveys Using Mobile Phones: An Analysis of Response Rates, Survey Procedures and Respondents' Characteristics

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Abstract

Telephone surveying has become the major mode of data collection in the sample survey field since the mid 1980s; presently other modes of advanced telecommunication such as mobile phones are fast becoming important supplements and even competitors to the fixed telephones. This paper uses a nationwide dual frame survey of fixed and mobile phone numbers to examine the potential of mobile phones for survey work, the methodological implications of their use and the differences to fixed phones surveys.

Introduction

The penetration rate of mobile phones has increased to such an extent in recent years that it has already exceeded fixed phone penetration in some regions. In the European Union, 81% of households have at least one mobile phone compared with 71% with a fixed telephone; the percentage of mobile-only households is also becoming more marked, reaching 24% in 2007 (EC 2008). In the US, more than 50% of households possess a mobile phone while a fixed phone is found in over 89% of the households (Brick et al 2006); the percentage of mobile only households was 13% in 2006 (Keeter et al. 2007). With the decline in households and persons with a fixed phone, the coverage in traditional fixed telephone surveys also decreases which implies that estimates from these surveys have more potential coverage bias. Moreover, it may become more difficult to reach the households with a fixed phone as well as mobile phones and who rely on the latter for most of their calls. Thus, sampling mobile phones may be necessary to gain access to the growing proportion of households that use mobile phones either exclusively or extensively.

A nationwide survey was designed to evaluate issues associated with conducting surveys on mobile phones. The study sampled telephone numbers from frames of both mobile phone numbers and fixed numbers. This article focuses on the operational feasibility of surveying mobile phone numbers. Specifically, the following issues are covered: (a) response rates from both samples – mobile and fixed, (b) survey procedures – time of contacts, level of effort, completion time of interviews - from both samples, and (c) mobile and fixed phone penetration within specific sub-groups of respondents. The next section gives an overview of the design of the study. The outcomes of the mobile phone sample are then presented and compared with those on the fixed phone sample. The last section summarizes the key findings.

Survey design

The study included two samples: the mobile phone sample and the fixed phone sample. The population of interest was the Portuguese adult population (age > 15 years).

The same survey company was hired to select and interview both samples. The Mobile Sample was comprised of randomly generated phone numbers. Mobile phones numbers are nine-digit and the first two digits identify the operator. The Portuguese Telecommunications Regulation Authority provides information about the market share of each of the three operators providing mobile phone service in Portugal which was used to divide the mobile sample into three subsamples. Within each two-digit prefix, mobile phone numbers were created by a generator of 7-digit random numbers. The selection method was ultimately very similar to a simple random sample from a set of numbers, not all of which have necessarily been attributed. In the mobile sample, interviews were conducted with the person who answered the phone. Interviewers confirmed that the person was aged 15 or older and in a safe place to talk before administering the questionnaire. Where this was not the case, an appointment was made with the respondent at a more convenient time.

The Fixed Sample was selected from Portugal Telecom Directory (the so called White Pages) which contains attributed residential numbers. An interval, K, was formed by dividing the population count of telephone numbers in the frame, N, by the desired sample size, n. The frame of telephone numbers was divided into n intervals of size K telephone numbers. One telephone number was drawn at random from each interval. Interviews were conducted with the last birthday adult at home at the time of the call, or in the absence of this adult, with any other adult available at the time of contact.

The interviews of both samples were administered using the company's CATI system. Data were collected over the same time period and using the same team of interviewers for both samples.

A total of 2000 interviews were obtained, 1000 using mobile phones and 1000 using fixed phones. The same questionnaire was used for the mobile and fixed phone sample and included questions about Internet usage, attitudes towards the Internet and demographics.

The same general scheduling protocols were used for both the mobile and the fixed phone sample. Up to 7 call attempts were made to each number to establish contact, except when the number was immediately identified as non-attributed or non-working (a message from the phone service operator provides this information). For the initial contact, the scheduling algorithm scheduled calls over different times of the day during weekdays.

Response rates

In this section we present the outcomes of contact results by sample type (Table 1). In order to conduct 2000 interviews of individuals aged 15 and older, 11617 numbers were required in the mobile phone sample and 4144 in the fixed phone sample. Nearly 60% of the mobile numbers dialed were non-attributed. In the fixed sample 26.3% of the numbers were found to be not-working or disconnected. In the mobile sample 61 contacts were rejected and coded as out-of-the-scope because the person answering the phone was under 15 years old.

The completion rate was 8.6% for the mobile phone sample and 24.1% for the fixed phone sample. Based on useful numbers, i.e. by excluding the non-attributed, non-connected and out-of-the-scope numbers, the completion rate was 21.1% for the mobile phone sample as opposed to 32.7% for the fixed phone sample.

Table 1. Detailed results of the calls by sample type

Results of calls	Total		Mobile		Fixed	
	n	%	n	%	n	%
Interviews conducted	2000	12.7	1000	8.6	1000	24.1
Refusals	840	5.3	496	4.2	344	8.3
Non-contact [a]	4899	31.1	3188	27.4	1711	41.3
Out-of-the-scope (age < 15 years)	61	0.4	61	0.5	0	0.0
Non-attributed/non-working number	7961	50.5	6872	59.1	1089	26.3
Total numbers dialed	15761	100.0	11617	100.0	4144	100.0

[a] Includes voicemail, busy, ring with no answer, hang up without answering the call.

Table 2. Interview rate, by sample type and time period

Time period	Mobile	Fixed
10 a.m. – 3 p.m.	19.8% (465)	– (0)
3 p.m. – 6 p.m.	11.9% (1386)	12.6% (484)
6 p.m. – 8 p.m.	27.6% (1547)	40.7% (995)
8 p.m. – 10.30 p.m.	23.4% (1331)	33.9% (1576)

Note: Numbers in ( ) are the number of cases in the time period. Only numbers identified as attributed and working are included. No fixed phone call attempts were made during the earlier period.

There were 496 refusals in the mobile phone sample, corresponding to 4.2% of the cases; the percentage for the fixed phone sample was 8.3%. On the basis of useful numbers, the refusal rate was 10.5% for the mobile phone sample and 11.3% for the fixed phone sample thus indicating that there is a similar tendency for refusal in the mobile and the fixed phone sample. The fact that the interviewers began the mobile phone interviews by asking respondents if it was a convenient time and place for the interview and only proceeded if this was confirmed by the respondent might have contributed to a reduction in refusals and thus to bringing mobile phone results closer to fixed phone results.

Regarding non-contacts the rate was 27.4% in the mobile sample whereas in the fixed sample was 47%. However, when restricting the analysis to useful numbers the scenario changes: the non-contact rate in the mobile sample is higher (68.1% against 56%).

Results of survey procedures
This section examines the efficiency of contacting and getting people's cooperation by time period, level of effort, in terms of number of call attempts and number of calls necessary per complete interview, and completion time of interviews, by sample type.

Interview rate by time period
The outcomes of the time periods of the interviews are good indicators of when people answer their phones and are available to cooperate with surveys. To make the analysis pertinent to this goal, phone numbers found to be non-attributed, non-working, or out of the scope are excluded. Using this definition, 4729 mobile numbers and 3055 fixed phone numbers were used

As interviewing was not conducted on weekends, the outcomes only concern weekdays. All last call attempts were classified in four time periods. Table 2 presents the interview rate by the four grouped time periods for the fixed phone and the mobile phone samples.

Table 3. Percentage of interviews by number of call attempt and sample type

Number of calls	Mobile	Fixed
1 call	63.0%	66.4%
2 calls	21.6%	18.6%
3 calls	9.0%	8.7%
4 calls	3.9%	2.4%
5 or more calls	2.5%	3.9%

A chi-square test shows that the interview rate across the four time periods for the mobile phone sample is statistically different (x^2=51.952, df=3, p<0.001) (ranging from 11.9% to 27.6%) between time periods. The fixed phone sample exhibits the most typical pattern identified in previous telephone surveys, with lower interview rates during the earlier hours than in the evening periods; differences across time periods (ranging from 12.6% to 40.7%) were statistically significant x^2=115.800, df=2, p<0.001).

Despite the significant differences found across time periods for the mobile sample the interview rate did not vary as much as in the fixed sample. A possible explanation is that the mobile phone is a personal device that is carried at all times and people can answer them anywhere and anytime thus increasing the likelihood of getting a successful contact; the fixed phone, on the other hand, can only be answered when someone is at home which is more likely later in the day.

Level of effort
This section examines the level of effort required to complete the interviews. Specifically, we look at the total number of call attempts and the number of calls necessary per complete interview.

In the mobile phone sample, a total of 20602 call attempts were made to obtain 1000 interviews as opposed to 8112 call attempts in the fixed phone sample. This means that while an average of 20.6 calls had to be made to obtain one complete interview in the mobile phone sample, only 8.1 calls

were required in the fixed phone sample. If we exclude the non-attributed/non-working and out-of-the-scope numbers in both samples the average number of calls per complete interview is 13.7 in the mobile sample and 7.0 in the fixed phone sample. In each case the mobile phone sample required a greater level of effort to obtain the same number of completed interviews.

Table 3 presents the percentage of interviews accomplished by number of call attempt. Between 1 and 7 calls were necessary to the telephone numbers that led to the successful completion of an interview. A chi-square test shows that the distribution of the percentage of interviews by number of call attempt was different across sample type x^2=13.743, df=4, p<0.008). Although in both samples the interview became less likely as the number of call attempts increased, the percentage of interviews that could be completed with one single call attempt was higher in the fixed sample than in the mobile sample.

Completion time of interviews
Short questionnaires are typically recommended when the mode of data collection is the telephone as maintaining long conversations requires a mode in which the respondent cannot hang up so easily. The questionnaire of our study was intentionally designed to be short following advice from the researchers of the survey company cooperating in the project; more specifically they warned us of the risk of high dropout rates, especially for the mobile sample, if the questionnaire took much more than 15

Table 4. Mean completion time (minutes) by time period and sample type

Time period	Mobile	Fixed
10 a.m. – 3 p.m.	11.58	--
3 p.m. – 6 p.m.	12.31	11.08
6 p.m. – 8 p.m.	11.93	11.06
8 p.m. – 10.30 p.m.	11.56	10.61
Overall	11.99	10.91

minutes to be administered. In this section we present the outcomes for completion times in the overall samples and across the four grouped time periods in which the interviews were accomplished (Table 4).

Mobile phone respondents took on average 11.99 minutes to complete the interviews while the fixed phone respondents took 10.91 minutes, i.e. mobile phone interviews took about 1 minute longer on average to complete than fixed phone. The comparison of the overall mean completion times between samples was statistically different ($t=-4.840$, $df=1998$, $p<0.001$). The mean completion time of the interviews was higher in the mobile sample for every time period and the major difference was found in the period 3 p.m. – 6 p.m.

On the whole, the lower mean times of completion were all obtained in the fixed phone sample namely in evening periods – 6 p.m.-8 p.m. and 8 p.m.-10.30 p.m. While these time periods favor finding people at home, they are also critical for household activities (e.g. cooking dinner, dining, putting children to bed). Calling respondents on the fixed phone in a time period when they are engaged in other tasks is likely to cause rushed responses which might have an impact in the overall mean completion time of fixed phone interviews.

Respondents' characteristics

Despite the massive dissemination of mobile phones, it is not thought to be uniform, i.e., mobile phone ownership and usage varies considerably between population groups. In this section we analyze the impact of using mobile phones on sample composition by looking at the proportion of interviews obtained via mobile phone and via fixed phone among specific sub-groups of the sample. Comparative profiles of sample type characteristics are shown within the sub-groups of gender, age, educational level, working status, household size and family life-cycle (Table 5).

Mobile and fixed samples were found to be statistically different at $p<0.001$ in all demographic characteristics except for gender. Regarding age, it is noted that approximately 70% of the interviews of respondents aged between 25 and 34 years were conducted over the mobile phone while only 27% of the respondents older than 55 were interviewed over the mobile phone.

Working status also has a significant effect on sample type composition. Nearly 60% of either employed or unemployed people were interviewed by mobile phone but only 21% of the interviews with the retired segment were conducted by mobile phone.

Respondents' life cycle also has an influence on this. Among the respondents living alone, 66.3% were interviewed by mobile phone while the proportion of mobile phone interviews with married people without children did not reach 40%.

Table 5 – Percentage of respondents in the fixed and the mobile sample by demographic characteristics

Demographic Characteristics	Mobile	Fixed	Significance test
Gender			χ^2=3.700 (df=1)
Male	52.2	47.8	
Female	47.9	52.1	
Age			χ^2=212.900*** (df=4)
15-24	58.1	41.9	
25-34	69.0	31.0	
35-44	60.2	39.8	
45-54	53.0	47.0	
55+	27.0	73.0	
Educational level			χ^2=17.362*** (df=2)
Basic level (9 years compulsory)	46.0	54.0	
Secondary/professional (3 years after compulsory)	53.9	46.1	
Superior/University	57.3	42.7	
Working status			χ^2=215.300*** (df=4)
Employed	60.9	39.1	
Unemployed	59.8	40.2	
Student	52.0	48.0	
Retired	21.0	79.0	
Other	43.6	56.4	
Household size			χ^2=35.909*** (df=3)
1 person	43.9	56.1	
2 persons	41.0	59.0	
3 persons	57.8	42.2	
4 or more persons	52.9	47.1	
Family life-cycle			χ^2=84.357*** (df=5)
Single living with the parents	51.1	48.9	
Single living alone	66.3	33.7	
Married having no children	39.6	60.4	
Married having children	62.7	37.3	
Single-parent family	63.3	36.7	
Other type of family	41.1	58.9	

*** Significant at $p < 0.001$

Regarding household size, mobile phone interviews are less likely in the case of smaller households – 1 or 2 persons – and more likely in bigger households.

As for educational level, 57.3% of the university respondents were interviewed on the mobile phone while among the basic level respondents mobile phone interviews were 46%.

In short, the outcomes illustrate that the proportion of completed interviews over the mobile phone varies according demographic characteristics, especially on age, working status and family life cycle of the respondent; gender does not differentiates mobile and fixed sample respondents.

While the average deviation between fixed and mobile sample (computed within all the sub-groups of each variable) is less than 5 percentage points for gender (4.3 percentage points) it goes to over 20 percentage points for age (25.3 percentage points), working status (23.2 percentage points) and family life-cycle (20.9 percentage points).

These results replicate to some extent the findings for mobile phone populations in other countries. In most European countries, mobile phone owners tend to be younger, are more often employed, single and are more likely to belong to households with three or more persons than those who do not have a mobile

phone (EC 2007). In the United States, mobile phone owners are more likely to be employed persons and single or never married; they are also less likely to be aged 65 years or older and retired (Link et al 2007).

Conclusion

Our findings support the idea that the use of mobile rather than fixed phones to collect data causes important differences to appear in response rates, survey procedures and sample composition.

Sample selection for mobile and fixed telephones was very different. In the mobile phone sample, 59.2% of the dialed numbers were of no use since they were non-attributed or out-of-the-scope numbers, while the figure for non-useful numbers for the fixed sample was only 26.3%. Although this is due to the non-existence of a sampling frame for mobile phone number selection, the time spent to screen those numbers and discover they were of no interest was in fact higher in the mobile sample than in the fixed sample. The refusal rate was around 10% in both samples but the completion rate was lower in the mobile than the fixed sample. The non-contact rate was higher in the mobile phone sample – 67.4%, after excluding non-useful numbers – against 56.0% in the fixed phone sample. Even though people always carry mobile phones everywhere, this does not mean the person can be more easily contacted than via the fixed phone. In fact, the largest proportion of the contacts coded as "non-contact" in the mobile sample – 55.9% – was coded as "voicemail", which means that a considerable share of mobile phone owners do not always keep their mobile phones switched on.

The mobile sample contacts were more evenly distributed across the day; while more than half the contacts (51.6%) in the fixed phone sample were concentrated in one single period (8 p.m. till 10.30 p.m.) the largest share of contacts in the mobile phone sample did not exceed one third

of the overall number of contacts, ranging from 10% to 32% across the time periods. This outcome is likely to reflect the fact that the survey company knows people always carry their mobile phones everywhere which enables them to prolong the schedule for interviewing.

The biggest share of interviews was accomplished on the first contact attempt both in the mobile and in the fixed sample; however, overall the mobile sample required more contact attempts per completed interview than the fixed phone sample. Fixed phone contacts were therefore more efficient.

The samples were different in terms of interview length; interviews with the mobile phone respondents took almost 10% longer to complete; however, some caution is needed before concluding that mobile interviews systematically last longer than fixed phone interviews. The completion time issue must be linked with the pricing strategies in each country for mobile phone services. Whereas receiving a call on a mobile phone is free of charge in Portugal, as in most European countries as well as Australia and New Zealand, the subscriber of the mobile phone in countries such as US, Canada, Hong Kong, Singapore or China has to pay for received calls (OECD 2000); when the call originates an expense for the recipient, there is likely to be a tendency to rush responses and thus make mobile interviews shorter than those by fixed phone. As this question is closely linked to the specific conditions of mobile phone service in each country, it certainly warrants further investigation.

Significant differences were found in respondents' characteristics between the samples. Although the demographic differences between mobile and fixed phone respondents are expected to become less prevalent as mobile phones dissemination increases and extends to other specific subgroups, at present mobile phones ownership is more marked among young-

er people, professionally active people and people either living alone or in families with children. This has a reflection on the composition of mobile phone samples.

Although there are some differences –some of them being disadvantages - to using mobile phones rather than fixed phones for collecting survey data, their use is likely to increase in the near future, both in the context of mixed-mode designs and in single mode designs. The coverage rate of fixed phone frames is likely to decrease even more as mobile phones continue to proliferate and this will surely be the main reason for bringing mobile phones to survey research. The challenge for survey methodologists will be to adapt old methods to this new survey mode, a domain that in the times ahead will be rich in investigation.

Acknowledgement

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