Using mobile phones for survey research

A comparative analysis between data collected via mobile phones and fixed phones

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The increase in mobile phone penetration is stimulating a trend towards the use of mobile phones to supplement or even replace traditional telephone surveys. Despite this trend, few studies have systematically compared differences between the two modes. This article describes a study in which both mobile and fixed phone were used to collect data on a national survey on internet and cultural practices. Findings revealed significant differences between mobile phone respondents and fixed phone respondents in terms of demographic characteristics and responses to some of the substantive items of the survey. In terms of data quality the mobile phone survey proved to be different from the fixed phone survey in two indicators: completion times and percentage of respondents with item omissions. The mobile phone survey was more difficult to implement than the fixed phone survey since much more screening was required to identify working phone numbers; in addition it yielded a lower response rate than the fixed phone survey.

Introduction

In the 1990s, telephone surveys became the dominant mode of data collection in countries with extensive telephone coverage. Phone surveys are based on the assumption that their sampling frame can provide good coverage of the target population. On one hand, this condition requires that the percentage of target population missing from the sampling frame is small and, on the other, the units excluded from the frame are not very different from those included. As a result of the appearance and development of mobile communications, we are currently moving away

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from the telephone coverage configuration that enabled telephone surveys to be developed.

Although the type of phone access varies greatly from country to country, across Europe there are some overall developments that can be identified regarding telephone arrangements: the percentage of households equipped with fixed phone is dropping, while the percentage of households equipped with mobile phone access is rising; additionally, the percentage of mobile-only households is increasing, while the percentage of households that have only fixed phone access is decreasing. In countries such as Finland, Italy, Portugal, Belgium and Slovenia, fixed phone coverage has already been overtaken by mobile phone coverage and there seems to be an unequivocal tendency to a widespread generalisation of the phenomenon to other countries. Presently, the percentage of households with mobile phone in the EU27 countries is 82% while the percentage of households with fixed phone is 73% (EU Statistics 2007). In the US, the percentage of households with at least one mobile phone already exceeds 50% and the trend is growing (Tucker *et al.* 2007).

The rapid and pervasive dissemination of mobile phones is stimulating a trend towards the usage of mobile phone surveys in studies designed to be representative of the general population, either to supplement or even to replace traditional telephone surveys. Mobile phone surveys offer the possibility of covering the part of the population that owns only a mobile phone and is therefore excluded from current fixed phone surveys. However, mobile phones-based research poses a set of methodological, technical, cost and ethical issues that are distinct from those associated with fixed phone surveys.

The study reported in this article examines differences between mobile and fixed phone surveys and assesses the feasibility of using mobile phones for survey research. Specifically the study will: (1) examine sample equivalence, (2) compare response rates, and (3) disclose differences in response content and data quality. The context of the study was a national survey in which fixed phone-based and mobile phone-based procedures were used to collect data from the general population of adults.

The paper is organised as follows. The first section discusses several sampling and non-sampling issues posed to survey research by mobile phones. Next, the research method is described, and subsequently the data are analysed. Finally, we discuss the findings and their implications for mobile phone survey research.

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Effects of mobile phones on survey research

Telephone survey methods and practices have been created for fixed phones (e.g. Groves *et al.* 1988). Mobile phones have special features that make them different from fixed phones so alterations must be made regarding sampling and non-sampling issues when using mobile phones to conduct surveys. The extent of the changes required depends largely on local conditions as there are great country-to-country differences in the infrastructures of mobile phone installations and the pricing strategies of the mobile phone service, which also imply differing usages of mobile phones.

The usage of mobile phones to conduct surveys has repercussions for sampling frames, respondents' eligibility, interview length, costs, non-response rates and respondent behaviour, as well as posing some ethical concerns.

Sampling frames

In most countries there are no lists of mobile phone subscribers; where they do exist, they suffer from multiple operators, users with more than one subscription/SIM card, and particularly from the lost link between the mobile phone number and geographic location. The absence of a directory forces mobile phone number samples to be created by randomly generating numbers, which implies the risk of generating many numbers not attributed. Moreover, while a fixed phone number has a correspondence to a geographic area, the number of a mobile phone usually does not indicate where the person lives or works; even if it did, the person could be anywhere. Therefore, while mobile phone-based research may be feasible for national surveys they are very difficult to implement for local or regional surveys since a great deal of screening would be required to guarantee that only respondents from the target area are surveyed.

Eligibility

As the owner of a fixed phone is always an adult, when calling a fixed phone we know that at least one adult can be reached. In the case of mobile phones, the user can be a child and confirmation must therefore be obtained that the respondent is eligible for the survey before starting the interview, and, if they are not, then who is. Finding eligible respondents can be more difficult in dual-frame telephone surveys in which mobile phone contacts are made to interview mobile-only respondents (while the

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rest of the interviews are made to fixed phone respondents) if an adequate frame of mobile-only users does not exist. In the absence of such a frame, considerable amounts of screening in the mobile phone frame are necessary to identify those eligible (i.e. the mobile-only users).

Interview length

People are often under special time constraints and special pressures when speaking on their mobile phones. The fact that respondents can be anywhere (and not necessarily at home), the risk of phone battery failure, the need to 'free' the mobile to receive calls, and so on, can have an effect on the time respondents are willing to stay on the phone. Researchers should take this into account when planning the length of a questionnaire that is to be administered by mobile phone and try to keep mobile phone interviews short (e.g. no more than 15 minutes).

Costs

The charging system for mobile phone services adopts one of two principles: the calling party pays (CPP) or the receiving party pays (RPP).[1] Under CPP, the caller pays for the entire cost of each telephone call[2] and, in particular, pays a termination charge to the receiving network for the termination leg of the call. With RPP, the receiving network typically makes no charge to the caller (or at least not a significant one) for receiving and terminating calls from other networks. Instead, the receiving network charges its own subscriber for this cost, so the called party pays its own network for the termination leg of calls. As a result, RPP does not mean that the receiver pays the entire cost of the call but that it is shared between the caller and the receiver[3] (Littlechild 2006). RPP is applied in several countries, notably the US and Canada, Hong Kong, Singapore and China. CPP is used in most other countries, including those in Europe, and Australia and New Zealand (OECD 2000).

The impacts of the CPP system and the RPP system on the survey research activity are distinct. In the RPP system, since the recipient incurs a cost for receiving a call, cooperating with a survey means a cost for the respondent. Under these circumstances, survey companies must consider

[1] In the US, the terms mobile party pays (MPP) and wireless party pays (WPP) are often used instead of receiving party pays (RPP).
[2] The exception is when the receiver is abroad, in which case both parties share roaming costs.
[3] However, provision can be made for the receiver to support the entire cost in each system (e.g. via 800 numbers).

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some form of reimbursement or monetary incentive to compensate the respondent and encourage participation. As the call is paid for by the caller in the CPP system, the survey company that operates under this system bears the entire expense of the survey calls;[4] the respondent incurs no cost for participating. Despite the fact that the average price per call/minute in RPP countries is about half that of CPP countries (Littlechild 2006), the overall cost incurred by the survey companies will more or less balance out once respondents are reimbursed.

Another cost-related issue that warrants consideration is the price charged by mobile phone services: calls between two mobile phones are typically charged at considerably higher rates than those between fixed phones; moreover, calls between different networks are charged at higher rates than within the same network. In short, calls within the mobile network are more expensive than calls within the fixed network and therefore the overall telephone expenses of a survey are greater for survey companies using mobile phones for interviews.

Non-response

Although there are no conclusive results regarding the performance of mobile phone surveys as opposed to fixed phone surveys in terms of response rates, there are several features of mobile phones that can induce lower overall response rates. First, a mobile phone is seen as a personal device and many users may consider receiving a call from strangers on their mobile phone an invasion of their privacy. The reaction may be a refusal or even a hang-up-without-answering as soon as they see an unfamiliar number on the phone screen. Second, the respondent may be more or less willing to cooperate depending on the tariff that has been contracted for the mobile phone. Charging for receiving calls, which is the case under the RPP system, may discourage the acceptance of some calls, namely those from unknown sources. Therefore, people with RPP tariffs are more likely to refuse cooperation in surveys than others with CPP tariffs.

Mobile phones have the advantage of making the person accessible at any time of the day because it is a personal device carried at all times. Those respondents who were previously difficult to reach are now reachable thanks to mobile phone. The time period for contacts can be extended and is not restricted mainly to evenings and weekends; even the holiday period,

[4] Except if the respondent is abroad, in which case he/she will incur roaming expenses. However, it is much more likely that in such circumstances respondents will choose not to answer a call coming from an unknown source, to avoid this cost.

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typically connected with high non-response, may become a good or even a better period to conduct surveys (Kuusela & Simpanen 2002). However, this advantage may become less salient under an RPP system because these subscribers, especially lower-income customers, are more likely to turn off their phone and set it to voicemail so as to control the costs caused by receiving calls (Littlechild 2006). In the survey research activity, the RPP system is therefore likely to reduce the probability of a successful call so that survey companies must make increased efforts in terms of number of calls (and attempts) in order to achieve the desired sample size.

Respondent behaviour

The respondent may not answer the questions with the same commitment as he/she would in a fixed telephone contact. According to Lavrakas *et al.* (2007), mobile surveys may encourage *satisficing*, since people engage in more multitasking when speaking on mobile phones so that the respondent gives the question-answering task less attention.

Ethical considerations

While a person who answers the telephone at a fixed number is almost certainly at home, someone contacted by mobile phone may be virtually anywhere. In some cases, the environment or the circumstances surrounding the respondent may not be safe or appropriate to conduct an interview. Responding to a mobile phone interview while driving a car or operating any other type of potentially harmful machinery presents a potential hazard to the respondent. Recognising this, any researcher who conducts interviews over mobile phones should take adequate measures to guarantee that the interview will be conducted under appropriate conditions and that respondents' security will not be jeopardised by taking part in the survey (MRS 2005, A.10; ICC/ESOMAR 2007, Article 3b). One way of doing this is by the interviewers explicitly asking respondents if they are in a position to provide full and accurate data and, if not, schedule a call-back. A second ethical consideration is related to the cost structure of the mobile phone service. Receiving a call in the RPP system implies a cost for the receiver and therefore responding to a mobile survey represents a financial burden for the respondents. According to the MRS Code it is survey companies' duty to clearly inform the respondents of the cost they are likely to incur if responding to a survey (MRS 2005, B.21 – final bullet point). Moreover, respondents should be offered appropriate

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remuneration for their time on the survey call. This reimbursement should be viewed as a gesture of goodwill by the survey organisation and not an incentive to increase respondents' propensity to cooperate (Lavrakas *et al.* 2007).

The transition to mobile phone surveys is thus determined not only by the expanded usage and coverage rate of mobile phones but also by the methodological, technological, economic and ethical constraints mobile phones impose to survey research.

The study

The aim of our study was to compare a mobile survey with a fixed telephone survey. The study used mobile phones and fixed phones data collection procedures to obtain data from the general population of Portuguese adults (age ≥ 15 years). Survey content focused on internet usage, attitudes towards the internet, cultural practices and demographics. Several types of comparison are made between the two survey modes. First, we compare demographic characteristics and response rates within each sample. We also compare the demographic characteristics of the samples to the demographic characteristics of the Portuguese population.

Second, we compare substantive estimates from the survey across the samples; we examine whether the pattern of responses differed systematically by mode and by question type (yes/no format, multiple choice, ordinal scales and open-ended).

Third, we examine various indicators of response quality across the two samples. We look at completion times and several specific indicators of survey *satisficing* (Krosnick 1991; Krosnick *et al.* 2002): acquiescence response bias (the indiscriminate use of 'yes' and 'agree' responses), non-differentiation (the indiscriminate use of one point on a response scale for a range of different items) and incomplete responses (item omissions).

If differences are found in any or all the above factors, decision makers should give careful thought to the use of data coming from distinct modes, especially when the assumption is made that both methods produce comparable data.

Research design

The target population of both the mobile and the fixed phone surveys was Portuguese adults (aged ≥ 15 years). Both surveys were conducted by the same survey company in order to overcome problems that might confuse

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the assessment of survey results if multiple sources of data collection were used. The survey introduction identified Marktest as the sponsor, which we expected to have a positive effect on cooperation since Marktest is one of the best-known survey companies operating in Portugal. For both surveys, interviews were conducted at the company's CATI centre over the same time period and with the same set of interviewers working simultaneously on both surveys.

For the fixed sample the Portugal Telecom directory (the so-called 'White Pages') was used as the sampling frame. This directory lists all numbers that have been attributed; it covers all Portuguese territory and is updated regularly. 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.

The mobile sample was not list-assisted as there is no database of mobile phone numbers. Moreover mobile operators treat their numbering system as confidential and provide no information regarding the attribution of numbers. Mobile phones have nine-digit numbers and the first two digits identify the operator. Portugal's Telecommunications Regulation Authority (ANACOM) 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 seven-digit random numbers. The selection method was much like a simple random sample from a set of numbers, not all of which have necessarily been attributed to people.

Although the sampling methods were not identical in the two surveys, they were both random methods, which prevents the risk of selection bias. We have found that the randomness underlying the selection of both samples safeguards the validity of the comparative analysis that is going to be made between the samples.

The sample sizes were identical by design. Both for the fixed sample and the mobile sample, 1000 interviews were conducted. In the fixed sample, 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. In the mobile sample, interviews were conducted with the person who answered the phone, though only persons aged 15 years or older were eligible. Because mobile phone users may take calls in a variety of situations (e.g. while shopping or while driving a car), interviewers read

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all respondents an introduction consent asking them to confirm that they were in a place where they could continue with the interview at the time of contact. If not, the interviewer offered to set an appointment to complete the interview at another time.

Since the mobile communications service in Portugal adopts a CPP charging strategy, no plan was considered by Marktest to reimburse respondents for their participation in the survey.

A common measurement instrument was used for the mobile and fixed phone surveys. The questionnaire included eight questions of nominal type, three batteries of ordinal type (25 items overall), one open-ended quantitative question on time spent on the internet per week (respondents should report the hours they spend on the internet as a number, integer or not) and a section on demographics.

Results

Our analysis begins with an evaluation of subsample equivalence between demographic characteristics of mobile and fixed phone samples. Table 1 shows the percentage distribution of six demographic characteristics for each sample.

The samples were significantly different from each other at $p < 0.05$ on all characteristics except for gender. Overall, major differences between the two sample groups are summarised as follows.

- Age: a greater proportion of younger people, namely in the 25–44 group responded to the mobile survey than to the fixed phone survey, whereas the opposite held for the 55 and over age group.
- Educational level: a greater proportion of respondents to the mobile phone survey than to the fixed phone survey have a university degree or a secondary school level of education. A higher percentage of people with no formal education was found in the fixed phone sample than in the mobile phone sample.
- Professional status: respondents to the mobile survey were more likely to be employed than fixed phone respondents; a greater proportion of retired respondents were found in the fixed phone survey than in the mobile phone survey.
- Household size: respondents from smaller households (one or two persons) are less prominent in the mobile phone survey than in the fixed phone survey.

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Table 1 Selected characteristics of respondents and adult population (percentage distributions)

	Survey mode			
	Mobile (n = 1000)	**Fixed (n = 1000)**	***p*-value**	**Portuguese adult population 2007**
Gender			$p < 0.054$	
Male	50.9	46.6		48.4
Female	49.1	53.4		51.6
Age			$p < 0.000$	
15–24	18.0	13.0		14.1
25–34	26.3	11.8		18.4
35–44	22.1	14.6		17.7
45–54	16.7	14.8		16.2
55 and older	16.9	45.8		34.2
Educational level			$p < 0.000$	
No formal education	2.5	12.0		12.1
Basic education (9 years compulsory)	49.1	48.6		63.3
Secondary education (12 years)	30.8	26.3		13.9
University level	17.6	13.1		10.7
Professional status			$p < 0.000$	
Employed	70.5	45.2		57.8
Unemployed	5.5	3.7		4.9
Student	10.2	9.4		8.1
Retired	9.7	36.4		19.1
Other	4.1	5.3		10.1
Household size			$p < 0.000$	
1 person	13.1	16.6		16.8
2 persons	20.6	29.5		28.9
3 persons	31.1	22.6		27.1
4 or plus persons	35.2	31.3		27.2
Marital status			$p < 0.000$	
Single	31.0	24.2		24.9
Married	58.1	58.9		64.1
Divorced	6.7	4.4		3.3
Widow	4.1	12.5		7.7

- Marital status: a greater proportion of single people was found in the mobile phone survey than in the fixed, whereas the opposite held for the widow group.

To some extent these results replicate the findings regarding the mobile phone user population in other countries. In Finland, more than 90% of people aged under 29 years have a mobile phone (Kuusela & Simpanen 2002). In Slovenia, mobile phone users exceed 80% in the secondary or university degree level of education, and are over 90% in the 15–34 years

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age group; households with one or two persons are less likely to have a mobile phone than other household sizes (Vehovar *et al.* 2004). In Italy, people aged 16 to 30 years, with a higher/university education, service-class workers, single parents or those living in households where two or more members work are more likely to have a mobile phone (Callegaro & Poggio 2004). In the US, mobile phone users are more likely to be found among the 18–34 years age group, among employed people, single people and households with children (Link *et al.* 2007).

The last column of Table 1 is for the adult (15 and older) Portuguese population, based on data from Statistics Portugal 2007. Neither sample represents the general adult Portuguese population very well; the mobile sample departs from the 2007 percentages for the Portuguese adult population by about 7% on average (deviation values ranging from 2.5% to 11.9%), while the fixed sample departs by about 5% (deviation values ranging from 1.7% to 7.4%). For both samples the biggest deviation occurs for the educational level variable.

Our second stage of evaluation examines whether response rates are equivalent for the two modes. Table 2 shows results from this assessment. In order to conduct 1000 interviews of individuals aged 15 and older, a total of 11,617 mobile phone numbers were dialled; among them 6872 (59.2%) were non-attributed numbers. Out of the total useful numbers (i.e. attributed or connected), the response rate for the mobile phone survey was 21.1%. When the number of attempts (excluding those to non-attributed numbers) is used in determining response rate, the rate drops to 7.3%, which is a more commonly reported rate for telephone surveys.

Table 2 Response rates by survey mode

	Survey mode	
	Mobile	**Fixed**
Total numbers dialled	11,617	4,144
Attributed/connected numbers	4,745	3,055
Total number of attempts	20,602	8,112
Number of out-of-the-scope (age <15 years)[a]	61	0
Number of refusals[a]	496	344
Number of no contacts[a]	3,188	1,711
Number of interviews[a]	1,000	1,000
Response rate (number of interviews/numbers dialled) (%)[b]	21.1	32.7
Response rate (number of interviews/numbers of attempts) (%)[b]	7.3	14.2

[a] Reflects the result of the last call attempt.
[b] Rates computed conditional on attributed/connected numbers.

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A total of 4144 numbers were dialled to complete the 1000 fixed phone interviews; of these, 1089 (26.3%) were found to be disconnected or non-working. The response rate for the fixed phone survey based on the attributed/connected numbers was 32.7%. If the total number of calls made (after excluding those made to disconnected/non-working numbers) is considered to determine the response rate, the rate drops to 14.2%.

The next set of analyses addressed differences in response content and how data substance might vary due to survey data collection mode. As the type of item was also considered in the analysis, we display the results according to question type (nominal, either yes/no format or multiple choice, ordinal or open-ended). As shown in Table 3, there were significant differences at $p < 0.05$ for four of the 12 nominal items. For these statistically significant scales, the mobile survey had a higher percentage of respondents saying they try to convince others about their opinion

Table 3 Estimates (%) for the nominal type items by mode

	Survey mode		
Item	**Mobile**	**Fixed**	***p*-value**
Tries to convince others about her/his opinion [a]	60.9	54.3	$p < 0.034$
Frequently discuss political matters [a]	45.9	54.8	$p < 0.031$
Already bought something via internet [a]	36.6	35.6	$p < 0.798$
Member of a virtual community [a]	13.9	13.1	$p < 0.720$
Have developed friendships via internet [a]	29.7	26.1	$p < 0.218$
Number of books read during last year [b]			$p < 0.296$
10 or more	32.1	32.5	
6 to 9	12.5	17.3	
3 to 5	28.4	27.5	
1 to 2	20.6	17.8	
Less than 1	6.4	5.0	
Place where most frequently uses the internet [b]			$p < 0.381$
At home	62.1	65.8	
At work	26.2	23.6	
At school/university	2.8	4.3	
At friends/family place	2.7	2.3	
Public places (libraries, museums, post-office)	3.5	2.5	
Cyber-shops	2.7	1.6	
Learned to work with the internet …[c]			
By himself (practising)	66.3	65.7	$p < 0.897$
By himself (reading books about the subject)	3.8	4.5	$p < 0.640$
At school/university	18.6	19.2	$p < 0.814$
With friends/colleagues	26.3	32.5	$p < 0.025$
Attending courses	15.3	25.4	$p < 0.000$

[a] Nominal scale, yes and no categories.
[b] Nominal scale, multiple-choice categories with a single choice.
[c] Nominal scale, multiple-choice categories with more than one possible choices.

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when discussing some issue (60.9% on the mobile survey versus 54.3% on the fixed survey); on the other hand, there was a lower percentage of respondents discussing political matters (45.9% on the mobile survey versus 54.8% on the fixed survey), saying they learned to work with the internet with friends or colleagues (26.3% on the mobile survey versus 32.5% on the fixed survey) or by attending courses (15.3% on the mobile survey versus 25.4% on the fixed survey).

For the ordinal types of item, only three belonging to the five-point Likert scale (Table 4) and one of the four-category ordinal scale items revealed significant differences between the modes at $p < 0.05$. In the overall set of 25 ordinal type items, we found 19 had lower mean score

Table 4 Estimates (mean values) for the ordinal type items by mode

	Survey mode		
Item	**Mobile**	**Fixed**	***p*-value**
Frequency of internet use to …[a]			
Search for information for study/learning	2.43	2.37	$p < 0.334$
Search for job-related information	2.81	2.97	$p < 0.018$
Search for information on goods and services	2.50	2.57	$p < 0.227$
Buy goods and services	3.31	3.37	$p < 0.199$
Send or receive email	1.67	1.65	$p < 0.866$
Participate in chat rooms	3.17	3.25	$p < 0.209$
Download videos/games/music	3.10	3.13	$p < 0.687$
Download program files or documents	2.91	2.88	$p < 0.651$
Read magazines and newspapers on-line	2.39	2.38	$p < 0.888$
Use the Messenger to communicate with friends	2.18	2.24	$p < 0.426$
How often do you …[b]			
Watch the news on TV	1.39	1.30	$p < 0.063$
Read the news in newspapers	2.22	2.29	$p < 0.344$
Listen to the news on the radio	2.24	2.39	$p < 0.096$
Agrees/disagrees that the following is an advantage of the internet …[c]			
Fast communication	1.52	1.60	$p < 0.045$
Freedom of information circulation	1.84	2.00	$p < 0.003$
Contact with other cultures and lifestyles	1.66	1.67	$p < 0.736$
Greater access to knowledge	1.49	1.45	$p < 0.197$
Having information free of charge	1.58	1.63	$p < 0.298$
Internet is user-friendly	1.62	1.64	$p < 0.579$
Diversity in the available information	1.62	1.57	$p < 0.215$
Discussion of ideas between peoples with common interests	1.88	1.92	$p < 0.469$
Credibility of available information	2.26	2.33	$p < 0.213$
Possibility to access information that cannot be reached by other means	1.88	1.97	$p < 0.090$
Internet allows me to access services without moving	1.48	1.58	$p < 0.012$
Communication with people and institutions is easier	1.51	1.57	$p < 0.138$

[a] Ordinal scale, 4 categories, ranging from 1 = 'daily' to 4 = 'never'.
[b] Ordinal scale, 5 categories, ranging from 1 = 'every days of the week' to 5 = 'never'.
[c] 5-point Likert scale with 1 = 'strongly agree' and 5 = 'strongly disagree'.

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values for the mobile survey than for the fixed phone survey. Since all the statements were worded positively and given the direction of the scales, the lower mean scores indicate that the mobile survey generated more positive evaluations of the internet than did the fixed phone survey, and mobile phone respondents use the internet for the various activities more frequently than the fixed phone respondents.

The open-ended quantitative question on the number of hours a week spent on the internet revealed that, in the mobile phone sample, 50% of the respondents spend less than five hours a week on the internet, while for the fixed phone sample the same proportion of respondents spend less than six hours. In both samples, 25% of the respondents spend more than 14 hours (Table 5). The significance test for the mean revealed no significant differences at $p < 0.05$, which means that mobile and fixed phone respondents have similar internet usage intensity: nearly ten hours a week, on average.

The comparison between data collected under different modes can also entail an examination of differences in a number of quality indicators (Jäckle & Roberts 2007). Quality indicators may include (1) indicators of *completeness*, such as the completion time of the interviews, the mean length of responses to open-ended questions, (2) indicators of survey *satisficing,* such as the percentage of item omissions, or (3) indicators of response *accuracy*, such as comparisons with external data; comparisons with external data are less common in surveys on attitudes and behaviours since this information is seldom available from external sources.

Prior research has found few differences in data collected via mobile phones and fixed phones. Roy and Vanheuverzwyn (2002) found consistency in results between mobile and fixed phone surveys when

Table 5 Statistics for the distribution of the number of hours a week on the internet by mode

	Survey mode		
Item	**Mobile**	**Fixed**	***p*-value**
Number of hours a week spend on the internet[(a)]			
Minimum	1	1	
Maximum	100	100	
Mean	10.4	10.2	$p < 0.756$
Quartile 1	2.0	2.0	
Quartile 2	5.0	6.0	
Quartile 3	14.0	14.0	
Standard deviation	12.9	12.5	

[(a)] Open-ended type.

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comparing estimates on listening to the radio. The level of detail and richness of information in open-ended responses was studied by Dipko *et al.* (2005), and no significant differences between mobile and fixed phone responses were found. Brick *et al.* (2007) investigated duration of the interviews, response to sensitive questions, the percentage of items with missing data and response to open-ended questions, and found significant differences only for the first two issues. The comparison of survey estimates from the mobile and fixed phone survey in the research by Link *et al.* (2007) revealed significant differences in only two of the ten survey variables examined.

We examined four measures of response quality: (1) completion times, (2) item omissions (i.e. 'don't know' or 'no opinion' responses), (3) acquiescence, and (4) non-differentiation, identified by Krosnick (1991) as signs of *satisficing* on the part of survey respondents. We estimated the propensity for non-substantive answers by counting the number of 'don't know' or 'no opinion' responses that each respondent gave across the 44 questions/items of the questionnaire (presented in Tables 3–5). In both surveys, interviewers accepted a 'don't know' or 'no opinion' response when respondents volunteered them without any probing.

To measure acquiescence, we calculated the proportion of 'agree' (either 'strongly' or 'somewhat'), 'yes' and 'daily' responses each respondent gave on 30 items (presented in Tables 3 and 4), excluding items on which the respondent gave a 'don't know' or 'no opinion' answer.

Finally, we looked at three batteries of questions (items presented in Table 4), each of which include questions about several items using the same response format. For each one, we calculated the mean of the root of the absolute differences in the answers between pairs of items, an index used by Chang and Krosnick (2003) and Fricker *et al.* (2005) to measure non-differentiation. Lower scores indicated less differentiation in the responses across the items in the battery.

In our analysis of completion times, we examined whether the duration of the interviews is different by mode. Past research presents inconsistent results on this matter. Kuusela and Notkola (1999) argue that mobile and fixed phone surveys do not differ in terms of length of interviews, while Nathan (2001) and Brick *et al.* (2007) state that mobile phone interviews tend to be longer than fixed phone surveys because the conditions of the respondent's environment may distract his/her concentration and thus delay the respondent's coming-up-with-an-answer.

Table 6 shows some statistics regarding the completion time of the interviews. For the fixed phone respondents the mean length of the

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Table 6 Statistics for the distribution of completion times (minutes) by mode

	Survey mode		
	Mobile	**Fixed**	***p*-value**
Completion times (minutes)			
Mean	11.99	10.91	$p < 0.000$
5% trimmed mean	11.77	10.69	
Median	12.00	10.32	
Standard deviation	3.84	3.48	

interviews was 10.91 minutes (the median was 10.32 minutes). The mobile phone respondents took about one minute longer on average to complete the interview (mean of 11.99 minutes, median of 12.00). The comparison of mean completion times between modes revealed a difference significant at $p < 0.05$, and supporting the argument that mobile phone interviews took longer to complete.

The respondents to the mobile phone survey were less likely to give 'don't know' or 'no opinion' responses than the respondents who answered over the fixed phone. In fact, across the 44 items we examined, 89.7% of the mobile respondents had fully completed questionnaires (i.e. without any 'don't know' or 'no opinion' responses); the corresponding figure for the fixed phone respondents was 85.5%. The difference was significant between the modes ($p < 0.038$).

We expected that the differences in the percentage of respondents with omissions between the two modes might vary by question type. Across the question types, we found that the ordinal and the open-ended types of question were the ones with the higher percentages of respondents with 'don't know' or 'no opinion' responses across the modes, having found significant differences at $p < 0.05$ for the open-ended quantitative type of item (in the fixed sample 10% of the respondents had omissions in the open-ended question while the figure for the mobile phone sample was 5.6% – see Table 7).

When comparing for acquiescence, the mobile phone respondents showed a slightly higher proportion of acquiescence responses (on average 57.3% of the answers inclined towards acquiescence for the mobile respondents versus 56.1% for the fixed telephone respondents). There is the same trend towards higher acquiescence in the mobile sample if we restrict the analysis to the items that used an agree/disagree format.

In the three batteries of items, the mobile respondents gave less differentiated responses to the items than the fixed phone respondents;

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Table 7 Respondents with omissions (%) by mode

	Survey mode		
Item type	**Mobile**	**Fixed**	***p*-value**
Yes/no format	0.6	0.0	$p < 0.093$
Multiple choice	2.2	3.3	$p < 0.262$
Ordinal scale	3.9	4.7	$p < 0.543$
Open-ended	5.6	10.0	$p < 0.006$

however, the differences were not significant between the two samples. The mobile respondents were also more likely than the fixed phone respondents to give identical answers to every item in at least one of the three batteries (34.7% of the mobile respondents gave 'straight line' responses to at least one of the three batteries versus 31.8% of the fixed phone respondents), but once again the difference was not significant ($p < 0.327$).

Discussion and conclusion

The study compared the respondents' demographics, the response rates, the pattern of responses and indicators of response quality in a survey conducted via mobile phone and fixed phone. We find that mobile phone respondents are different from fixed phone respondents in terms of demographic characteristics and in some of the substantive items of the survey. In terms of data quality, the mobile phone survey was not worse than the fixed phone survey. In addition, the study allows the feasibility to be assessed of conducting a telephone survey within a mobile phone sampling frame. The conclusion is that mobile phone surveys are feasible, but considerably more difficult to conduct than fixed phone surveys.

An important difference between the two modes occurs in sample selection. Without a sampling frame, samples of mobile phone numbers must be randomly generated, which involves spending significant amounts of time on screening to identify attributed numbers. In our study, 6872 of the 11,617 mobile numbers dialled were non-attributed numbers (i.e. 59.2% of the dialled numbers were of no use, while for the fixed phone this figure was only 26.3%). According to Marktest the time of 'dialling and waiting to hear that the number is not connected/non-working' is estimated to be 15 seconds (on average), which means it took nearly 28 hours to screen the 6872 non-useful mobile numbers compared to only 4.5 hours in the fixed phone sample.

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Our findings support the idea that mobile phone users are different from fixed phone users. Although we can expect that the demographic differences between the two samples may become less prevalent as mobile phone dissemination increases and extends to specific subgroups, at present mobile phones samples tend to over-represent younger people and employed people, and to under-represent people living in smaller households and those with lower educational levels.

When examining response quality indicators, significant differences were found in the percentage of respondents with omissions and in the completion time of the interviews. Contrary to our initial expectation, the difference in the percentage of respondents with omissions indicated a better performance of the mobile survey (i.e. the mobile survey had a higher percentage of respondents with fully completed questionnaires). The mobile survey was also found to be superior regarding this indicator for every item type except for the yes/no format type; for the open-ended question type the difference between modes was significant. Moreover, the best percentage of respondents with omissions was found in the least burdensome type of questions (the yes/no format); this was true for both surveys. This outcome implies that consideration should be given to the best format for the questions when designing questionnaires to be applied either by fixed or by mobile phone. As for completion time, mobile interviews took almost 10% longer to complete than the fixed phone interviews.

The experimental conditions of both surveys are examined to understand the differences found between modes regarding the above mentioned response quality indicators. The research was designed to guarantee experimental validity, but at the same time we wanted the research to rely as much as possible on the real-world procedures of telephone surveying used by survey research industry. We did not interfere with Marktest's survey procedures, namely how the respondents were approached and at what time the contacts were made. Regarding contact with respondents, the fact that the mobile respondents were interviewed only after confirming that it was a convenient moment to conduct an interview is likely to have contributed both to longer completion times and to more complete questionnaires of the mobile respondents. In addition, the time the contact was made – quite different in both surveys – is a further consideration. While 59.7% of the fixed phone interviews were conducted between 8.00 pm and 10.30 pm, this was true for only 33.8% of the mobile interviews. Although this time period favours finding people at home, it is also critical for household activities (e.g. cooking dinner, dining, putting children to

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bed). Calling respondents in a time period when they are engaged in other tasks is likely to cause rushed responses; in fact, the lowest mean time of completion in the fixed phone survey was registered precisely in this time period, which means that fixed phone respondents tended to complete their interviews more quickly at this time, which had an impact on the overall mean completion time of fixed phone interviews.

The completion time issue must also be linked with the pricing strategies in each country regarding mobile phone services. Portugal is a CPP system country but in countries where the call is at the expense of the recipient, the tendency to rush responses may make mobile interviews shorter than those by fixed phone. Therefore, it cannot be concluded that mobile interviews systematically last longer than fixed phone interviews as the local conditions of the mobile phone service are likely to influence this issue; this question is certainly worthy of further research.

Moreover, our questionnaire was intentionally designed to be short following advice from Marktest's researchers, who warned us of the risk of high dropout rates for the mobile survey if the interviews took much more than 15 minutes. The same rule of conducting short questionnaires to avoid dropouts was applied in the early days of telephone surveys; however, nowadays it is common to conduct interviews on the phone that last 30–40 minutes. As the use of mobile phones for survey research increases, this trend towards lengthening the questionnaires will undoubtedly be seen. Whether longer questionnaires will cause greater differences in completion time between modes is another question that warrants future research.

These days, the telephone is losing full penetration thus reducing its mythical advantage of automatic generalisability, and this trend is certain to increase in the future. Therefore, practitioners and researchers need to take adequate steps to improve survey quality, such as using multiple methodologies together or switching to new methods altogether, but they should not disregard the problems posed to the survey activity by combining different methods or adopting new ones. Mixed phone designs will be easier to deal with if there is evidence that conducting an interview over a fixed phone or over a mobile phone has no influence on how the respondents come up with their answers. Future studies are needed so that the differences (and similarities) between the methods can be monitored, and consequently informed decisions can be made as to the best survey design for market research.

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References

Brick, J., Brick, P., Dipko, S., Presser, S., Tucker, C. & Yuan, Y. (2007) Cell phone feasibility in the US: sampling and calling cell numbers versus fixed numbers. *Public Opinion Quarterly*, **71**, 1, pp. 23–29.

Callegaro, M. & Poggio, T. (2004) Where can I call you? The mobile phone revolution and its impact on survey research and coverage error – a discussion of the Italian case. Paper presented at the 6th International Conference on Logic and Methodology, Amsterdam, Netherlands.

Chang, L. & Krosnick, J. (2003) National surveys via RDD telephone interviewing vs the internet: comparing sample representativeness and response quality. Working paper, available at: http://www.psy.ohio-state.edu/social/CSR-KN-HI.doc.

Dipko, S., Brick, P., Brick, J. & Presser, S. (2005) An investigation of response difference between cell phone and landline interviews. Paper presented at the Annual Conference of the American Association for Public Opinion Research, Miami Beach, Florida, US.

EU Statistics (2007) *Special Eurobarometer 274: E-Communications Households Survey*. Retrieved from http://ec.europa.eu/public_opinion/archives/ebs/ebs_274_sum_en.pdf.

Fricker, S., Galesic, M., Tourangeau, R. & Yan, T. (2005) An experimental comparison of web and telephone surveys. *Public Opinion Quarterly*, **69**, 3, pp. 370–392.

Groves, R., Biemer, P., Lyberg, L., Massey, J., Nicholls, W. & Waksberg, J. (eds) (1988) *Telephone Survey Methodology.* New York: Wiley.

ICC/ESOMAR (2007) *International Code on Market and Social Research*. Retrieved from www.esomar.org/index.php/codes-guidelines.html.

Jäckle, A. & Roberts, C. (2007) Assessing the effect of data collection mode on measurement. Paper presented at the 56th Session of the International Statistical Institute, Lisbon, Portugal.

Krosnick, J. (1991) Response strategies for coping with the cognitive demands of attitude measures in surveys. *Applied Cognitive Psychology*, **5**, pp. 213–236.

Krosnick, J., Holbrook, A., Berent, M., Carson, R., Hanemann, W., Kopp, R., Mitchell, R., Presser, S., Ruud, P., Smith, V., Moody, W., Green, M. & Conaway, M. (2002) The impact of 'no opinion' response options on data quality: non-attitude reduction or an invitation to satisfice? *Public Opinion Quarterly*, **66**, pp. 371–403.

Kuusela, V. & Notkola, V. (1999) Survey quality and mobile phones. Paper presented at the International Conference on Survey Nonresponse, Portland, US.

Kuusela, V. & Simpanen, M. (2002) Effects of mobile phones on telephone survey practices and results. Paper presented at the International Conference on Intelligent Computing, Copenhagen, Denmark.

Lavrakas, P., Shuttles, C., Steeh, C. & Fienberg, H. (2007) The state of surveying cell phone numbers in the United States: 2007 and beyond. *Public Opinion Quarterly*, **71**, *5*, pp. 840–854.

Link, M., Battaglia, M., Frankel, M., Osborn, L. & Mokdad, A. (2007) Reaching the US cell phone generation: comparison of cell phone survey results with an ongoing landline telephone survey. *Public Opinion Quarterly*, **71**, *5*, pp. 814–839.

Vicente.indd 20 30/06/2009 13:01:00

Littlechild, S. (2006) Mobile terminations charges: calling party pays versus receiving party pays. *Telecommunications Policy*, **30**, pp. 242–277.
MRS (2005) *Code of Conduct*. Retrieved from http://www.mrs.org.uk/standards/codeconduct.htm.
Nathan, G. (2001) Telesurvey methodologies for household surveys: a review and some thoughts for the future. *Survey Methodology*, **27**, pp. 7–31.
Organisation for Economic Co-operation and Development (OECD) (2000) *Cellular Mobile Pricing Structures and Trends*, 19 May. Retrieved from http://www.oecd.org/dataoecd/54/42/2538118.pdf.
Roy, G. & Vanheuverzwyn, A. (2002) Mobile phone in sample surveys. Paper presented at the International Conference on Intelligent Computing, Copenhagen, Denmark.
Tucker, C., Brick, J.M. & Meekins, B. (2007) Household telephone service and usage patterns in the United States in 2004: implications for telephone samples. *Public Opinion Quarterly*, **71**, 1, pp. 3–22.
Vehovar, V., Belak, E., Batagelj, Z. & Cikic, S. (2004) Mobile phone surveys: the Slovenian case study. *Metodoloski zvezki*, **1**, 1, pp. 1–19.

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