Prevalence of Cell Phone Sharing

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31.01.2013

How to cite this article: Busse, B., & Fuchs, M. (2013). Prevalence of Cell Phone Sharing. *Survey Methods: Insights from the Field.* Retrieved from http://surveyinsights.org/?p=1019

Abstract

With the growing mobile-only population landline telephone surveys are increasingly complemented by mobile phone interviews using a dual frame approach. Typically it is assumed that a mobile phone is a personal device solely used by one individual. Even though several articles dealt with the eventuality that several persons may be reached when calling a mobile phone number, respondent selection procedures are currently not implemented. This paper provides further insight into this phenomenon. Using data from a 2010/11 survey conducted in the German cell phone population mobile phone sharing was examined indicating noteworthy prevalence rates. The sharing population also differed to the non-sharing population with respect to sociodemographic variables. Results are discussed in light of potential consequences for field work.

Keywords

mobile phone sharing, mobile phone surveys, respondent selection

Introduction and background

With the proliferation of mobile phones which coincided with a reduction of the landline telephone penetration in many countries (Busse & Fuchs, 2012a) it has become inevitable to supplement telephone surveys by mobile phone interviews in order to avoid coverage error (Blumberg & Luke, 2010; Dutwin, Keeter, & Kennedy, 2010; Lee, Brick, Brown, & Grant, 2010). Since mobile phone surveys are still prone to their own coverage error and at the same time cause much higher costs than traditional landline telephone surveys do (Guterbock, Diop, Ellis, Holmes, & Le, 2011; Link, Battaglia, Frankel, Osborn, & Mokdad, 2007), it has become a commonly accepted procedure to combine landline and cell phone samples using a dual frame approach when conducting telephone surveys (Brick, Dipko, Presser, Tucker, & Yuan, 2006; Hu, Balluz, Battaglia, & Frankel, 2010; Kennedy, 2007; Lee, Brick, Brown, & Grant, 2010).

A difficulty in the application of the dual frame approach arises from the computation of proper inclusion probabilities for respondents. Gabler and Ayhan (2007; see for similar approach Kalsbeek & Agans, 2008) suggested a dual frame formula reflecting individual inclusion probabilities:

$$\pi_i \approx k_i^F \times \frac{m^F}{M^F} \times \frac{1}{z_i} + k_i^C \times \frac{m^C}{M^C}$$

The formula denotes a person`s inclusion probability in the fixed-line telephone frame (first part of the formula), combined with his/her inclusion probability in the cell phone frame (second part of the formula). The factor $k$ denotes the number of fixed-line numbers ($^F$) or mobile phone numbers ($^C$) in a person`s household. The capital letter stands for the universe of fixed-line numbers or mobile phone numbers in the sampling frame, whereas the lowercase letter m stands for the number of fixed-line telephone numbers or mobile phone numbers in the sample. Finally, z denotes the number of eligible household members. The inverse of this quantity is considered in the computation of the inclusion probability of a person in the landline frame (first part of the formula). By contrast, in the second part of the formula referring to the mobile phone frame potential respondents other than the person answering the phone are not considered. Consequently, when calculating the cell phone component in the dual frame formula the number of potential eligible respondents for each cell phone number is constant (1.0). Even though preliminary findings from the literature (Brick, Brick et al., 2007; Brick, Edwards, & Lee, 2007; Tucker, Brick, & Meekins, 2007) suggested that considerable portions of the cell phone population actually share their mobile phone with other people (not necessarily only within households) respondent selection procedures (e.g., the birthday method, Salmon & Nichols, 1983) are typically not used in cell phone interviews.

In this paper we contribute to the growing concerns over the assumption according to which mobile phone sharing can be ignored. Since in our view, cell phone sharing holds the potential to influence sampling for cell phone surveys and also for other survey modes using the cell phone frame, such as online surveys recruiting members in the mobile phone frame or mobile web surveys, we argue for an implementation of a simple proxy indicator for cell phone sharing in the field work of mobile phone surveys instead of a person-selection procedures. A discussion of potential consequences for design weighting can be found elsewhere (Busse & Fuchs, 2011).

Literature review and research question

Evidence for cell phone sharing is limited (AAPOR, 2010). One of the first methodological studies on cell phone sharing was conducted by Brick, Brick et al. (2007) in the U.S. They found 33 percent cell phone sharing. Since this particular validation study consisted of only 50 respondents, the result has to be interpreted with care. Encouraged by findings from this study Brick, Edwards and Lee (2007) asked for cell phone sharing in screening interviews conducted in cell-only households (n=176) also in the U.S. This study conducted in 2005 revealed 8 percent mobile phone sharers. Within households that were identified as cell phone sharing households a respondent selection procedure was administered. Brick, Edwards and Lee (2007) concluded that even though implementing a respondent selection procedure in cell phone surveys potentially leads to problems with gatekeepers refusing to participate in the survey similar to landline telephone surveys it is advisable not to neglect cell phone sharing since this holds the potential for bias in the sample composition.

Further on Tucker, Brick, and Meekins (2007) reported a secondary analysis done with a supplement of the 2004 U.S. Current Population Survey (CPS), which revealed 66 percent of mobile-only households with more than one adult resident as mobile phone sharing households. They examined the population of cell phone sharers for bias in several sociodemographic variables and found more married couples and respondents of Hispanic origin in sharing households. Also cell phone sharing households consisted more often of five or more persons (Tucker et al., 2007). Carley-Baxter, Peytchev, and Black (2010) analyzed cell phone sharing in the U.S. and found sharing rates of 15 percent for mobile-only respondents and of 11 percent for mobile phone users who also have a landline telephone. In addition, they found persons with multiple mobile phones at their disposal more often prone to cell phone sharing. Link and colleagues (2007) assessed sharing rates in the 2007 Behavioral Risk Factor Surveillance System Survey (BRFSS, n=1,174) also conducted in the U.S. Results were similar to the rates reported by Carley-Baxter and colleagues (2010).

When comparing available findings concerning cell phone sharing, it is crucially important to note that no common definition of cell phone sharing exists. In the supplement of the 2004 CPS respondents were asked to report cell phone sharing using the following question: “How many of the cell phone numbers are answered by more than one household member?” By using this question wording cell phone sharing was defined as (1) a phenomenon occurring within a household and (2) among all household members, including those not belonging to the target population of the survey. Besides the potential under- or overestimation of cell phone sharing caused by this question wording, the answers provided no indication of the frequency or regularity of sharing behavior. In the 2007 BRFSS, which was conducted in the cell phone as well as in the landline frame in several U.S. states, the authors defined a threshold of “one third of the time” for joint cell phone usage to indicate cell phone sharing (Link et al., 2007).

For Germany knowledge regarding cell phone sharing is also limited. For the CELLA study conducted by Häder and Häder (2009), Schneiderat and Schlinzig (2009) yielded a sharing rate of 3 percent in one of the study`s pretests (n=266). However this rather small fraction of the general cell phone population included only those respondents who reported that they would “always” share their mobile phone with another person, while 11 percent of respondents, who admitted to share their mobile phone from time to time with other persons were not considered (Schneiderat & Schlinzig, 2009). This inconsistency in the definition of the key concept of cell phone sharing was presumably responsible for the discrepancies in the sharing rates reported above. However, potential cultural differences in cell phone sharing across countries may also be held responsible for the differential prevalence rates.

The most recent study concerned with consequences of cell phone sharing is a paper by Wolter, Smith, and Blumberg (2010). They conceptualize cell phone sharing with the notion that one sampling unit (cell phone number) may lead to more than one reporting unit (respondents). When discussing implications of cell phone sharing for sampling in dual frame telephone surveys they point out that it is necessary to determine the number of persons that can be reached when calling a particular cell phone number as well as their probability to answer the call.

However, this approach ignores the fact that the inclusion probability of a particular respondent is not only affected by decisions and behaviours of other individuals who potentially answer the respondent's mobile phone (which may decrease the respondent's inclusion probability without his or her initiative). At the same time, the respondent himself or herself may actively answer incoming calls on other people's mobile phone (which may increase his or her inclusion probability). According to this reasoning, we differentiated two types of cell phone sharing:

(1) *Passive cell phone sharing* occurs when a mobile phone that is owned by the intended respondent is actually answered also by another person who may or may not possess an own mobile phone. Since mobile phones are portable devices this may involve individuals residing inside or outside the same household. If this form of cell phone sharing remains undetected during field work inclusion probabilities for the mobile phone owner may be lower than 1.0 since multiple persons from the target population may be reached using the same mobile phone number. If the person answering the phone does not own a personal mobile phone, the risk arises that individuals would be included in the sample who do not belong to the mobile phone population. Thus, when reaching a sharing partner the researcher has to decide whether the contacted person should be considered a regular respondent (e.g. if the mobile phone owner and the contacted person use the cell phone in equal parts) or whether the interview should be conducted with the mobile phone owner. We call this behaviour passive cell phone sharing since the owner's inclusion probability is affected without his or her active involvement.

(2) *Active cell phone sharing* denotes a behaviour where an intended respondent answers not only calls on his or her own mobile phone but also on one or multiple other persons' mobile phones (inside or outside the same household). In this case the inclusion probability of the intended respondent would increase since multiple phone numbers can be used to reach this person. Again, the researcher had to determine the frequency and regularity of this behaviour in order to estimate inclusion probabilities. We call this behaviour active cell phone sharing since a potential respondent increases his or her inclusion probability by means of his or her intentional behaviour and decision.

These two types of cell phone sharing shall be assessed in the remainder of this paper.

Methods

Results presented in this paper are based on data from the "Experimental Mobile Phone Panel", a project funded by Deutsche Forschungsgemeinschaft (Germany). In winter 2010/11 a recruitment study for the panel was conducted in the CATI facility of Darmstadt University of Technology in order to provide a refreshment sample for the panel. During this recruitment study we asked for active and passive cell phone sharing, as well as for typical sharing situations.

The sample for the refreshment survey was drawn using stratified random sampling from a sampling frame maintained by GESIS Mannheim (Germany) as a service for the scientific community (Gabler & Häder, 2009). The frame was built using the following procedure: For each mobile phone access code (known in advance) all possible number blocks of 10,000

were tested to ascertain whether at least one cell phone number was listed. To do this, telephone directories as well as Google search and other lists were used. All blocks that were presumed empty were dropped while for the non-empty blocks all possible cell phone numbers were generated. The frame comprises all listed and generated numbers and is assumed to cover the universe of all working cell phone numbers in Germany.

In total a sample of 25,000 cell phone numbers was drawn from the frame using stratified random sampling. Using AAPOR standard definitions (2011) AAPOR RR1 was 12 percent and accordingly 18 percent for AAPOR RR3. Calling hours were Monday through Friday 4 pm to 9 pm and 11 am to 9 pm on weekends. At the beginning of each recruitment interview we asked whether the phone we were calling was owned by the person answering the call ("Is this your mobile phone?"). If the person answering the phone denied ownership of the cell phone and in addition that the phone was used in equal shares among a group of people (0.5%), we administered the last birthday method to chose a respondent from the group of eligible persons using this cell phone (not necessarily from within a household). If the respondent answering the phone confirmed ownership, no respondent selection procedure was used.

The average interview length was 16 minutes. We asked respondents for their telephone equipment and usage, survey attitudes, life style and some sensitive questions on political attitudes, homophobia and gender attitudes. The interviews also consisted of a sociodemographic section and a panel recruitment question. In the questionnaire module on telephone equipment and usage, we asked for active and passive cell phone sharing. The first question referred to passive cell phone sharing, positioned before the question on active sharing: "Some people take calls on mobile phones of other household members or affiliated parties. If your mobile phone rings and you are not in its vicinity, will the call usually be answered by another person?". Subsequently we inquired active sharing: "And vice versa, do you answer calls on the mobile phones of affiliated parties?" For both questions respondents were offered the following response options: "always", "most of the time", "seldom", "never". In addition, the questionnaire contained the category "only when requested" not read by interviewers. Respondents who reported active cell phone sharing were asked to describe a typical situation when they answer another person's mobile phone using an open-ended text question.

For the analyses reported in this paper, all 1,579 completed interviews from the recruitment survey were considered regardless of consent to panel participation. As our sample yielded an overrepresentation of mobile-onlys we calculated a weighting factor correcting for this bias based on the latest Eurobarometer survey[1] yielding 8 percent mobile-onlys in the German mobile phone population. It is important to note that the net sample was also biased with respect to sociodemographics. Compared to the German mobile phone population documented in the Eurobarometer studies conducted in parallel to our survey in the second half of 2010 our sample over-represented young ($p < .000$), male ($p < .000$), highly educated ($p < .000$), employed ($p < .000$), single as well as widowed and divorced ($p < .000$) individuals. The respondents of the 2010 recruitment study were also more often not living together with a partner ($p < .000$). This nonresponse bias was also compensated for using post-stratification weights. All subsequent analyses were conducted using weighted data.

The proportion of item missing values for the income variable was substantial. Other sociodemographic variables also showed considerable proportions of item missing value. In order to include as many cases as possible in the analysis when using sociodemographic variables we conducted multiple imputations. We chose predictive mean matching procedure and imputed 19 percent of the income variable data, 3 percent of responses for age and education, 2 percent for the employment variable and 1 percent of marital status data.

Results

Prevalence of Cell Phone Sharing

Table 1 summarizes the response distributions concerning the two questions covering active and passive cell phone sharing.

Active cell phone sharing: About 8 percent of respondents indicated that they would always answer incoming calls on the mobile phone of affiliated persons living inside or outside the same household when the owner of the mobile phone is not in its vicinity. Further, 11 percent reported to answer incoming calls on other affiliated persons' phones most of the time. About a quarter of all respondents (23%) indicated that they would answer incoming call on other people's cell phones only seldom. Still the majority of respondents never answered calls on another person's cell phones (58%) and 2 percent indicated spontaneously to do so only when requested.

Passive cell phone sharing: When asked to report passive sharing, one fifth of respondents indicated that affiliated persons inside or outside the household always (9%) or most of the time (13%) answers incoming calls on their cell phone and 23 percent indicated that this occurred only seldom. Here, too, for the majority of respondents other people never answered incoming calls on their phone (55%). Again, the percentage of respondents who reported spontaneously that other people answer incoming calls only when requested by them was very low (1%). It is important to note that the responses provided by interviewees did not indicate the frequency of calls answered by the sharing partner.

Table 1: Distributions of responses concerning active and passive mobile phone sharing (percentage and case count)

	Active cell phone sharing	Passive cell phone sharing
Always	8 (120)	9 (144)
Most of the time	11 (175)	13 (199)
Seldom	23 (367)	23 (362)
Never	56 (878)	55 (863)
Only when requested	2 (37)	1 (12)
Total	100 (1,578)	100 (1,578)

Note. Weighted data from the Experimental Mobile Phone Panel recruitment study 2010/11; differences in the case count due to weighted data and rounding.

When combining the information concerning active and passive cell phone sharing (see Table 2), more than half of all cell phone respondents were either involved in active cell phone sharing only (9%), in passive cell phone sharing only (12%) or in both types of behaviours (33%) always, most of the time or seldom (the category "only when requested" was not

considered since in these cases sharing was initiated by the mobile phone owner). Consequently, about half of the respondents revealed a mobile phone usage behaviour that holds the potential for inducing bias in a mobile phone survey when administered without a person selection procedure.

Table 2: Percentage (and case count) of active and passive cell phone sharing

		Passive cell phone sharing		
		Always, most of the time, seldom	Never, only when requested	Total
Active cell phone sharing	Always, most of the time, seldom	33 (521)	9 (142)	42 (663)
	Never, only when requested	12 (182)	46 (733)	58 (915)
Total		45 (703)	55 (875)	100 (1,578)

Note. Weighted data from the Experimental Mobile Phone Panel recruitment study 2010/11; differences in case count compared to Table 1 due to weighted data and rounding. The categories "always", "most of the time", and "seldom" were combined into active sharing and passive sharing.

Interestingly, we found about the same prevalence rates of active cell phone sharing and for passive cell phone sharing among mobile-only respondents compared to respondents who could also be reached by landline telephone (42% vs. 38% among mobile-onlys for active cell phone sharing and 45% vs. 39% among mobile-onlys for passive cell phone sharing; no significant differences). However, respondents who had more than one mobile phone number at their disposal yielded a significantly higher prevalence of active cell phone sharing (50% vs. 40% for respondents with just one mobile phone number; $p < .05$) confirming results reported by Carley-Baxter an colleagues (2010). For passive cell phone sharing no significant difference occurred (47% vs. 44%).

Situations in which cell phone sharing occurs

In order to explore cell phone sharing behaviour in greater detail we asked respondents, who reported active sharing to describe typical situations when they answer other people's mobile phones. Respondents were exposed to an open-ended narrative question since prior knowledge concerning cell phone sharing situations in Germany was limited and did not allow for an exhaustive closed-ended question. Responses were recorded by interviewers and subsequently collapsed into eight broader categories (*Table 3*). The question was not administered to respondents who reported passive cell phone sharing only, since they are typically not present when other people answer their phones.

Table 3: Percentage (and case count) for typical sharing situations reported in the 2010/11 recruitment study of the Experimental Mobile Phone Panel

	Respondents who reported active sharing, no passive sharing	Respondents who reported active and passive sharing	Total	
Absence of cell phone owner	34 (48)	44 (231)	42 (279)	*
Caller ID is known to sharing partner	18 (25)	20 (103)	19 (128)	
Cell phone owner is tied up with something else	16 (23)	21 (110)	20 (133)	
Only on cell phone of close relative or friend	22 (31)	18 (92)	19 (123)	
After prior consultation with cell phone owner	17 (25)	7 (37)	9 (62)	***
Cell phone owner is awaiting an (important) call	11 (15)	8 (43)	9 (58)	
Always when cell phone is in vicinity	4 (6)	5 (25)	5 (31)	
Other	4 (6)	4 (19)	4 (25)	

*Note. Weighted data from the Experimental Mobile Phone Panel recruitment study 2010/11. The categories "always", "most of the time", and "seldom" were combined into active sharing and passive sharing respectively. Active sharing only: n=150; active and passive sharing: n=561. Of the respondents reporting active sharing only 7 did not describe any typical sharing situation; neither did 22 respondents reporting active and passive sharing. * p < .05; ** p < .01; *** p < .001.*

Most active sharers indicated in their open-ended response that they would answer incoming calls on other people`s cell phone when the owner is absent (42%), for example, because the mobile phone owner is in another room or gone out shopping or to work. Respondents also provided evidence that they answer other people's mobile phones when the cell phone owner is tied up with something else (20%). Similarly, about one fifth of respondents (19%) provided responses according to which they would only answer calls on the cell phones of close relatives or close friends, but not on cell phones of other affiliated persons. In the scenarios described above, the respondent acts like a voluntary stand-in for the mobile phone owner. Based on the information available we are unable to rule out that the person answering the cell phone would potentially also participate in a survey interview instead of the owner in case a survey organization would call and ask for cooperation. However, further research is needed.

One fifth of the active sharers also indicated that they would engage in cell phone sharing when the caller ID of the incoming call is known to them (19%). In this situation cell phone sharing would most likely not result in a survey interview with the sharing partner since a survey research organization would be using a caller ID unknown to the sharing partner.

Finally, 9 percent refer to sharing “after prior consultation with the mobile phone owner” and 9 percent indicate that they would answer calls on an affiliated person’s mobile phone if the “mobile phone owner is awaiting an (important) call” (but unable to take the call). Again, in these situations it is highly unlikely that the sharing partner would participate in a survey instead of the mobile phone owner. Interestingly, 5 percent of respondents provide evidence according to which active sharing of mobile phones was something usual, occurring whenever the mobile phone is in greater vicinity of the sharing partner than of the mobile phone owner.

We found some differences of respondents who reported active and passive sharing to those who reported active sharing only (the question was not administered to respondents reporting no sharing or passive sharing only): Active and passive sharers turned out to practice sharing significantly more often in the absence of the mobile phone owner (44% vs. 34%, $p < .05$). Also, prior consultation with the mobile phone owner is significantly less important for those who were involved in active and passive sharing (7% vs. 17%, $p < .001$) suggesting that prior consultation is less often required when sharing occurs mutually. It is important to note that these results are based on responses to an open-ended question. Thus, we need to further investigate the frequency and prevalence of various sharing situations in future studies.

Information from field work

In addition to dedicated questionnaire items covering mobile phone sharing, we also assessed cell phone sharing using information from the initial phase of each mobile phone interview throughout the panel: Over the course of the panel we documented all instances where a person other than the mobile phone owner answered our survey call. In the two recruitment studies we asked the contacted persons whether the called mobile phone was owned by them. In case of denial we asked a few questions on the sharing situation. In about 1 percent of all survey calls throughout the two recruitment surveys the person answering the phone indicated that the cell phone was owned by another person (see *Table 4*). In the follow-up panel waves we verified identification data (sex, year of birth, height and handedness) we had collected during recruitment surveys for all panel members against the responses provided by the actual respondent in the follow-up wave. Using this identification data we aimed to assure that the same person was interviewed in each following panel wave. Using this methodology we detected 2 to 10 percent of cell phone numbers where the person answering the phone did not match the respondent from the recruitment interview (see *Table 4*) indicating sharing either in the actual interview or in the prior recruitment interview.

Table 4: Percentage (and case count) of mobile phone sharers identified by interviewers in the recruitment studies and in the panel waves

	Recruit-ment 2009	Wave 1	Wave 2	Wave 3	Recruit-ment 2010	Wave 4	Wave 5
The person answering the phone is not the mobile phone owner	1 (30)	7 (66)	7 (23)	10 (24)	1 (37)	5 (70)	2 (21)

Note: In the recruitment study we identified sharers by asking whether the cell phone we were calling belonged to them. In subsequent waves sharing was identified when another person than the intended respondent answered the cell phone.

Since this rate in the follow-up waves was higher than in the recruitment interviews we speculate, that several undetected sharing partners had participated in the recruitment interviews and, thus, provided identification data in the recruitment interview which did not match the owner of the cell phone. We assume that the initial question “Is this your mobile phone?” was difficult to answer, in part because sharing violates common privacy norms according to which a cell phone is a personal device (it may contain personal text messages, calendar entries, contact lists and the like). However, it is also possible, that the owner of the cell phone is potentially not its main user.

Sociodemographic properties of active and passive cell phone sharers

In order to determine whether cell phone sharing holds the potential to induce bias in mobile phone samples we assessed whether active cell phone sharers or respondents who reported passive cell phone sharing differed from the remaining sample. In case of sociodemographic differences active sharing (the respondent answers survey calls on other people’s phones) could produce a bias by overrepresenting certain sociodemographic properties in the sample. Vice versa, respondents who report passive sharing on their mobile phones may be underrepresented in the sample since other people may answer incoming survey calls instead of them.

To assess differences between sharers and non-sharers, we fitted logistic regression models using sociodemographic variables as predictors for three populations: (1) respondents who were involved in active and passive cell phone sharing (“always”, “most of the time” and “seldom”; see *Table 1*), respondents who reported (2) active cell phone sharing only and respondents (3) who indicated passive cell phone sharing only. In all models the respective cell phone sharing group was compared to respondents who reported neither active nor passive cell phone sharing. Due to the limited number of cases in the data set explanatory variables were dichotomized with the exemption of age: males vs. females, higher education entrance degree vs. lower educational degree, working vs. not working, household income larger than 2,000 Euro vs. lower income and married vs. other status (see *Table 5*).

Table 5: Determinants of cell phone sharing behaviour (odd ratios compared to non-sharers)

	Active and passive cell phone sharing	Passive cell phone sharing only	Active cell phone sharing only
Sex (1=male)	1.06	1.07	0.80
Age (z-transformed)	0.54 ***	1.05	0.60 ***
Education (1=higher education entrance degree)	1.03	0.08	1.38
Employment status (1=working)	0.76 *	0.58 **	0.62 *
Household income (1=above 2,000 Euro)	1.36 *	1.28	0.70 +
Marital status (1=married)	3.93 ***	2.61 ***	2.30 ***
Nagelkerke’s R^2	.15	.09	.06
N	1,280	870	872

*Note. Weighted data from the Experimental Mobile Phone Panel recruitment study 2010/11; missing values for sociodemographic variables imputed by multiple imputations. The question was only administered to respondents who reported active sharing (with or without passive sharing). Odd ratios denote differences of the respective sharing group to the non-sharing portion of the sample. + p < .1; * p < .05; ** p < .01; *** p < .001.*

Results reported in *Table 5* suggest that respondents who reported both, active sharing and passive cell phone sharing, were significantly younger than non-sharing cell phone respondents ($p < .001$). Also, they were more often married ($p < .001$), were more likely to earn a household income of more than 2.000 Euro ($p < .05$) and were less often working ($p < .05$). Respondents who reported passive sharing only exhibited a similar pattern: They were also less often working than non-sharing respondents ($p < .01$) and more often married ($p < .001$). Active sharing (without simultaneous passive sharing) was also indicated significantly more often by younger respondents ($p < .001$), by respondents who were married ($p < .001$) and by respondents who were not working ($p < .05$). However, active sharing only seemed to be marginally less prevalent among high income households.

Hence, cell phone sharing seemed to be more prevalent in specific subpopulations. It should be noted that we are unaware of the sociodemographic characteristics of the sharing partner. Thus, we cannot determine for sure whether active or passive sharing would in fact induce a bias in the sample or whether the sharing partner resembles the owner of the phone in terms of sociodemographics characteristics.

Discussion

In this paper, we assessed the prevalence of cell phone sharing in a random sample of mobile phone users in Germany 2010/11. The study served as a recruitment survey for a mobile phone panel study; several panel waves were administered thereafter. The research reported in this paper was driven by concerns that cell phone sharing might interfere with random selection of respondents as determined by the researcher and thus with the quality of cell phone samples.

Based on our results cell phones rarely assume the role of a household telephone which is used in equal shares among household members. Only a small portion of all cell phone numbers prone to sharing were used in this way. For the majority of cell phone numbers affected by sharing an owner or main user could be identified and sharing did not involve equal shares usage of cell phones by groups of potential respondents (which is plausible because high mobile phone penetration rates suggest that most individuals have their own mobile phone).

Nevertheless cell phone sharing occurs: for the purpose of this analysis, we diagnosed active sharing if a respondent reported to answer incoming calls on another person's cell phone "always", "most of the time" or "seldom". Cell phone sharing in this sense was reported by 42 percent of respondents. Vice versa 45 percent of respondents indicated that other people would answer incoming calls on their cell phone "always", "most of the time" or "seldom". It may seem questionable to consider also respondents who were involved in cell phone sharing only "seldom". However, we aimed to determine the extent to which sharing occurs regardless of its frequency and regularity. For the development of practical solutions that help improve the administration of cell phone surveys in the field it might well be more appropriate to ignore cell phone sharing that occurs only seldom.

Interestingly, the majority of sharing respondents either reported both, active and passive cell phone sharing, or denied either form of cell phone sharing. It remains an open question whether this follows from the fact that we administered both questions in close proximity and

respondents felt obliged to report consistently. In future studies we shall test a random order of sharing questions as well as separating them by buffer items or other substantive sections of the questionnaire. Also, we need to develop less burdensome and less difficult sharing questions.

Given the available information we can only speculate whether sharing may actually lead to survey interviews with another person than the cell phone owner. Several of the circumstances described by respondents as typical sharing situations at least have the potential to yield a completed interview with a person who is not the owner of this phone. The fact that we actually detected several respondents during field operations of subsequent panel waves who answered survey calls on a cell phone that was answered by another individual in the recruitment interview (2% to 10%) were in support for this hypothesis. This raises concerns that the basic assumption according to which a cell phone has just one owner and/or one user is fundamentally flawed. Even if a sharing partner might not complete a survey interview instead of the cell phone owner, it is important to note that sharing partners might refuse to participate in the survey without further consultation with the cell phone owner. However, so far we are unaware of the frequency of this phenomenon.

Even though results seem to indicate low prevalence rates of cell phone sharing it requires an increased attentiveness by survey organizations, since sharing is more prevalent among specific sociodemographic segments of the mobile phone population: Cell phone sharing occurs more often among young, married respondents living in high-income household who are not working. So far we do not know whether cell phone owners and their sharing partners differ from each other in sociodemographics or substantive variables. Thus further research is needed in order to answer the question whether survey results might be biased when neglecting sharing.

So far, we are unable to suggest a simple, uniform respondent selection procedure for cell phone surveys (similar to the birthday method in landline telephone surveys), because given the various types of sharing multiple strategies might be necessary: In the recruitment interviews we asked all individuals who denied ownership of the cell phone we were calling whether the person who answered the survey call would be using the mobile phone in equal shares with the cell phone owner. Half of the sharers we detected during field work indicated equal shares usage of the cell phones, the other half reported that the mobile phone belonged exclusively to another person. In case of equal shares usage of the cell phone, we implemented the last birthday method to choose one of the eligible cell phone users as respondent. If the cell phone belonged exclusively to another person we asked to talk to the mobile phone owner.

As known from landline telephone surveys extending the initial phase of a telephone interview increases the risk of losing the respondent or gatekeeper because he or she might hang up before the actual interview starts (de Leeuw & Hox, 2004; Gaziano, 2005). Consequently a respondent selection procedure or a short question on whether the person answering the phone is actually the owner of the mobile phone may have the potential to reduce response rates considerably. Interestingly, when implementing the procedure described above in the recruitment survey we did not increase nonresponse: all cases where cell phone sharing was detected during the introductory phase of the interview led to a complete. However, this finding relies on a small number of cases only. Thus, it is still an open question whether nonresponse would be increased when using this procedure in larger samples. Accordingly, when implementing a respondent selection procedure or a question on the ownership of the mobile phone researchers have to weigh the potential bias due to sharing against bias due to additional unit nonresponse. At this point it is left to determine in future studies whether measures should be taken as soon as any type of sharing is detected or whether such procedure should only be used in the rare occasions where a mobile phone is shared in equal

parts among a group of people (similar to a household phone). Additionally it should be highlighted that mobile phone sharing might occur across household borders (e.g. with couples where partners live in separated dwellings). In this case it might be much more difficult to reach the sharing-partner not living with the mobile phone owner and consequently nonresponse might be increased. Also, mobile phones are portable devices. Thus, cell phone sharing may involve individuals residing outside the same household depending on the situation when the survey call reaches the mobile phone user.

In addition, if respondents have multiple mobile phone numbers at their disposal, the questions needed to determine cell phone sharing would become rather complex and absorb considerable time prior to the actual interview. Accordingly, it would be desirable to develop a reliable proxy-indicator for sharing behaviour regardless of the particularities of the situation, of the number of cell phones used, of the number of people inside and outside the household involved as well as of the frequency and regularity of this behaviour. We could then use this indicator to compute design weights compensating for elevated or reduced inclusion probabilities of respondents while the interview is still conducted with the person answering the phone. So far we can only speculate whether simple questions like “Within the last four weeks, how many times did someone else take a call on your mobile phone?” or “How many times did you take a call on someone else’s cell phone within the last four weeks?” are sufficient. Whether this is a sufficient mechanism to compensate for the potential negative impact of cell phone sharing on data quality need to be determined in future studies.

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[1] Eurobarometer studies are administered on an ongoing basis on behalf of the European Commission four times a year with an overall sample size of about 30,000 cases per year across 27 participating countries. The German sample consists of 1,500 cases in each wave. We used weighted data representing the German mobile phone population for Eurobarometer estimates that served as a standard of comparison for our data.

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