

The When and the Where of Cell Phone Only Incidence

Eran Ben-Porath, Melissa Herrmann, David Dutwin – *SSRS/Social Science Research Solutions*
Richard Possett, Anna Fleeman – *Arbitron*

63rd Annual Conference of the American Association for Public Opinion Research

Hollywood, FL

May 2009

Cell phone-only users are an elusive yet highly-sought population for public opinion research. Recent accounts indicate that the percentage of cell phone-only adults in America is gradually increasing, with almost 18.4% of adults residing in a cell phone-only household (Blumberg & Luke, 2009b). Within geographical units, such as states, the variance in this percentage is wide, ranging from about 4.5% in Vermont to as much as 34.6% in Oklahoma (Blumberg & Luke, 2009a).¹ The rapid increase in cell phone-only households and individuals poses a challenge for the survey research community primarily because researchers perceive this population as meaningfully different from casual cell-phone users who still rely, to a certain extent, on landlines (e.g. Blumberg & Luke, 2007; Fleeman, 2006). Therefore, reaching the cell-phone only's (CPOs) becomes a necessity in survey research.

Below, we expand on the need for the inclusion of CPOs in sampling designs and discuss the difficulties facing survey firms trying to reach this population. We then detail a study conducted by Arbitron and Social Science Research Solutions (SSRS) that sheds some light on possible ways of increasing the incidence of CPO adults. These findings pertain to the best times to dial cell phone sampling frames and some geographical considerations as well.

The Importance of Reaching CPOs:

CPO households and individuals become a central concern for survey research in view of findings that indicate this group differs from casual cell phone users in meaningful ways. For one, they are demographically different. CPOs are younger (e.g. Tuckel & O'Neil, 2005, Jay & DiCamillo, 2006; Blumberg & Luke, 2009b). Looking at

¹ This is the upper bound of Blumberg and Luke's estimate; the lower bound is 14.6% and the mean 25.1% in Oklahoma.

exit poll data in the 2004 election, Keeter et al. (2007) found that nearly twenty percent of 18 to 29 years olds did not own a landline. In Blumberg and Luke's most recent count (2009b), the percentage of 25-29 year olds living in cell phone only households is 41.5%. Similarly, low income populations are now almost twenty percent cell-only (Blumberg & Luke, 2007; 2009b), and cell phone-only persons also more likely to have attained lower levels of education.² In other words, neglecting to account for CPOs in one's sampling frame may introduce bias in the population estimates of the sample. For example, college students are the most likely 'occupational' CPO category (Jay & DiCamillo, 2006, Tuckel & O'Neil, 2005). When CPOs are not covered by the sampling design, the likelihood of adequately representing college students in a survey is reduced. This, in turn, could affect estimates of attitudes or behaviors such as obtaining health insurance or drinking habits (see Blumberg & Luke, 2007; 2009b).

The coverage issues stemming from neglecting to account for CPOs and the biases they involve could be accounted for, in theory, by post-hoc corrections (i.e. weighting). However, research suggests that CPOs are different than landline users in more substantial ways than simple demographics, leading to "non-negligible coverage biases even after adjusting for demographic differences" (Blumberg & Luke, 2007, p. 747). On the question of age, for one, young CPOs are sociologically or culturally different than casual cell phone users of the same age group. For example, Blumberg & Luke (2007) found risky behaviors such as binge drinking were more prevalent among CPO young adults than young adults with landline service. A study by the Pew Research Center for People and the Press (2006) found that young CPOs were less likely than other

² Some of these associations are confounded. College students can be mislabeled as having "low educational attainment" since they have yet to earn a college degree, by definition.

young people to be married, or own a home (see also Keeter, 2007). They were also more likely to support policies such as providing assistance to the poor. In other words, cell-phone only status is a meaningful social category in and of itself, which deserves adequate representation in surveys in order to provide proper representation of the general population.

The Difficulty of Reaching CPOs:

The need to target CPOs creates a problem for survey research in that it is far more costly to reach this population than a landline RDD frame. There are multiple reasons for this spike in costs. For one, cell phone samples, to date, cannot be ‘scrubbed’ for business or non-working numbers. There is no listed sample database for cell-phones, thereby preventing analyses in order to screen 100-banks that have no listed telephone numbers, as is commonly done with landline telephones. The lack of listed information of course also prevents the use of pre-notification letters, which are known to increase the likelihood of cooperation. Furthermore, cell phones are hard to pinpoint geographically by exchange or even area code, as previous research finds over 30% of cell phone users residing in a different county than the location associated with their phone number (Fleeman & Estersohn, 2006). And as we demonstrate below, a percentage of cell phone users resides well outside the market associated with their cell phone number, since people do not tend to change their number when they move. This means that completing an interview with cell phone users in a designated area will require more calls than with a landline sample.

Adding to the complexities of reaching CPOs is the fact that cell phone users at times simply shut off their phones (Jay & DiCamillo, 2006) and are more likely to be

screening their calls, choosing who to answer and who to ignore (Tuckel & O'Neill, 2005). In other words, this is a group that is likely to avoid calls altogether and particularly calls from unrecognizable numbers. Survey research, according to the same study, should have a harder time still with CPOs, since most Americans say they would not want to participate in surveys on their cell phones.

Cell phone surveys are further complicated by the fact that incoming calls to a cell phone incur a certain degree of cost for the respondent. Although presently many cell phone subscribers pay a monthly fee that covers far more minutes than they use, there could still be many circumstances where answering a twenty minute survey could increase the respondent's phone bill. As a result, cell phone sample members may be more reluctant to participate and survey companies are often compelled to offer some incentive or compensations for airtime.

The costs of cell phone dialing are also inflated as a result of the federal restrictions on the use of dialers when calling cell phones. This means that all calls to cell phones need to be done manually, which is more time-consuming than on an automatic dialer. Consequently, not only are more call attempts needed to reach cell phone users, but each attempt to reach them will require more time, and consequently extract higher costs.

When attempting to interview a set percentage of CPOs in a survey, further complications emerge. There is no way of identifying a phone number in a cell phone-only respondent within a sample of cell phone numbers. If the average percentage of CPOs in the U.S. is about 20%, then only every fifth contact with a cell phone respondent will meet the eligibility criteria for CPO completes and 80% of cooperative respondents

will be terminated.³ As well, a significant percent of cell phone owners are under the age of eighteen. These problems further exacerbate the costliness of CPO samples. In view of the needs to target CPOs coupled with the costs of doing so, methods for reaching higher incidences of CPOs within a cell phone frame are a necessity for survey research.

The Study:

The results we detail in the following section are based on 168,080 interviews collected over an 18 month period between January, 2007 and June, 2008. During this period, SSRS conducted interviews with respondents randomly selected from a sample of cell phone numbers. These numbers were spread across a total of 15 designated market areas (DMAs) in large metropolitan areas. The interviews consisted essentially of one question: “Thinking about where you currently live, is there at least one phone inside your home that is currently working and is not a cell phone?” On the basis of their responses to this question, respondents were coded as either casual cell phone users or, if they answered “no,” as CPOs. In addition, respondents were asked whether they were 18 or older⁴ and for their zip code. For the purposes of the current study, we focus exclusively on those 18 or older. Zip code information allowed us to estimate the proportion of respondents whose actual residential zip code falls outside the DMA associated with their telephone exchange code or even that of adjacent markets.

Having collected the data and identified all cases as CPO or casual cell, analyses were conducted to establish whether there were temporal or geographical parameters that would advise researchers of the best circumstances under which to dial a cell phone sample with the expectation of screening for CPOs. The core of the analysis involves

³ This figure will be lower when accounting for the ever-shrinking percentage of landline users who do not own cell phones.

⁴ Starting April, 2008 the age requirement question was used as a screener prior to the cell only question.

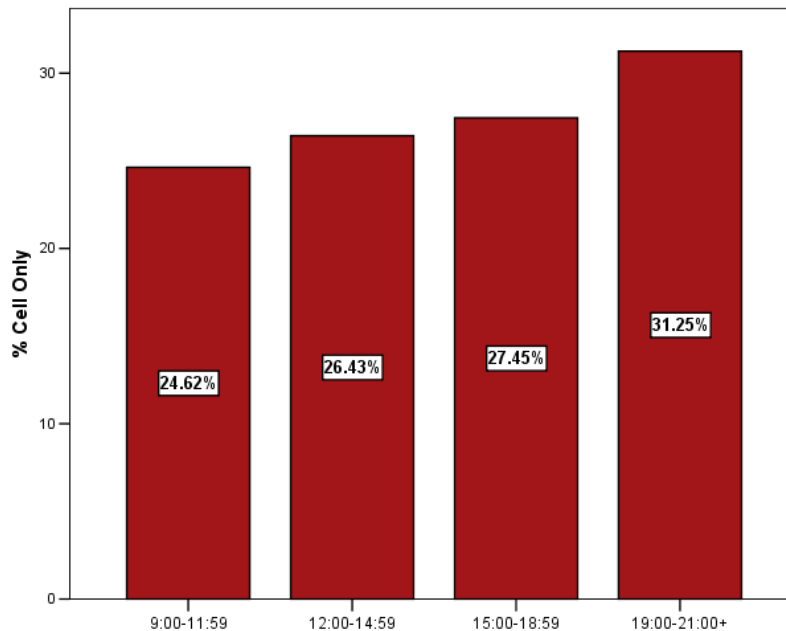
binary logistic regression models in which the outcome value is the dichotomous CPO status (1=CPO). In the analyses described below we detail the control variables included in the regression models.

Results:

When

Of the 168,895 respondents, 26.03% reported CPO status, while the remaining 73.94% said they were also getting called on a landline. This relatively high percentage most likely has to do with the fact that all numbers dialed were cell phone numbers, therefore they excluded people who do not have a cell phone at all or those who keep their cell phone shut for long periods of time⁵. Overall, this number seems like a reasonable estimate of the prevalence of CPO status for the sample and the period of time studied.

Figure 1: Percent CPO by Day-Part:

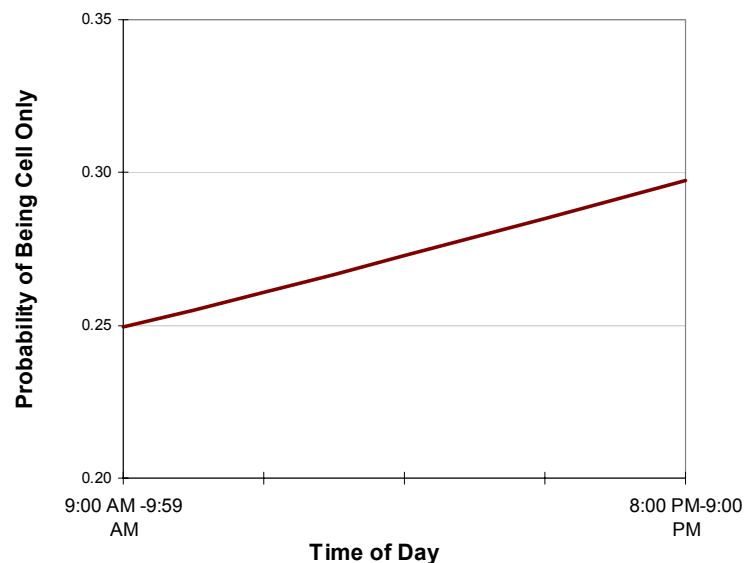


Note: N=168,895. $X^2(df=3)=258.86$; $p<.001$.

⁵ According to Tuckel and O'Neill (2005), shutting off the phone is less common among CPOs.

Turning to the particular issues at the center of this study, CPO incidence was significantly higher in the later parts of the day (see Figure 1). This finding extends beyond the overall higher likelihood of reaching survey respondents in the evening since this is compared with reaching non-CPOs, who completed the survey as well. Whereas in the AM only 24.62% of the respondents were CPO, in the final time-slot, between 7:00 PM and 9:00 PM, the percentage of CPOs grew to 31.25% (the association between day-part and CPOs incidence was monotonous: $\gamma=.067$; $p<.001$). Due to the greater quantity of numbers dialed during the morning hours, the total percentage of CPOs is closer to the lower number, but as this figure indicates, later dialing should correspond with a higher percentage of CPOs.

Figure 2: Linear Association between Time of Day and CPO Incidence:

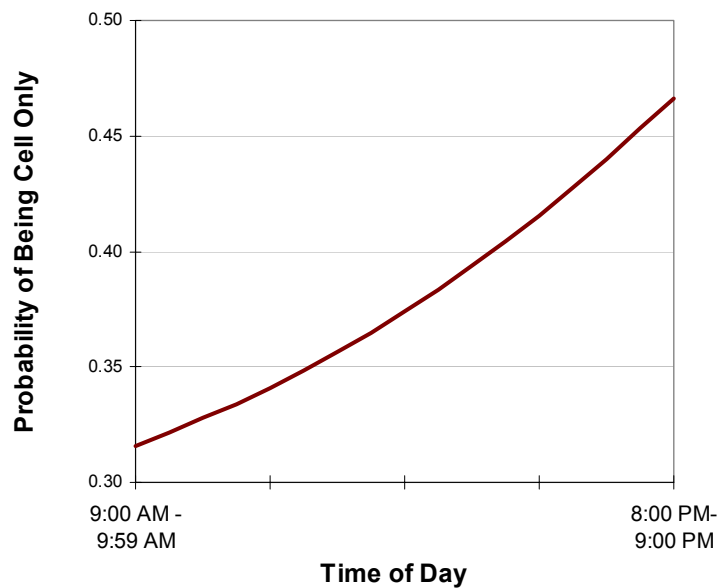


Note: $N=168,895$. Based on binary logistic regression model controlling for market, season, day of the week and year. Time of day, calculated by hours: $B=.022$; $SE=.101$; $p<.001$.

In view of this finding, we tested the proposition that the association is not only monotonous across day-parts, but also linear on an hour by hour basis. Therefore, if 9:00 AM was zero hour and 9 PM the 12th hour, time of day can be treated as a continuous

hour variable. In order to assess the association between time of day and the incidence of CPOs, the hour variable was included in a binary logistic regression model, controlling for extraneous factors such as DMA (14 dichotomous variables and one reference category), day of week (six dichotomous variables and Thursday as a reference category)⁶, season (fall as reference category) and year (2007 or 2008). Logistic regression finds that hour is positively associated with the likelihood of being CPO (B=.022; SE=.101; p<.001). The odds ratio (1.022) indicates that every hour after 9:00 AM increases the likelihood of CPO status by 2% (see Figure 2).

Figure 3: Quadratic Association between Time of Day and CPO Incidence:



Note: N=168,895. Based on binary logistic regression model controlling for market, season, day of the week, year and time of day (in hours). (Time of day)²: B=.002; SE=.001; p<.005.

What Figure 1 indicates visually is that at the tail-end of the day, the spike in CPO incidence becomes sharper. When looking at CPO percentages at each hour, this becomes more apparent: CPO percentage at 7:00 PM was 29.65%, while at the 9:00 PM slot this

⁶ There were some observed differences in CPO between days of the week, but those differences were overall small and this variance did not seem to have any systematic explanation.

spikes to 43.24% (Table 1). This should be interpreted with some caution in view of the relatively small number of respondents at 9:00 PM (n=222). In order to test this possibility of a non-linear association the logistic regression was performed again, this time including a quadratic, hour-squared, variable. Hour-squared was found positive and significant (B=.002; SE=.001; p<.005), while the linear hour variable was no longer statistically significant (B=-.036; SE=.020; p<.100). Figure 3 illustrates this association clearly as the curve representing the association, becomes steeper toward 9:00 PM.

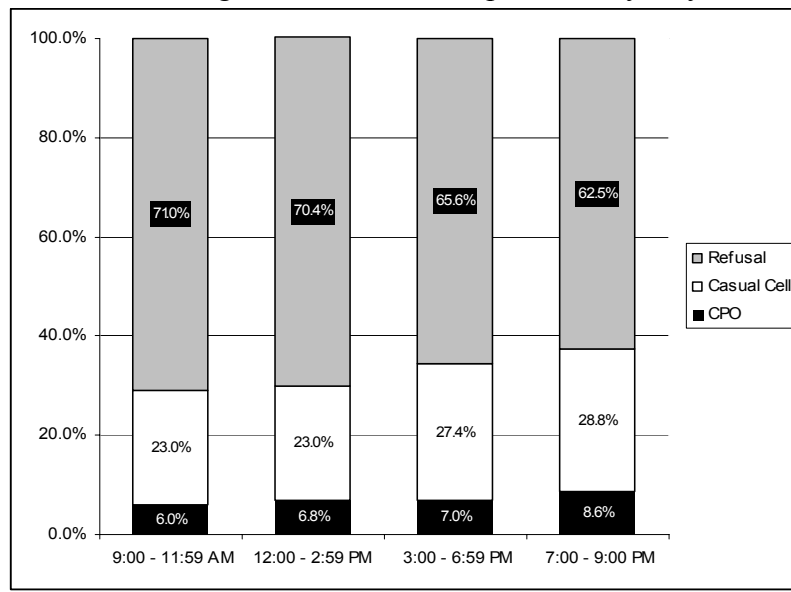
Table 1: CPO Percentage by Hour:

	<i>N</i>	<i>Percent CPO</i>
9.00	16157	24.9
10.00	27881	24.8
11.00	33008	24.3
12.00	22954	26.3
1:00	21327	26.5
2:00	9045	27.3
3:00	7977	26.5
4:00	3938	26.6
5:00	4609	27.1
6:00	11276	28.0
7:00	7554	29.7
8:00	3037	34.5
9:00	222	43.2
Total	168985	26.1

In sum, the quadratic function above indicates that researchers targeting cell phone only respondents would do best to allocate the bulk of their dialing hours around the latest possible time. This is not only to say that evening dialing yields more completes, which it obviously does, but also that within the evening hours, it is far easier to reach CPOs. By the same token, the time in which cell phones are dialed can also affect the estimate of CPOs in a market.

This finding should be qualified by the degree to which it varied from one market to the next. The monotonous change in CPO incidence was significant in all but two of the markets. This has to do, more likely, with the very small number of late completes in these markets (on the west coast), than some systematic departure from the overall trend. There were several markets in which we observed the straight linear association, but the quadratic relationship did not materialize. With this in mind, the findings should be interpreted as indicative of a general population trend, rather than one that applies similarly in all markets.

Figure 4: Resolved Dispositions by Day-Part:



Note: N=624,853.

Beyond the higher incidence, the later time slots also seemed to correspond with a smaller proportion of refusals. As figure 4 indicates the relative increase in CPO incidence after 7:00 PM is coupled with a decline in refusals, since casual cell phone usage is also higher at this point in time. During the morning hours, refusals accounted for 71.0% of the resolved cases, while CPOs were only 6.0%, in the latest time slot, following the increase in casual cells that begins in the afternoon and the late evening

spike in CPOs (up to 8.6% of resolved cases), the share of refusals goes down to 62.5%.

In other words, the later time slots increase the overall likelihood of resolving phone calls as either completes or ineligible, as far as being CPO.

Where

The findings indicate that in targeting cell phone only respondents, researchers need to consider the degree to which respondents reside outside their designated market areas. 16.0% of the 37,752 CPOs contacted for this study lived in zipcodes that fell outside their assumed markets. This means that for studies seeking respondents from particular areas, relying on the cell phone exchange may still lead to a sizeable amount of ineligible respondents on account of living outside the intended area of the study.

Between-market variation was, again, notably high – with the percentage of out of market CPOs, ranging from 8.9% to 22.1%.

This finding is a likely product of the manner in which cell phone numbers are acquired and the mobility of CPOs. If, for example, a person purchases the cell phone somewhere near her workplace rather than her residence, her number will be associated with the workplace location. To the extent that the workplace is in a different DMA than the residence, the phone number cannot account for the person's residential address. Furthermore, as previous studies have found, CPOs are less likely to be homeowners and are likely to be younger. Accordingly, CPOs would be likely to switch addresses and move to a different part of the country altogether (consider, for example college students). Since cell phone numbers are portable, a change of residence does not mean a change in cell phone number. When a cell phone user moves out of their DMA, it is likely that their number moves along with them.

A further indication of the portability issue can be assessed through the percentage of CPOs, who not only reside outside the DMA associated with their zip code, but also outside any of the adjacent DMAs. Markets were considered adjacent if they shared geographical borders. So, for example the New York market was considered adjacent to the Binghamton, Philadelphia, Albany/Schenectady, Hartford/New Haven, Wilkes-Barre/Scranton markets. In other words, this operationalization of adjacent markets creates large geographical regions. 10.6% of CPOs had zip codes outside these large adjacent-market regions, meaning they lived nowhere near the market area associated with their cell phone number. The market-by-market variance for living in non-adjacent DMAs varied from a low of 7.4% to 15.1%.

Discussion:

Cell phone only pose a challenge to survey researchers. They are a necessary component for representative sampling frames, but a hard, and expensive, target population. The underlying social causes that lead a person to shun traditional landline service, correspond with factors known to be less likely to participate in surveys: being young, single, low income and renting a home – are attributes of CPOs and of low response populations. Thus, the need to reach CPOs is intertwined with the difficulty of reaching them. In view of this concern, this paper set out to provide some insight into the temporal and geographical properties of cell phone-only incidence. The findings can be instructive for designing CPO data collection efforts.

Perhaps the most practical bit of information stemming from this study is to dial cell phone samples as late as legally possible when targeting CPOs. While the likelihood of completing interviews with casual cell phone users increased in the early evening

hours, the percentage of CPO interviews spiked (in relative terms) only after 7:00 PM. The jump in percentage of CPOs among the cell phone interviews grew by the sharpest measure between 8:00 and 9:00 PM. This suggests, for example, that when planning to reach CPOs, the greatest number of interviewers should be allocated for the latest time slots. At the same time, trying to reach CPOs during the day is highly inefficient, as their percentage is lowest within the cell phone completes, which are low in the daytime to begin with.

A second implication of this finding has to do with the way in which CPO estimates are calculated. Data collected early in the day are bound to yield lower estimates of the proportion of cell phone only individuals or households than similar estimates produced from calling during the latest time slots. In other words, this type of data collection needs to be wary of this of possible day-part bias in estimating CPO incidence.

The findings on the geographic attributes of CPOs confirm what previous research has found. The cell phone number cannot always serve as an indicator of its owner's geographic location. This is true not only at the relatively small county level, but also in the context of the large metropolitan areas represents by DMAs, or by entire clusters of adjacent DMAs. About 10% of this sample resides in areas outside these clusters. From an operational standpoint, this suggests that, on average, a tenth of a market is not covered in regional sampling frames determined by the telephone exchange, while a tenth of the numbers dialed would be ineligible since they reside outside the targeted area.

The findings concerning residence of CPOs cannot be compared to casual cell phone users since calls with casual users were terminated before the zip code question was asked. Nevertheless, from what we know about CPOs' higher likelihood of renting homes and lower likelihood of being married, it seems probable that they are the most likely to change their residence across regions.

Put together, the finding of this research indicate that the differences between CPOs and casual cell phone users are evident in their patterns of availability for survey research. These differences can translate into possible coverage bias, exceeding costs or inaccurate estimates of the prevalence of CPOs. Survey researchers, therefore, need to take into account the uniqueness of CPOs when deciding on when and where to dial cell phone samples with the intent of interviewing cell phone only users. Future replications of this study can provide further insight into the association between temporal and geographical parameters and the demographic or cultural underpinnings of CPO status. This could be realized if the cell phone status information is collected along with a handful of questions such as age, marital status and home ownership or even behavioral and attitudinal questions.

REFERENCES

Blumberg, S. J., & Luke, J. V. (2007). Coverage bias in traditional telephone surveys of low-income and young adults. *Public Opinion Quarterly*, *71*, 734-749.

Blumberg, S. J., & Luke, J. V. (2009a). Wireless substitution: State-level estimates from the National Health Interview Survey, January-December 2007. Retrieved April 23, 2009 from: <http://www.cdc.gov/nchs/data/nhsr/nhsr014.htm>.

Blumberg, S. J., & Luke, J. V. (2009b). Wireless substitution: Early release of estimates from the national health interview survey, July-December 2008. Retrieved May 6, 2009 from: <http://www.cdc.gov/nchs/data/nhis/earlyrelease/wireless200905.htm#Status>.

Fleeman, A.. (2006, May). Do you hear what they hear? Radio Listening differences between cell-only respondents and those reached on landlines. Presented at the annual conference of the American Association for Public Opinion Research, May 20, Montreal, Canada.

Fleeman, A., & Estersohn, D. (2006, May). geographic controls in a cell phone sample. Presented at the annual conference of the American Association for Public Opinion Research, Montreal, Canada.

Jay, E. D., & DiCamillo, M. (2006, May). Identifying recent cell phone-only households. Presented at the annual conference of the American Association for Public Opinion Research, Montreal, Canada.

Keeter, S. (2007). How serious is polling's cell-only problem? Retrieved April 27, 2009 from: <http://pewresearch.org/pubs/515/polling-cell-only-problem>.

Keeter, S., Kennedy, C., Clark, A., Tompson, T., & Mokrzycki, M. (2007, May). What's missing from national RDD surveys? Paper presented at the annual conference of the American Association for Public Opinion Research. Anaheim, CA. Retrieved April 7, 2009 from: <http://pewresearch.org/assets/pdf/514.pdf>.

Pew Research Center for People and the Press (2006). The Cell phone challenge to survey research: National polls not undermined by growing cell-only population. Retrieved April 23, 2009 from: <http://people-press.org/report/276/>.

Tuckel, P. S., & O'Neil, H. (2005, May). Ownership and usage patterns of cell phones: 2000-2005. Paper presented at the annual meeting of the American Association For Public Opinion Association, Miami Beach, FL.