Home Is Where the Cooperation Is: The Association between Interview Location and Cooperation among Cell-Phone Users

Christopher Ward[1], Becky Reimer[1], Meena Khare[2], Carla Black[3]
[1]NORC at the University of Chicago
[2]National Center for Health Statistics, CDC
[3]National Center for Immunization and Respiratory Diseases, CDC

Abstract

Interviewing respondents on cell-phones poses challenges to survey researchers. While it is increasingly important to include cell-phone samples in telephone surveys as the proportion of cell-only and cell-mainly households continues to rise in the United States, cell-phone samples often have lower response rates than landline samples. Consequently, researchers who wish to maintain high response rates are often forced to sacrifice cost, timeliness, or both. Using data from the National Immunization Survey, a national, dual-frame random-digit dial survey sponsored by the Centers for Disease Control and Prevention, we examined whether respondents' level of cooperation varies by their telephone status and location at the time of the interview. Specifically, we used regression models to compare the cooperation rates for respondents who are contacted on landlines while at home, those who are contacted on cell-phones while at home ("cell-at-home"), and those who are contacted on cell-phones while away from home ("cell-away"). Our models included a number of respondent characteristics that may be related to the likelihood of cooperation versus breakoff during the survey. Results indicated that observed differences in cooperation between landline and cell-phone-while-away respondents are primarily due to cell-away respondents being less likely to respond. Our results also suggest that time of interview is a significant predictor of likelihood to provide permission to access children's health care records. This research provides insight into the behavior of cell-phone respondents and the conditions under which they may be most likely to respond. Given the differences in cooperation among cell-at-home, cell-away, and landline respondents, we discuss implications for data quality and limitations of the analysis.

Keywords: response, cooperation, consent, cell-phone, landline, CATI, location, interview, data quality, regression

The findings and conclusions in this paper are those of the authors and do not necessarily represent the views of the National Center for Health Statistics, Centers for Disease Control and Prevention, or NORC at the University of Chicago.

Background

Random-digit dial (RDD), computer-assisted telephone interviewing (CATI) surveys have been integral to interviewer-assisted survey research for decades, providing a comparatively low-cost means of conducting large-scale studies across wide geographical regions. The rapid adoption of the cell-phone, however, has proven to be a challenge in designing CATI surveys, as interviewing respondents on cell-phones results in increased costs and lower response rates in comparison to landline-based surveys (Curtin, Presser, and Singer, 2005). Legal concerns regarding the auto-dialing of cell-phones dictate that cell samples be manually dialed by interviewers, which can render them costlier than landline samples. Compounding the challenges that cell-phones pose are other factors specific to landline telephones, such as increased concerns with privacy, increased frequency of telemarketing calls, higher prevalence of business and nonworking landline telephone numbers, and the decline of landline telephones in households, especially among the young and less affluent (Blumberg and Luke, 2012). Likewise, cell-phones are associated with response rates no greater than those in equivalent landline studies (Brick et al., 2006).

An important difference between landline telephone respondents and cell-phone respondents is that the latter group may be mobile. Whereas a landline interview must be conducted at a fixed place (e.g., in a residential, population-based study, the telephone interview is conducted in the respondent's home), a cell-phone respondent can participate in an interview at a place of his or her choice wherever there is a cell-phone signal. A growing body of research suggests that the circumstances of cell-phone interviews conducted away from home pose unique challenges to data collection in comparison to landline interviews or cell-phone interviews conducted at home (Link et al., 2007). In particular, interviewing a respondent who is away from home introduces increased cognitive burden and an increased risk of respondent breakoff, and can render the interview more difficult to control for the interviewer. To date, we are not aware of any study that has empirically examined whether the location of the cell-phone respondent at the time of the interview may affect his or her likelihood of response. Indeed, Link et al. (2009) called for extending research into the effect of burdens on respondents who are in an area of "high distraction" (e.g., away from home) that may threaten their "cognitive engagement" at the time of the interview.

To reduce the potential for noncoverage bias in estimates from landline RDD surveys, most population-based surveys are now using an address-based (to improve coverage of no-phone households) or a dual-frame sample design to include a sample of cell-phone numbers. In light of the rapid adoption of cell-phones and the concomitant challenges associated with conducting CATI surveys on cell-phone frames, we pose the following research question: Does cooperation vary by the respondent's location? A key corollary of the question arises: is the behavior of cell-at-home respondents any different from that of landline respondents? We used data from the National Immunization Survey (NIS; http://www.cdc.gov/nchs/nis.htm) to research these two questions.

Research Data and Methods

Analyses were performed on data from the 2012 NIS, a large, national- and state-level, dual-frame RDD telephone surveillance survey sponsored by the Centers for Disease Control and Prevention. To collect data about childhood vaccinations, the NIS screens for households with at least one child between 19 and 35 months of age and uses a take-all

household approach (i.e., the study does not screen to determine the extent to which a respondent owned or used one or more cell-phones or landline telephones). During the fourth quarter of 2011 data collection, to identify the location of the respondent at the time of the interview, the NIS added an additional question that is key to our study: "Would you mind telling me if I reached you today away from home or at home?" The structure of the survey is outlined in Table 1.

There are two key dependent variables of cooperation in the study. The first dependent variable was whether the respondent *granted consent* to make his or her child's vaccination records available to researchers. Granting consent is a key measure of cooperation, allowing NIS research staff to collect valuable vaccination histories from the child's health care providers. The second dependent variable was the *number of vaccination providers* nominated by the respondent. The number of providers is a key proxy of data quality. As respondents nominate more vaccination providers, it is more likely that NIS researchers can obtain the child's complete vaccination history. It is impossible to know the true number of vaccination providers a respondent's child may have, so the number of nominated providers was merely an estimate of data completeness (see Table 2 for the distribution of responses).

The location of cell-phone respondents (whether at home—"cell-home"—or away from home—"cell-away") was collected in the demographics section of the survey (Section C), whereas landline respondents (including both users of traditional landlines as well as related telephone types, such as Internet telephones) were presumed to be at home at the time of interview. Several known correlates of survey response were also collected in this section, including whether the respondent is the child's mother, the mother's race and ethnicity, total household income, the mother's level of education, and whether the mother lived in the same place as at the time of the child's birth. For cell-phone respondents, the demographics section also included information about whether they use cell-phones exclusively or as their main type of phone communication. The time of day, another correlate of cooperation, was also collected.

Analytic Subsample

Given the position of the respondent location question deep within the instrument in the demographics section, the analytic subsample includes only respondents who screened and completed the interview on one call. This criterion also ensured that respondent behavior during the interview (that is, from screening to completion) could be linked with his or her location. To ensure comparability across households, the subsample is limited to the first child named in multiple-child households. Interviews conducted in the U.S. Virgin Islands were excluded because these households tend to exhibit significantly different response patterns. Twenty-six interviews where cell-phone respondents reported "don't know" or "refused" to the location question at the time of interview were also dropped from analysis. From these criteria, two distinct subsamples were established. The first analytic subsample included the 15,067 cases (approximately 59 percent of the total 2012 sample of 25,334) that met the inclusion criteria. A second subsample (n=10,946), used to estimate the second model, included only respondents who nominated at least one vaccination provider and who granted consent to contact providers.

Analysis

To establish the first model of cooperation, a logistic regression model was estimated to examine the relationship between respondent location and the probability of granting consent to contact children's health care providers. The logistic regression is expressed as follows:

$$ln\ \frac{p}{1-p} = \beta_0 + \beta_1 x_1 + \cdots + \beta_n x_n$$

Where p is the probability of the outcome variable, $x_1 \ldots x_n$ are the independent variables, and $\beta_0 \ldots \beta_n$ are the model coefficients. The model incorporated two groups of independent variables. The first group included variables that are ordinarily controllable through survey design features such as screening, sampling, or other mechanisms: the respondent's location, the time of interview, whether the respondent is the child's mother, and whether the respondent is cell-only/-mainly (that is, cell-only users and dual users who report using a cell-phone more extensively than a landline telephone). The second group included socio-demographic and other related covariates commonly associated with survey response, including the mother's education, having the child's shot card, housing tenure, having multiple eligible children in the household, household income, race, ethnicity, and age. The dependent variable was whether the respondent granted consent for researchers to contact vaccination providers to obtain records.

The Poisson regression was chosen because the number of nominated providers is a count variable with an approximate Poisson distribution (see Table 2). The nonlinear relationship between variables in Model II and the outcome variable (number of providers) would cause a violation of the linearity assumption in linear regression; therefore, a zero-truncated Poisson regression was estimated for the second model to examine the relationship between respondent location and the number of nominated vaccination providers. The Poisson regression is expressed as follows:

$$log\ E(y|x) = \beta_0 + \beta_1 x_1 + \cdots + \beta_n x_n$$

Where $log(E\ y\ x\ )$ expresses the log count of the expected value of y given x, $x_1 \ldots x_n$ are the independent variables, and $\beta_0 \ldots \beta_n$ are the model coefficients. The model included the same independent variables as the logistic regression model, as well as an additional variable: whether the child's mother currently lives at the same location as she did at the time of the child's birth. The model included this variable to account for household geographic mobility, which is highly correlated with the number of the child's nominated vaccination providers.

Both models incorporated weight, stratum, and cluster variables to account for the complex sample design of the NIS (Long and Freese, 2006). Models incorporated imputed versions of variables on the public-use file when available. Backward- and forward-selection stepwise regressions were conducted on both models to confirm the appropriate specification of variables.

Results

Table 3 highlights the key performance indicators of data collection across all interviewed households across all four quarters of 2012 and contrasts statistics between landline and cell-phone respondents. In 2012, the Council of American Survey Research Organizations (CASRO) rate for landline respondents was 64.54 percent; for cell-phone respondents, it was 30.64 percent. The overall rate of consent to contact providers was 74.67 percent for landline respondents, but the rate for cell-phone respondents was lower at 71.30 percent. Table 4 further compares the rates of consent to contact providers across all three location types among households in the analytic subsample. Note that due to the restricted nature of the analytic subsample, these rates are not comparable to the NIS provider consent rates for the overall sample.

Model I for Consent Rate

Table 5 presents the results of the Model I logistic regression. Controlling for other variables, there is not a statistically significant difference in the likelihood of granting consent between cell-home and landline respondents. However, cell-away respondents are significantly less likely to grant consent than landline respondents (OR = 0.730).

Several characteristics of the interview and of the respondent are also associated with a greater likelihood of granting consent. Controlling for other variables in the model, respondents who are contacted before 5 p.m. have greater odds of granting consent (OR = 1.269) than those contacted from 5 p.m. to 7 p.m., but no significant difference between evening (5 p.m. to 7 p.m.) and nighttime (after 7 p.m.) calling was observed. Mothers and respondents in households under the poverty ratio were also more likely to grant consent than non-mother respondents, such as fathers and grandparents (OR = 1.591 and 1.397, respectively). Likewise, some characteristics were associated with a lower likelihood of response, such as having multiple NIS-eligible children (OR = 0.692) and refusing to report any household income data (OR = .472).

Model II for Number of Nominated Providers

Table 6 presents the results of the Model II Poisson regression. In parallel to the findings from Model I of household consent to contact vaccination provider(s), controlling for other variables, no significant difference was observed from Model II for the log count of vaccination providers reported when comparing landline and cell-home respondents (β = 0.058). In contrast to Model I, however, cell-away respondents did not report significantly fewer vaccination providers than their landline counterparts (β = -0.057).

Some variables were associated with reporting significantly more providers, including reporting having the child's shot card (β = 0.121), reporting the mother's age was 29 or younger (β = 0.181), and having multiple NIS-eligible children in the household (β = 0.195). Several of the variables in the model were associated with reporting fewer providers, including residing at the same dwelling since the child's birth (β = -0.473) and reporting the mother's race as black (β = -0.283).

Limitations

These analyses have some limitations. Since the question that ascertains a cell-phone respondent's location is asked late in the interview (in Section C), the analytic subsample

may be biased towards more cooperative respondents. The potential effect of this bias could be magnified in the first analysis because the sample was limited to respondents who completed the interview on one call.

Variations in cooperation rates observed between landline and cell-phone respondents based on location might be underestimated due to selection bias, given that we may observe only the most cooperative cell-away respondents. This would be possible to measure if location were obtained in the screener. However, the study was unable to measure whether this is true due to the position of the cell location question late in the interview.

Another limitation is the means by which we are measuring data quality in Model II. On the one hand, the model attempts to assess completeness of data by identifying the relationship between regressor variables and the number of nominated providers. On the other hand, the number of providers nominated by a respondent may be spuriously related to a number of socio-demographic, geographic, and other related factors. For example, stepwise regression revealed that the inclusion of Census region in Model II did significantly improve model fit (although not in Model I), but the variable was excluded due to concerns that Census region was spuriously related to the likelihood of having multiple providers rather than associated with the *completeness* of the respondent's enumeration. Accounting for a broad range of variables attempts to control for spuriousness, but it is ultimately difficult to determine whether a respondent is offering incomplete data or whether his or her child merely has few providers while specifying a parsimonious model.

Conclusions and Further Research

In the context of two definitions of cooperation—offering consent to contact vaccination providers and enumerating those providers—this study found minimal difference in the first definition of cooperation between landline and cell-at-home respondents after controlling for other variables found in previous research to be associated with response. Being away from home during the interview is a powerfully negative predictor of granting consent to contact providers. This finding is in contrast to the findings of the second model, wherein cell respondents away from home reported no fewer providers than their cell-home and landline counterparts, controlling for a host of other variables.

The behavior of cell-away respondents appears to account for much of the overall differences between landline and cell-phone respondents in the first model. Although not tested directly in this study, previous research suggests that the extra burden, distractions, and privacy concerns faced by cell-away respondents was likely to account for these observed differences in behavior (Link et al., 2007). The study's findings are consistent with previous research: cell respondents who are away from home at the time of interview appear to be less likely to respond than are respondents—whether on landline or cell telephones—who are at home.

The same issues found to be at play in previous research may help explain the contrasting findings between the two models in this study. It is possible that these concerns are subject to situational variation. Those who complete the interview while in particularly busy or public situations may be especially distracted or concerned about privacy, leading them to decline consent at a higher rate than other respondents. The cell-away respondents who do grant consent and provide contact information for their children's

vaccination providers could be those who are in calmer settings during the interview. If so, it would be congruent with our findings that the amount of provider information they provide does not substantially differ from that provided by landline or cell-home respondents.

These findings are congruent with nascent research on the behavior of cell-phone respondents who are away from home at the time of the interview. These burdens have implications for CATI survey operations, including the development of rules for scheduling calls, methods of screening respondents, means of averting refusal or breakoff, and methods of selecting a respondent in the household. To improve cooperation, survey interviewers could increase calling attempts during more amenable times, screen for cell-phone respondents who are at home, use the CATI instrument to alert interviewers when respondents are away from home to avert breakoff at key points of the interview, or screen for respondents who are most knowledgeable about the survey topic. However, many of these options could impose additional respondent burden or introduce greater costs to survey design.

Our preliminary findings suggest that modifying these features to minimize the potentially deleterious effects of interviewing cell-phone respondents while they are away from home may improve respondent cooperation. The challenges of interviewing cell-phone respondents increase as the proportion of cell-only and cell-mainly households grows, thus magnifying the effect of cell respondents who are away from home at the time of interview. Future research should examine the efficacy, effects, and efficiency of methods to mitigate the effect of additional burden introduced by interviewing cell-phone respondents who are away from home.

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Appendix

Table 1: Structure of the National Immunization Survey, 2012

Section Title	Topic
Section S	Screener
Section B	Child(ren)'s Vaccination History
Section C*	Demographic and Socioeconomic Information This section includes the question about whether cell respondent is at or away from home at the time of interview.
Section D	Contact Information for Vaccination Providers This section includes the question asking the respondent to grant consent for NIS researchers to contact the child's health care provider(s) to obtain vaccination records.
HIM	Health Insurance Module

*A completed Section C defines a completed interview.

Table 2: Model II: Number of Providers Nominated for First-Mentioned Child in Households Granting Consent (2012 NIS)

Number of Nominated Providers	1	2	3	4	5	6	7
Number of Households	7,849	2,558	474	55	8	1	1

Table 3: Key Data Collection Statistics (2012 NIS)

Telephone Type	CASRO Response Rate	Age-Eligible Children with Completed Household Interviews	Number of Completed Interviews with Consent	Rate of Consent to Contact Provider(s)
Landline	64.54%	12,325	9,203	74.67%
Cell-phone	30.64%	13,009	9,276	71.30%

Table 4: Provider Consent Rates by Respondent Location (2012 NIS)

Phone Type	Sample Size	Consent Rate
Cell-away	2,050	67.1%
Cell-home	5,308	72.9%
Landline	7,709	74.9%
Overall	15,067	73.1%

Table 5: Model I: Logistic Regression Model of Rate of Respondent Consent to Contact Vaccination Providers (2012 NIS)

Parameter	Odds Ratio	Coefficient
Intercept	2.696***	0.992***
Cell-home	0.987	-0.013
Cell-away	0.730**	-0.315**
Reference: Landline		
Daytime (before 5 p.m.)	1.269**	0.238**
Nighttime (after 7 p.m.)	1.125	-0.117
Reference: Evening (5 p.m.–7 p.m.)		
Whether mother has college degree	0.923	-0.080
Whether R is mother	1.591***	0.464***
Whether cell-only/-mainly	0.935	-0.067
Whether R owns dwelling	1.032	0.031
Whether R has shot card for child	1.107	0.102
Number of NIS-eligible children in household	0.692***	-0.368***
Mother's race/ethnicity: Hispanic	0.951	0.050
Mother's race/ethnicity: non-Hispanic black only	0.914	-0.129
Mother's race/ethnicity: other	1.049	0.048
Reference: Mother's race/ethnicity: non-Hispanic white only		
Poverty status: above, > $75,000	0.957	-0.044
Poverty status: below	1.397**	0.335**
Poverty status: unknown	.472***	-0.750***
Reference: Poverty status: above, < $75,000		
Mother's age ≤ 29	0.950	-0.051

* = $p < .05$; ** = $p < .01$; *** = $p < .001$

Table 6: Model II: Zero-Truncated Poisson Regression of Number of Respondent-Nominated Vaccination Providers (2012 NIS)

Parameter	Coefficient
Intercept	-0.602***
Cell-home	0.058
Cell-away	-0.057
Reference: Landline	
Daytime (before 5 p.m.)	-0.025
Nighttime (after 7 p.m.)	-0.074
Reference: Evening (5 p.m.–7 p.m.)	
Whether mother has college degree	0.014
Whether R is mother	0.117
Whether cell-only/-mainly	0.004
Whether R owns dwelling	-0.072
Whether R/mother lived in same place since child's birth	-0.473***
Whether R has shot card for child	0.121*
Number of NIS-eligible children in household	0.195*
Mother's race/ethnicity: Hispanic	-0.013
Mother's race/ethnicity: non-Hispanic black only	-0.283**
Mother's race/ethnicity: other	-0.084
Reference: Mother's race/ethnicity: non-Hispanic white only	
Poverty status: above, > $75,000	-0.034
Poverty status: below	-0.109
Poverty status: unknown	-0.023
Reference: Poverty status: above, < $75,000	
Mother's age ≤ 29	0.181**

* = $p < .05$; ** = $p < .01$; *** = $p < .001$