Residential Mobility, Family Structure and the Cell-Only Population

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Abstract

The cell phone only (CPO) population has grown rapidly over the past several years, causing concern for researchers who rely mostly on random digit dialing (RDD) of landlines to conduct their research. While early research on CPOs has focused largely on age differences, CPOs may differ from those with landlines in many other ways even after controlling for age. In this paper, we use the Cooperative Congressional Election Study--an internet survey based on matched random sampling--and the American National Election Study--an in-person survey based on stratified residential sampling--to examine the potential effects of the cell-only population for survey research. These surveys are ideal for studying the causes and consequences of cell-only lifestyles for survey research because they reach cell-only and landline respondents through a single sampling frame. We reach two main conclusions: (1) CPO households are not simply a function of age, but of other factors as well, especially residential mobility and family structure and (2) there are notable differentials in vote preferences and turnout between CPOs and others, but these differences can largely be accounted for by controlling for mobility and family structure.

Introduction

The rise of cell-phone only households (CPOs) presents a new challenge for telephone surveys. It is difficult to reach CPOs through random digit dialing (Lavrakas et al. 2007). This may bias political and social surveys conducted over the phone, because relevant demographics, most notably age, correlate with both CPO-status and political or social behavior (Keeter 2006, Keeter, Dimmock and Christian 2008; Blumberg 2009). One strategy to correct for such biases is to control for or weighting by demographics that predict CPOs. The first studies to attempt this focus primarily on age. For example, Keeter (2006) found that adjusting for age removed the effects of CPOs on predictions of voting preferences in the 2004 election. Unfortunately, that adjustment now appears inadequate, as Keeter, Dimmock and Christian (2008) found in their analysis of the 2008 election.

We argue that one's willingness to rely exclusively on cell-phones reflects not only age, but also residential mobility and indicators of family structure. First, the act of moving provides an opportunity for individuals to shed their landlines, and cell numbers are more portable than landlines. Second, CPO status also correlates with social structure and community ties. Individuals who are married and have children are more connected to people and institutions in their neighborhood and thus may feel a need to have multiple phone lines, including a traditional landline. Drawing on multiple surveys we show that younger people who have moved in the last year, are single and have no children are highly likely to be CPOs. Those in families who have lived at their address for at least 3 years and have school-aged children are highly likely to have cell and landline phone connections. Such factors are also correlated with turnout and vote preference. Adding mobility and family structure to standard logit models predicting turnout and vote preference, people from CPO households become much less distinctive in vote choice and are not statistically different from other households in turnout.

One practical implication of this analysis is that mobility and family structure ought to become part of the standard demographic controls in data analyses or factored into the weights of RDD phone surveys.[1] The results also carry an ominous message for RDD phone surveys. Over the long-run social mobility and generational replacement are pushing out traditional landlines.

Data and Methods

This paper analyzes the 2006 and 2008 Cooperative Congressional Election Study (CCES) and the 2008 American National Election Study (ANES). The CCES surveys each contain large samples (36,500 in 2006 and 32,800 in 2008), which facilitate the examination of a relatively small segment of the population, namely CPOs. These surveys were conducted through the Internet, making it possible to reach those who lack landline phone service through the same sampling frame as others in the sample (those with only a landline and those with both cell phone and landline service). Both CCES surveys were conducted by YouGov/Polimetrix using a matched random sample design. A subset of respondents recruited for online surveys were selected by matching them on a set of demographic characteristics to a randomly selected set of individuals from the population of American adults. Propensity score weights for the samples were developed so as to ensure that the sample represents the demographic characteristics of the adult population as reflected in the 2004 and 2008 Current Population Survey. Additional information about the sampling methodology and the total survey error for vote and other objective indicators is presented in the guides to each of the surveys, posted at http://web.mit.edu/polisci/portl/cces/index.html. The CCES asked respondents what phone service they had - landline only, cell phone only, both, or no phone service.[2]

The 2008 ANES uses an entirely different sampling and interview methodology. The ANES draws a stratified national random sample of households in the United States and performs in-person interviews. Like the CCES, the ANES is able to reach both landline and CPO respondents through a

single sampling frame.[3] The residential sampling and interview strategy utilized by the ANES has

the advantage of reaching even those respondents who may not have computer access or who would

be unwilling to participate in online surveys. This extremely costly approach, however, affords for

far fewer respondents, and thus much less statistical power than the CCES.

The National Health Interview Survey (NHIS) provides a benchmark for the estimate of the

CPO population (Blumber and Luke 2009) and a validity check on the CCES and NES.[4] Table 1

presents estimates and 95% confidence intervals of the CPO population for each of the surveys.

[TABLE 1 ABOUT HERE]

All three surveys produce relatively close estimates of the CPO population in 2008. The

percentage of American adults in CPO households is estimated to be 18.4% by the NHIS, 20.0% in

the CCES, and 22.3% in the ANES. The confidence intervals for the CCES estimate overlaps with

those from both the NHIS and ANES estimates, while the intervals for the ANES and NHIS do not.

The CCES estimates a somewhat lower percentage of the population in landline only households

and correspondingly higher percentage in households with both services. Although these

differences are statistically significant, they are substantively modest (6 percentage points).[5]

Who Is "Cell Phone Only"?

Much of the research on the characteristics of CPOs focuses on age. The importance of

mobility and family structure become abundantly clear upon estimating a logit model that predicts

CPO households as a function of mobility, marital status, school aged children, and other factors.

Residential mobility was measured using the CPS version of this question which allows the

following categories: Less Than 1 Month, 1-6 Months, 7-11 Months, 1-2 Years, 3-4 Years, 5 or

More Years. The data analysis includes dummy variables for each of the first 5 categories; "5 or More Years" is the reference category. We include 1-0 indicators for Gender (female), Married, Single, Kids under 18, Own home, Rent home, Northeast, Midwest, South, White, Black, and Hispanic. Age is a continuous measure with a mean between 45 and 48 in each of the three studies. Income takes on 14 categories, with a median category of 8 ($50,000-59,999) in the 2008 CCES. Education is an ordinal variable, which takes a value of 1 if the respondent did not complete high school up to 6 for someone who has done post-graduate work. Appendix 1 presents descriptive statistics.

[TABLE 2 ABOUT HERE]

The CCES and ANES point to two very important predictors of cell-phone use: age and mobility. Americans in their 30s are twice as likely as those in their 50s to be cell-only, even after holding constant the other variables in the model. Residential mobility is equally important. Controlling for other variables (including age), an individual who reported moving during the previous six months month was more than three-times as likely to be without a landline as one who had been living at the same residence for over five years. Someone who had moved within the last two years was more than twice as likely to be cell-only compared to an individual who had not moved within the previous five years.

Additionally, renting, region, marital status, and children under 18 predict cell-phone only status. In the 2008 CCES, renters are 7 percentage points more likely to be CPO households, and those with kids under 18 are less likely to be cell-only by 4 percentage points. Those living in the Northeast U.S. are about 4 percentage points less likely to be CPO (this effect was even larger in the ANES model). Married people are less likely than singles to be cell-only by 2 points and less likely

than divorced, separated, and those in domestic partnerships by 5 points. All of these factors are indicators of family structure.

Education, income, gender and race show modest effects. Many of the coefficients for these variables fail to achieve statistical significance in the ANES, owing perhaps to the smaller sample size. The large sample size of the CCES provides sharper estimates, but none of these factors proved strong predictors of CPO-status.

CPO Status and Vote Choice

CPO status poses a potential threat to the validity of phone polls to the extent that CPO use predicts behavior of interest. In this section, we show that CPO status has just such an independent effect on presidential vote choice.

For the ANES and CCES, we estimate two models, one that includes standard demographic and partisan controls along with the indicator of CPO status and a second that adds the variables capturing residential mobility and family structure. If the size of the coefficient for CPO status declines once these additional measures are added to the model, then this is an indication that accounting for mobility and family structure may help to reduce the bias arising from CPOs. In each model, the dependent variable equals 1 if the respondent voted for Obama and 0 if he/she cast a vote for McCain. The demographic indicators are the same as in Table 2. Party identification consists of indicators for those who identify themselves as either a Democrat or as a Republican; independents and other party are the omitted category.[6]

Table 3 displays the estimated coefficients and demonstrates that the inclusion of mobility and family structure reduces the effect of CPOs on vote choice. The control variables in the models have coefficients in the expected direction. The key comparison in the table is the coefficient on CPO in models 1 and 2 for each survey. In the first model (without mobility and family structure)

the effect of CPO is substantively large. The estimates imply that CPOs express higher preferences for Obama by about 9 percentage points in the CCES and 5 percentage points in the ANES. The two models show similar differences between CPOs and other households, even though the large standard error in the ANES does not allow us to claim statistical significance in that model. In both analyses including controls for mobility and family structure reduced the coefficient on CPO by 30 to 40 percent. The difference between the CPO coefficients was statistically significant for the CCES data ($F = 24.98$, $p<.01$), but not for the ANES ($F = .23$, $p = .63$).[7] This reduction in the effect of the CPO coefficient appeared to largely be caused by family structure variables such as marital status and children, which had a significant effect on vote preferences. The residential mobility measures did not exert significant effects vote choice.

[TABLE 3 ABOUT HERE]

CPO Status and Turnout

Turnout raises two distinct concerns. First, voter turnout is a subject of study in and of itself -- who votes?   Second, it is an important component in designing political surveys, as surveyors want to screen correctly for "likely voters." The results from Table 2 suggest that the failure to represent CPOs in a sample will create substantial biases for either of these purposes. CPOs tend to be younger and more mobile, and these are two of the strongest predictors of voting (Wolfinger and Rosenstone 1980; Squire, Wolfinger, and Glass 1987; Highton 2000).

The ANES and CCES reveal substantial differences in reported vote between CPO and other households. In the 2008 CCES post-election study, 72.7% of landline respondents said that they had voted in the election while just 62.8% of CPOs reported voting (the difference was significant at $p<.01$). In the 2008 ANES data; 80.1% of landline respondents reported voting while just 67.4% of

CPOs reported doing so (p<.01). It is worth noting that the reported turnout in the ANES is considerably higher than in the CCES.

The key question here is whether the CPO difference remains after controlling for mobility and family structure, as well as age.   Reported turnout rates are susceptible to social desirability bias, with many respondents claiming to have voted when they actually did not do so (Neuman 1986; Silver et al. 1986; Ansolabehere and Hersh 2008). Of particular concern, age is correlated with overreporting the vote, making the reported turnout less than ideal for testing the actual effect of CPOs on turnout. Fortunately, the 2006 CCES provides a better indicator of turnout, as that study included vote validation data for respondents in 26 states and the District of Columbia (see Ansolabehere and Hersh 2008 for more information on the validation study).[8] Analysis of 2006 CCES Validated Vote allows us to test whether CPOs differ from other households once mobility is added to other demographic predictors of turnout.

Table 4 parallels the approach in Table 3. For each pair of models we estimate the effect of CPOs holding constant age, income, education, female, black, Hispanic, white, region, and party identification. The second model in each pair adds indicators of mobility and family structure. We perform this analysis for the set of all respondents, and then for the subset of people who indicated in the pre-election survey that they were likely to vote.[9]

[TABLE 4 ABOUT HERE]

CPOs are less likely to vote than those with landlines.   Holding the other variables in the model at their means, CPOs were about 8 or 9 percentage points less likely to vote than those with landlines. The effect is the same in the entire sample and in the subsample of likely voters.[10] After including controls for residential mobility and family structure, the magnitude of the coefficients for

CPO status falls by 70% and is no longer significant in either model (the difference in coefficients is statistically significant for both pairs of models).[11] In contrast with the vote choice models, residential mobility emerges as one of the strongest predictors of turnout, and it captures much of the CPO effect.

Conclusion

Today, one in five households relies exclusively on cell phones for telecommunications. That fact has created coverage problems for phone surveys, and the demographics of this population -- younger, mobile, less socially connected-- may create biases in political surveys conducted by phone. Even as survey organizations are increasingly likely to dial cell phones, many still do not do so and a significant archive of survey data accumulated over the past several years is not properly weighted to account for these biases. Our analysis indicates that controlling for age, mobility and family structure (among other demographics) could help to account for some of the non-coverage bias from excluding CPOs. However, the utility of this approach goes only so far. Accounting for mobility and family structure only reduced the effect of CPO status in the vote choice model from the CCES, it did not eliminate the effect entirely.   And such statistical adjustments may be only a stop-gap.   The importance of age and mobility suggest that CPOs will continue to increase with time.

Appendix 1: Differences Between CPOs and Landline Respondents (CCES and ANES)

	2008 CCES			2008 ANES		
	Only Landline	CPO	Both	Only Landline	CPO	Both
All Respondents	9.3%	20.0%	69.9%	13.7%	22.3%	63.2%
Age						
Under 30	5.8%	39.6%	53.7%	4.0%	49.2%	46.4%
30 to 50	9.2%	20.1%	69.7%	9.4%	21.3%	68.0%
50 to 65	10.6%	9.8%	79.0%	13.9%	13.9%	71.1%
Over 65	13.4%	4.3%	81.7%	34.7%	4.1%	60.9%
Race						
White	9.8%	19.2%	70.3%	12.4%	20.9%	66.2%
Black	8.0%	19.1%	71.5%	19.6%	25.1%	53.7%
Hispanic	7.5%	25.9%	64.8%	16.0%	30.6%	51.4%
Other	7.7%	23.1%	67.7%	13.8%	23.6%	60.4%
Gender						
Male	8.3%	21.9%	68.9%	13.1%	23.4%	62.4%
Female	10.3%	18.2%	70.8%	14.2%	21.4%	63.8%
Education						
No HS	17.3%	19.2%	60.8%	28.3%	18.8%	50.0%
HS Grad	12.1%	16.9%	70.0%	16.4%	23.5%	59.2%
Some Coll.	6.9%	24.3%	68.2%	10.3%	27.3%	61.7%
2-Yr Coll.	5.9%	19.2%	74.5%	6.9%	23.4%	69.3%
4-Yr Coll.	4.7%	22.9%	72.1%	8.3%	21.3%	70.3%
Post-Grad	5.7%	15.4%	78.7%	11.3%	13.5%	75.2%
Home Ownership						
Own	8.0%	11.0%	80.6%	13.1%	12.5%	74.0%
Rent	12.3%	34.2%	51.9%	14.5%	42.3%	41.4%
Other	8.0%	27.8%	62.9%	21.8%	15.5%	62.7%
Length of Residence						
< 1 Month	9.2%	46.8%	39.2%	2.8%	61.1%	32.9%
1-6 Months	5.6%	50.7%	42.6.2%	8.8%	56.0%	34.0%
7-11 Months	7.6%	36.2%	54.1%	8.4%	46.0%	44.6%
1-2 Years	9.2%	31.3%	58.6%	8.5%	36.0%	53.6%
3-4 Years	9.2%	20.9%	69.5%	15.3%	22.7%	61.3%
5+ Years	10.2%	9.2%	80.0%	16.5%	9.2%	73.9%
Marital Status						
Married	7.8%	13.4%	78.2%	10.5%	15.7%	73.5%
Single	8.7%	33.7%	56.4%	9.8%	39.3%	49.5%
Other	14.0%	20.6%	64.3%	23.6%	18.6%	56.3%
Children Under 18						
Yes	8.2%	19.0%	72.0%	7.7%	21.3%	70.1%
No	9.8%	20.5%	68.9%	17.1%	22.9%	70.1%
Income						
<$25,000	20.1%	25.6%	51.6%	19.1%	23.6%	55.9%
$25,000 - $50,000	10.2%	22.4%	66.8%	9.6%	25.7%	64.3%
$50,000 - $100,000	5.1%	17.9%	76.7%	7.2%	15.8%	77.0%
$100,000>	2.0%	13.5%	84.4%	3.1%	13.1%	83.5%
Region						
Northeast	10.4%	16.3%	72.5%	17.1%	10.2%	72.2%
Midwest	10.4%	20.9%	68.3%	15.5%	22.2%	61.9%
South	8.5%	20.0%	70.4%	12.8%	23.1%	62.9%
West	8.6%	22.3%	68.4%	11.6%	29.0%	58.8%

Note: All figures calculated using sampling weights. Table excludes a small proportion of respondents who report having no phone service.

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Table 1: Comparing Telephone Status of Adults in Three Surveys

Survey	Landline Only	Cell Only	Both
2008 NHIS	15.1%	18.4%	63.7%
	(14.0%, 16.3%)	(17.1%, 19.8%)	(62.1%, 65.3%)
2008 CCES	9.3%	20.0%	69.9%
	(8.9%, 9.7%)	(19.4%, 20.6%)	(69.2%, 70.5%)
2008 ANES	13.7%	22.3%	63.2%
	(12.2%, 15.4%)	(20.3%, 24.5%)	(60.7%, 65.5%)

Note: All estimates produced with sampling weights applied. 95% confidence intervals in parentheses. Table excludes a small proportion of respondents who report having no phone service.

Table 2: Logit Models Predicting Cell-Only Status

Independent Variables	2006 CCES β	SE	2008 CCES β	SE	2008 ANES β	SE
Age (in years)	-.039	.003	-.045	.002	-.047	.007
In residence < 1 month	1.693	.221	1.496	.158	2.033	.412
In residence 1-6 months	1.462	.125	1.209	.073	1.551	.258
In residence 7-11 months	1.145	.160	.948	.090	1.363	.373
In residence 1-2 years	.877	.090	.749	.064	1.029	.209
In residence 3-4 years	.398	.110	.514	.065	.669	.233
Own Home	-.218	.166	.080	.092	.341	.622
Rent Home	.575	.160	.611	.087	.908	.611
Married	-.708	.099	-.461	.060	.002	.196
Single	-.033	.105	-.279	.073	-.185	.220
Kids Under 18	-.424	.093	-.405	.053	-.604	.174
Income	-.028	.011	-.031	.007	-.071	.026
Education	.059	.027	.080	.017	.057	.058
Female	-.305	.071	-.228	.045	-.109	.150
Black	-.570	.215	-.170	.115	.288	.401
Hispanic	-.082	.193	.226	.111	.715	.407
White	-.065	.160	.218	.094	.372	.380
Northeast	-.054	.112	-.415	.073	-1.035	.299
Midwest	.185	.100	-.004	.066	.162	.222
South	.153	.090	.044	.059	.073	.187
Intercept	-.257	.291	.163	.170	-.116	.856
Observations	13,319		30,309		2,138	
Log Likelihood	-3,460.418		-11,090.077		-944.807	
Pseudo R^2	.226		.175		.205	

Table 3: Logit Models Predicting Reported Vote for President (2008)

Independent Variables	CCES 1 β	CCES 1 SE	CCES 2 β	CCES 2 SE	ANES 1 β	ANES 1 SE	ANES 2 β	ANES 2 SE
Cell-Only	.364	.072	.228	.077	.188	.269	.135	.286
Age (in years)	-.016	.002	-.015	.002	-.018	.006	-.017	.008
Income	-.028	.008	.001	.009	-.049	.032	-.014	.036
Education	.166	.018	.153	.019	.013	.076	-.005	.078
Female	.174	.050	.191	.050	.193	.206	.248	.213
Black	2.603	.202	2.614	.200	3.165	.802	3.222	.829
Hispanic	.541	.148	.531	.147	-.362	.531	-.314	.534
White	.050	.101	.058	.102	-1.130	.491	-1.109	.484
Northeast	.038	.076	.047	.078	-.117	.352	-.100	.364
Midwest	-.067	.071	-.013	.072	-.303	.282	-.235	.298
South	-.579	.067	-.516	.068	-.976	.251	-.924	.255
Democrat	2.211	.058	2.176	.058	1.841	.246	1.923	.240
Republican	-2.700	.070	-2.696	.070	-2.701	.287	-2.748	.296
In residence < 1 month			.115	.268			-1.045	.780
In residence 1-6 months			-.065	.122			-.771	.445
In residence 7-11 months			-.141	.124			-.189	.600
In residence 1-2 years			.047	.084			-.147	.294
In residence 3-4 years			-.009	.072			.694	.361
Own Home			.146	.134			-.086	.794
Rent Home			.222	.137			.489	.800
Married			-.354	.066			-.162	.288
Single			-.075	.094			.159	.372
Kids Under 18			-.226	.064			-.227	.274
Intercept	.377	.177	.466	.232	2.742	.700	2.495	1.162
Observations	24,954		24,802		1,439		1,436	
Log Likelihood	-8,841.434		-8,704.221		-514.464		-502.400	
Pseudo R^2	.486		.491		.481		.492	

Table 4: Logit Models Predicting Whether Those Reporting Registration/Turnout Were Validated as Registered/Voting (2006 CCES)

	All Respondents				Respondents Intending to Vote			
	Model 1		Model 2		Model 1		Model 2	
Independent Variables	β	SE	β	SE	β	SE	β	SE
Cell-Only	-.371	.082	-.109	.089	-.326	.086	-.086	.092
Age (in years)	.021	.002	.013	.002	.017	.002	.010	.003
Income	.029	.008	-.006	.004	.020	.009	-.003	.010
Education	.064	.021	.082	.021	.033	.021	.052	.022
Female	.019	.052	.007	.053	.059	.054	.050	.055
Black	-.191	.151	-.152	.155	-.162	.155	-.131	.159
Hispanic	-.218	.146	-.213	.151	-.188	.150	-.196	.154
White	.219	.116	.196	.253	.230	.120	.365	.132
Northeast	.312	.083	.284	.085	.375	.086	.348	.088
Midwest	.538	.069	.460	.071	.567	.071	.492	.073
South	.093	.067	.037	.069	.120	.068	.074	.070
Democrat	.337	.063	.376	.065	.304	.065	.342	.067
Republican	.200	.062	.173	.064	.153	.063	.132	.065
In residence < 1 month			-1.518	.256			-1.468	.264
In residence 1-6 months			-1.023	.136			-.964	.141
In residence 7-11 months			-.795	.177			-.760	.182
In residence 1-2 years			-.432	.074			-.430	.076
In residence 3-4 years			-.043	.080			-.021	.083
Own Home			.217	.150			.121	.159
Rent Home			-.090	.151			-.175	.160
Married			.070	.071			.036	.073
Single			-.001	.098			.006	.102
Kids Under 18			.062	.065			.053	.066
Intercept	-1.531	.179	-1.031	.253	-1.096	.187	-.560	.265
Observations	8,849		8,685		8,475		8,325	
Log Likelihood	-5,742.174		-5,518.959		-5451.293		-5254.026	
Pseudo R^2	.037		.056		.030		.047	

Note: Analysis limited to 26 states (and the District of Columbia) where complete 2006 vote records were available. The first two models are limited only to respondents who said that they were registered to vote; the second pair of models include only respondents who said that they would vote (or had already voted early).

End Notes

[1] A completely different approach to this problem is to use dual mode samples, but such studies are considerably more complicated to analyze (Brick et al. 2009). The results in this paper are informative about biases in some of these modes.

[2] In 2006, this question was only asked of half of the sample (16,171 cases); in 2008, it was asked of all 32,800 respondents. Unfortunately, this question does not allow us to distinguish between those in the "both" category who use cell phones versus a landline phone for most of their calls.}

[3] The ANES measures phone status through a different battery of questions than the CCES. Respondents are first asked "How many telephone numbers are there in this household, including regular phone numbers, fax numbers, and cell phone numbers that are answered by anyone who lives here?" Follow up questions then determine how many of these phone lines were cell phones. When the number of cell lines was equal to the total number of phone lines, we coded that respondent as cell-only. Additional information about the ANES is available in the user's guide, posted at http://electionstudies.org/studypages/2008prepost/2008prepost.htm (Lupia et al. 2009).

[4] The NHIS provides an effective sampling approach for estimating the size of the cell-only population, but includes few questions useful for measuring the political significance of this group. Beyond this benchmark, we do not analyze the NHIS data further in this paper. See http://www.cdc.gov/nchs/data/nhis/earlyrelease/wireless200905.htm for more information.

[5] It is likely the case that internet penetration is correlated with cell phone penetration; this pattern would explain why the CCES would under-estimate the proportion of the public that only has a landline.

[6] Removing controls for party identification does not alter the substantive results.

[7] The Wald test for the equality of coefficients uses an F-distribution rather than a Chi-square since the standard errors have been adjusted using survey weights. Our findings were consistent regardless of whether we compared standardized or unstandardized coefficients.

[8] Validation data were not available yet for the 2008 CCES or the ANES.

[9] This also includes respondents who said that they had already voted early or absentee.

[10] We found a similar difference among those who claimed to have voted during the post-election survey as well.

[11] The Wald test to for difference on the CPO coefficients results in an F = 60.12 (p<.01) for the first pair of models and F = 49.34 (p<.01) for the second pair of models.