

**Appendix B:**  
**Survey and Sampling Methodology**

## SURVEY AND SAMPLING METHODOLOGY

The 2009 Danville Social Capital Survey was conducted by the Center for Survey Research (CSR) using a Computer-Assisted Telephone Interviewing (CATI) system, employing an innovative triple-frame telephone sampling methodology that included Random Digit Dialing [RDD] of landline telephones, a random sample of directory-listed telephone numbers, and RDD sampling of cell phone exchanges. A discussion of the general methodology appears in Section I of this report. This appendix provides additional details on how the questionnaire was developed, how the sample was selected, how the survey was administered, how the statistical weighting was implemented and how statistical testing was used to evaluate the results.

### Sample

CSR employed a triple-frame sample design, combining landline-based Random Digit Dialing (RDD) and a directory-listed household sample with randomized cellular (wireless) telephone numbers derived from regional cell phone rate centers to reach a random sample in the geographic area impacted by the Danville Regional Foundation, specifically, the City of Danville and Pittsylvania County, VA in addition to Caswell County, N.C. RDD produces a more representative sample of the population than do most other sampling methods because households are selected for contact at random and all households with a working landline telephone can be reached. Listed and unlisted residential telephones have equal probability of being included in an RDD study. However, because of the increase in the use of cell phones by respondents, the rise in cell phone-only adults, and the decreasing efficiency in RDD, leading survey organizations have begun to field telephone surveys that include cell phone samples. Cell phone samples are less efficient to call than landlines (fewer completions per hour) but reach populations that are less well represented in landline samples. CSR was the first academic survey organization in Virginia to use this developing methodology.

CSR fielded a pilot cell phone survey in January-February 2008<sup>1</sup> which provided its researchers with an opportunity to develop appropriate procedures, disposition codes, survey questions, and training materials for surveying cell phones. The pilot demonstrated the viability of cell phone surveying and allowed assessment of the costs, which are two to three times higher (per interview) than ordinary RDD interviewing. Respondents in the cell phone pilot were offered a cash incentive to complete the interview, in recognition of the fact that some cell phone users incur usage fees if they stay on the phone to complete the interview. The cell phone pilot not only showed the feasibility of cell phone calling, but demonstrated that the demographics of those reached via cell phone are quite different from those currently reachable via landline phone. Cell phone respondents are markedly younger, more likely to be single and never-married, more likely to be renters, newcomers to the area, low-income, and members of minority groups (African-American or Hispanic).

In addition, the pilot study and a follow-up 2008 survey included a cell phone incentive experiment which demonstrated that if cell phone samples were randomly divided into two groups where half were offered a \$5 incentive and the other half \$10, using the higher \$10.00 incentive actually led to a net cost savings. Given a standard cost estimate of \$32 per interviewing hour for telephone production, the increase in the rate of completions per hour can actually save more than the cost of an extra \$5.00 in incentive payment. (The per-hour estimate does not include processing fees and other administrative costs.) For that reason CSR uses the \$10 gift card incentive for its cell phone samples.

To partially offset the additional cost of including cell phones, the sample design included a substantial number of cases to be completed from a random sample of directory-listed numbers, referred to below as “listed sample.” (Listed sample is sometimes referred to as EWP sample in the literature because it is

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<sup>1</sup> Abdoulaye Diop, Young-Il Kim, John Lee Holmes, and Thomas M. Guterbock. *Prince William County Cell Phone Pilot Survey [A Supplement to the 2007 Citizen Satisfaction Survey]: Summary Report of Results*. Center for Survey Research, March 2008.

derived from the “electronic white pages.”) In 2008 and 2009 conference presentations, CSR researchers have argued that the cost of pursuing an RDD sample may not be worthwhile if cell phone numbers are sampled as well, arguing that listed sample combined with cell phone sample might offer a closely comparable degree of representativeness.<sup>2</sup> But rather than discard the RDD approach entirely, CSR’s recent survey designs split the landline sample into an RDD portion and a listed-sample portion drawing on a random selection of directory-listed telephone numbers from the targeted region. This choice facilitates further exploration of whether an RDD + Cell sample frame produces different results from the more efficient EWP + Cell sample frame.

In summary, an RDD sample of 3,156 telephone numbers (45% of the total) randomly generated from five-digit call groups known to be in operation in Danville, Caswell and Pittsylvania County, and a second, general directory-listed sample from electronic white pages of 1,494 telephone numbers (21% of the total) were combined with a cell phone sample of 2,413 numbers (34% of the total) in an effort to ensure greater targeting of harder to reach populations and geographies. Samples were purchased from Survey Sampling, Inc. of Fairfield, CT, a commercial sampling company that uses state-of-the-art methodologies. Table B-1 summarizes the sample purchased and completions (completions and partials used for analysis) for the different sample types and Table B-2 cross-tabulates this with the three geographic regions.

**Table B-2: Summary of Survey Sample Types Used, 2009**

Phone Type	Sample	(%)	Completes + Partials	(%)	Ratio (sample: completes)
RDD	3,156	44.7%	514	50.1%	6:1
Listed	1,494	21.2%	357	34.8%	4:1
Cell	2,413	34.2%	155	15.1%	16:1
<b>TOTAL</b>	<b>7,063</b>	<b>100.0%</b>	<b>1026</b>	<b>100.0%</b>	<b>7:1</b>

**Table B-3: Respondents by Sample Type and Area, 2009**

2009 AREA	Sample Type			
	Random Digit Dialing	Directory Listed (EWP)	Cell phone	Total
City of Danville	182	111	69	362
Pittsylvania County	279	203	72	554
Casswell County	53	43	14	110
<b>Total</b>	<b>514</b>	<b>357</b>	<b>155</b>	<b>1,026</b>

<sup>2</sup>Thomas M. Guterbock, James Ellis, Abdoulaye Diop, Kien Le, and John Lee Holmes. “Who Needs RDD: Combining Directory Listings with Cell Phone Exchanges for an Alternative Sampling Frame” Paper presented at the Annual Meetings of the American Association for Public Opinion Research, New Orleans, May 2008.  
Thomas M. Guterbock, James Ellis, Abdoulaye Diop, Kien Le, and John Lee Holmes. “Who Needs RDD II: An Assessment of Coverage Bias in Dual-Frame Designs that Combine Directory-Listed and Cellphone Samples.” Poster presented at the Annual Meetings of the American Association for Public Opinion Research, Hollywood, FL, May 2009.

## Respondent Selection

Telephone surveys risk biases owing to variation among members of a household in the likelihood of answering the telephone. For example, persons who do not work may be more likely to be available to answer the phone than are those who are employed. Various methods have been developed to randomize respondents within households in order to reduce these biases. CSR used a “minimally intrusive method” (MI) which combines random selection (between all adults in the household) by computer with the “last-birthday” method (if a household has three or more adults), in which we ask to speak to the adult in the household who had the most recent birthday or, if last birthday is unknown, with the Kish selection process of enumerating first names of eligible household members for random selection by the computer.<sup>3</sup> This protocol was applied to all households reached via the RDD or listed samples.

However, we found that in the Danville Region, especially for listed sample, we were sampling an inordinately high number of older female respondents using that method. Accordingly, as of April 15<sup>th</sup> landline household selection was switched to another simple procedure known to maintain randomness while targeting younger males. Interviewers asked for the youngest male who was at home at the time of the call, and if there was no male resident at home at the time, the youngest female at home at the time of the call was requested. This “youngest male/youngest female (YMYF) method avoids the intrusion of asking for a household roster or asking the person who answers the call to remember who among the adult residents had the most recent birthday or who will have the next birthday. Note that it is essential to this method that it be “the YMYF at home now” so that older adults have a random chance of being the youngest person at home at any given time. The program recorded which selection method was used and the results are presented in Table B-3 below. The gender imbalance in the sample was corrected in our weighting process, discussed later this Appendix.

**Table B-3 : Gender of Requested Respondent by household selection method**

Gender	Number from MI Selection	Number from YMYF	Number from Cell*	Final Total	% of Final Unweighted Dataset
Male	206 (32%)	99 (47%)	66 (42%)	371	36.7%
Female	436 (68%)	112 (53%)	91 (58%)	639	63.3%

\*No selection done for cell contacts

Cell phone adults were considered to be sampled as individuals. Prior research by others has shown that the percentage of cell phones actively shared by more than one adult is low and that it is very difficult in practice to accomplish a ‘hand-off’ of the cell phone from one adult to another randomly selected user of the phone.<sup>4</sup> Therefore, no within-household selection was attempted in the cell phone interviews for this study.

<sup>3</sup> Programmed by CSR into the CATI system based on the method’s description in Louis Rizzo, J. Michael Brick and Inho Park “A Minimally Intrusive Method for Sampling Persons in Random Digit Dial Surveys,” *Public Opinion Quarterly*, Vol. 68, No. 2 (2004), pp. 267-274.

<sup>4</sup> J. Michael Brick, W. Sherman Edwards, and Sunghee Lee.”Sampling Telephone Numbers and Adults, Interview Length, and Weighting in The California Health Interview Survey Cell Phone Pilot Study.” *Public Opinion Quarterly* ( 2007) 71: 793-813.

## Questionnaire

CSR worked with the client to develop a conceptual outline of the purposes of the survey. The main purpose of the survey was to measure how people feel about the region and their future in it, to measure people's attachment to their community, and to measure the region's social capital which includes civic engagement, political involvement, and connectedness to the community. The Sponsor also requested that some questions be included relevant to health issues and issues surrounding children and youth in the area. Since there has been extensive research in the area of social capital and community attachment, CSR included questions from other surveys that have shown to be reliable measures of these concepts. The following is a list of the previous surveys that were consulted: *Maintaining America's Social Fabric: The AARP Survey of Civic Involvement (1997) conducted by Thomas M. Guterbock; the social Capital Benchmark Study (1995) conducted by Robert Putnam; the Northwest Area foundation Horizons Social Capital Survey (2005) conducted by the Oregon Survey Research Laboratory; the Commonwealth Education Poll (2006) conducted by the VCU Center for Public Service/Survey and Evaluation Research Laboratory for the Commonwealth Educational Policy Institute; and the Albemarle County, Chesterfield County, and Prince William County Citizen Satisfaction Surveys regularly conducted the Center for Survey Research at the University of Virginia.*

As is standard practice for reducing questionnaire length, the survey employed the practice of "question rationing," that is, asking certain questions of fewer than all respondents, in order to ask a larger number of questions and obtain a sufficiently large sample of responses to each question without making the survey substantially longer for any individual respondent.

The questionnaire was pre-tested twice, first from March 16-17, 2009 and then again on March 23, 2009. The first pre-test resulted in 34 completed interviews with households in Danville city. The survey length on the pretest was 27 minutes on average from hello to hang-up. In addition to the average interview length being too long the first pretest used listed sample. For the second pretest an RDD sample drawing from all three areas of Danville, Caswell and Pittsylvania was used on a shortened instrument. The second pretest resulted in 29 completions at an average length of 24 minutes from greeting to goodbye. Based on this pretest, we refined our training procedures, further adjusted the question-rationing percentages downward and made further changes in an effort to bring the median survey length to around 20 minutes, and corrected minor errors in the CATI program for production interviews. In addition, the introduction screen was refined twice through both the pretests in an effort to inform that there would be some questions about the respondent's personal activities while avoiding the implication that this was the survey instrument's main purpose.

## Interviewing Procedures

CSR conducted the telephone interviews from its Computer-Assisted Telephone Interviewing (CATI) Laboratory at the University of Virginia. CATI is a system in which computers are employed to increase the efficiency, accuracy, and flexibility of telephone surveys conducted by trained interviewers. Questions appear on the computer screen in programmed sequence as the interviewer presses the keys on the keyboard to record the respondent's answers. Accurate, instantaneous data entry is assured by the system. The computer system stores the database of telephone numbers and is used to control the sampling process, dial each sampled number, schedule callbacks, and record the disposition of each attempted call.

Production calling for the survey was carried out from May 11 through June 24, 2009. All telephone calls for the study were made from the CATI laboratory under the direct supervision of CSR staff. Landline numbers were dialed automatically by the WinCATI computer system while cell phones were manually dialed. Calling was done on Sunday through Friday evenings and on Sunday afternoons. The interviewers received at least six hours of training prior to production interviewing. Many had prior interviewing experience on similar studies, some had prior experience with the Danville studies specifically, and many were veterans of several cell phone studies. Each phone number was given from 8 to 12 call attempts before it was treated as a "no answer" or "busy" number. Landline phones answered by automatic answering machines were treated the same as "no answer" calls (although counted

separately); CSR interviewers did not leave messages on the answering machines of potential landline respondents but simply returned the phone number to the sample pool for another calling attempt at a later time. However, answering machine announcements that identified the phone number as a place of business were recorded as such and not re-attempted.

For cell phones, which are often answered by voicemail systems, interviewers left an appropriate message on the first calling attempt only. The message included an invitation to call back at a toll-free number, but very few callbacks were received. Nevertheless, the messages probably served to increase future receptivity to calls from CSR especially as the message included the phrase that “qualified respondents would be compensated \$10 for answering our questions.” On cell phones that identified themselves as businesses, the number was not removed until the cell phone owner confirmed that it was a business only or three attempts were made. This is because many small business owners use their cell phone for business and personal affairs but leave only a business message on their voice mail.

To reduce “non-response bias” CSR makes several efforts at “conversion calling” for households where a potentially eligible respondent has refused to participate once or twice. Non-response bias in surveys results when qualified respondents do not complete a survey, usually because they are reluctant to cooperate. In conversion calling, our most highly trained interviewers call back households in which we previously had someone refuse to take the survey. First, we kept track of the “tone” of initial refusals. “Hard” refusals, those in which people explicitly asked not to be called again, or were noticeably agitated or upset about our phone call, were not called back at all. “Soft” refusals, those for which it seemed that we only caught someone at a bad time, were called back once more after an interval of at least three days. In addition, “hard” refusal respondents who additionally request to be put on CSR’s do not call list are removed from calling for three years. This is in keeping with best practices recommendations in the survey industry.

## **Productivity and Response Rates**

A total of 7,063 phone numbers were attempted in the course of the survey, resulting in 1026 complete or nearly complete cases used for analysis. The interviews took an average of 20.6 minutes to complete once a qualified respondent was identified, with a median time of 19.8 minutes.<sup>5</sup> Interviews completed on the cell phone (15.1%) were longer than those on the landline (84.9%) by 1.7 minutes on average. Cell phone surveys tend to be slightly shorter at the beginning (.3 minute on average) because of the simpler selection process but longer at the end (1.8 minutes on average) because of the need to obtain information for providing the incentive.

Landline surveys have a more complex selection process (discussed above) aimed at randomizing participant selection within a household. For the cell phone it was assumed that the person answering the phone was the primary user unless stated otherwise by the respondent. This contributed to cell phone surveys being shorter at the respondent selection portion on average than landline. However, overall, cell phone interviews tend to be longer: the average length from greeting to goodbye on a landline interview was 22.4 minutes whereas for the cell phone it was 24.1 minutes. If we look at the point at which a qualified respondent was selected, the cellular telephone survey took 22.1 minutes on average compared to 20.3 minutes for the landline.

The final disposition of each of the attempted phone numbers is shown in two tables at the end of this Appendix. The disposition report is presented in a format that has been recommended as an industry

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<sup>5</sup>These times indicate the “completion time”—the time that it took the interviewer to complete the interview from within-household selection of a qualified respondent to goodbye. For this year, the amount of time that the respondent household was actually on the phone, e.g. from greeting to goodbye, comprised an average of 22.34 minutes, with a median of 21.34 minutes.

standard by the American Association for Public Opinion Research.<sup>6</sup> The AAPOR rate was calculated by a custom analysis of the complete call history of each attempted number, using a program written in SPSS by CSR technical staff. CSR completed a total of 1009 interviews (including those completed in the conversion phase of calling), for an overall response rate of 22.7%.<sup>7</sup> There were also 17 partial interviews which were sufficiently complete for inclusion in the study.

The true response rate depends on how one estimates the percentage of working residential phones that exist among the many numbers that never answered our many call attempts. An estimate of 26.1% for the landline only RR3 (not shown in the table) is based on the most conservative assumption (equivalent to the CASRO rate) that the percentage of residential households among unreachable numbers is the same as the percentage among those we reached, *i.e.*, 72.9%. However, because CSR completed multiple attempts to nearly all of the no-answer numbers and based upon prior experimentation with listed and RDD samples in Virginia, we estimate that the residency rate is around 20% of no-answer numbers and that our true response rate (adjusted RR3) for landlines is closer to 27.1%. Within the landline sample the adjusted RR3 for RDD production was 26.5% and the unadjusted RR3 for listed production was 28.4%. For the Cell phone portion of the sample, the estimated response rate is 13.9% and as with directory-listed sample the adjustment is not used.<sup>8</sup>

Finally, the efficiency of the calling can be expressed in terms of number of completions per hour of calling (CPH). The overall interview production rate (0.83 interviews per hour) is less than prior surveys, mostly due to the addition of cell phones as well as declining rates of RDD productivity nationwide. For the 1465 landline cases the production rate was 1.02, whereas for the 281 cellular respondents production was .41. Table B-4 breaks out the production rates for each sample component.

**Table B-4: Respondents by Sample Type, 2009**

<b>DANVILLE Social Capital Survey 2009 Productivity</b>		
	<b>Completes</b>	<b>Rate/hr</b>
PR1: RDD	514	1.24
PR2: Listed	357	1.29
PR3: Cell	155	0.75
<b>Cell only</b>	155	0.75
<b>Landline only</b>	871	1.26
<b>TOTAL</b>	<b>1026</b>	<b>1.14</b>

<sup>6</sup>The American Association for Public Opinion Research. 1998. *Standard Definitions: Final Dispositions of Case Codes and Outcome Rates for RDD Telephone Surveys and In-Person Household Surveys*. Ann Arbor, Michigan: AAPOR. For updates, see also the AAPOR website, [www.aapor.org](http://www.aapor.org).

<sup>7</sup>Calculated according to AAPOR suggested formula RR3, with  $e1=.42$  and  $e2=.94$ . We estimated the percent of working, residential numbers among those that were found to always be busy or no-answer (the residency rate) to be .20. This estimate is based on the results of prior CSR experiments that compare RDD sample results with directory-listed sample results for Virginia. We estimated  $e2$  by dividing households determined to be eligible by the N of households overall. The estimated  $e2$  was applied to housing units where eligibility could not be determined. We derived  $e1$  by taking the product of  $e2$  and the estimated residency rate. This rate was applied to numbers that were never reached and could not be determined to be residential households. Partial interviews are not counted in the numerator of the RR3 formula but are counted in the RR4. Our RR4 response rate with partial interviews included was 23.1%.

<sup>8</sup>The RR4 estimates for RDD and directory-listed samples were 27.0% and 28.9%, respectively.

## Geography

The definition of the Danville region for inclusion in the study was developed in consultation with the study sponsor. We did not set quotas during the calling period nor weight the data by geography for analysis. However, the three areas were sampled separately and the table below groups respondents into areas according to the respondents' self-reported location in a question that appears early in the interview. The regions used for the landline sample of the Danville region were defined by their FIPS code assignments. For cell phone sample, the two counties and City of Danville were assigned based on the billing coordinates of the exchange. Both Pittsylvania and Caswell counties have their own rate center, as does Danville and so the sampling company was able to define the sample by the three localities. Table B-7 provides the sample distribution of the three areas indicating how the current 2009 sample responses fall into each.

**Table B-7: Distribution of Current Responses by Geography**

Survey Areas	Population of Households, ACS 2007		Sample Proportions, 2009*		Completions & Partial, 2009	
	(count)	(%)	(count)	(%)	(count)	(%)
City of Danville	19,972	37.0%	3,565	50.5%	362	35.3%
Pittsylvania County	25,419	47.1%	2,479	35.1%	554	54.0%
Casswell County	8,572	15.9%	1,019	14.4%	110	10.7%
<b>Total</b>	<b>53,963</b>	<b>100%</b>	<b>7,063</b>	<b>100%</b>	<b>1,026</b>	<b>100%</b>

\*Note that for cell phones Danville rate center was predominant but covered all three areas

## Weighting

Statistical weighting of the survey results was designed this year to accomplish two objectives: (1) to correctly represent the demographic characteristics of the area, and (2) to properly represent different types of phone service in the Danville area (cell phone-only cases, landline-only cases, and those with both kinds of telephone service) as well as the correct proportion of unlisted landline telephones.

As expected when using telephone survey method, the sample composition did not exactly match the composition of the entire population of households. This is because of random sampling error, differences in rates of refusal between different groups, and differences among households in the amount of time that someone is home to answer the phone. The net result is a sample that somewhat over-represents females, under-represents homeowners, and under-represents African Americans. To correct these imbalances, CSR weighted the sample data. Statistical weighting is larger for those respondents who are in underrepresented groups, and smaller for those who are in overrepresented groups, so that the aggregate result is what we would have obtained from a fully uniform, random sample of the whole population.

*Demographic weighting.* In order to calculate the correct weights, CSR drew upon information from the U.S. Census Bureau's 2007 American Community Survey. The proportion of males to females from the population was then a basis for our weight based on gender. The proportion of homeowners and non-homeowners was combined with a dichotomized race variable (black and non-black categories) to create two sets of weights based on race/homeownership.

*Cell phone weighting.* Current research on cell phone interviewing is still in its infancy, and there are no standard, accepted methods for weighting the results of a 'dual frame' sample that combines completed interviews from landline samples with completed interviews from cell phone samples. Prof. Guterbock has been working on the development of appropriate methods, and our approach to the current study applies his latest research to the available local data. Here we treat RDD and listed samples as one

“landline” sample, thus treating our triple-frame design as a dual-frame sample (cell phone and landline sampling frames).

The heart of the weighting problem is simple: there is no available external source that will tell us the percentage of the Danville population that has cell phone-only service, landline only, or both. Authoritative data are collected at the national level by the Centers for Disease Control in the National Health Interview Survey, a very large, continuous, in-person data collection focused on health issues.<sup>9</sup> That survey determines the phone-service status of each household in a representative national sample, and results from as recently as the second half of 2008 are currently available. However, these data are available only at the national or broad regional level. It is doubtful that these broad averages across regions are directly applicable to the Danville region.

The estimation problem is made somewhat more difficult by the fact that rates of survey response are not even across different phone-use segments. That is, cell phone-only adults are much more likely to answer their cell phones than are those who have both kinds of phones. This is understood to reflect differences in telephone behavior between cell phone-onlies and dual-phone users. Cell phone-onlies are presumably more likely to have their phones with them, to have their phones turned on, and to accept calls from unknown numbers than are those who continue to rely on landline phones. For these reasons, the percentage of cell phone-only cases encountered in actual cell phone surveys is much higher than their actual share among all cell phone users. It is probably also the case that landline-only households are somewhat overrepresented within landline samples, as compared to those who have both kinds of phone. The latter group is referred to below as the *overlap sample*, because the households having both landline and cell phones lie at the intersection of the cell phone frame and the landline frame.

In order to estimate the degree of under-representation of the overlap sample segment in the cell phone sample and in the landline sample, we compared results from the 2007 California Health Interview Survey (a telephone survey combining RDD sample with cell phone-only households) with the results from NHIS for the Western Region of the United States (second-half 2007 results).<sup>10</sup> Using algebraic formulas developed by Prof. Guterbock, we were able to determine the values for two *response rate ratios*:  $r_1$ , the ratio of the response rate to cell phone calling in the overlap sample compared to the response rate of cell phone-onlies, and  $r_2$ , the ratio of the response rate to landline calling in the overlap sample to the response rate of landline-onlies. The NHIS for the Western region reports that the phone-service proportions in the Western region were: 13.2% cell phone-only, 67.9% dual-phone (overlap), and 18.9% landline only. If response rates were equal ( $r_1 = r_2 = 1.0$ ), and if California’s phone usage is the same as that of the Western region, then the CHIS 2007 would have found 16.3% of the cell phone completions to be cell phone-onlies. Instead, CHIS 2007 reports 34.6% percent cell phone-onlies. CHIS should have found 21.7% landline-onlies in the landline sample, but actually had 32.7% landline-onlies in its landline RDD sample. Applying Guterbock’s formulas to these data results in an estimate of  $r_1 = .368$  and  $r_2 = .598$ .

The basic weights were determined using final survey data as shown in Table B-8. The “estimated true” values are derived by application of the values for  $r_1$  and  $r_2$  estimated above to the data from our 2009 survey completions in the Danville region.

<sup>9</sup> Steven J. Blumberg and J.V. Luke. “Wireless Substitution: Early Release of Estimates from the National Health Interview Survey, July-December 2007.” National Center for Health Statistics, May 13, 2008. Available at: <http://www.cdc.gov/nchs/nhis.htm>.

<sup>10</sup> Thanks to Michael Brick of Westat for sharing some of the preliminary results from CHIS 2007 for this purpose.

**Table B-8: Initial estimates of the phone-service segments in Danville**

	Cell phone sample		Landline sample		Combined samples		Est. true	Weight	Weighted N	
<b>Cell Only</b>	47	30.3%	0	0.0%	47	4.6%	11.84%	2.584	121	11.8%
<b>Overlap (Both)</b>	107	69.0%	630	72.3%	737	71.8%	71.75%	0.999	736	71.8%
<b>LL Only</b>	1	0.6%	241	27.7%	242	23.6%	16.41%	0.696	168	16.4%
	<b>155</b>		<b>871</b>		<b>1026</b>		<b>100%</b>		<b>1026</b>	

Once these estimates were made, a further decision needed to be made about weighting the overlap sample. By design, we did not complete a very large number of cell phone cases because of their greater expense. In theory, if all phones in the Danville region had been called with equal likelihood, we would have reached one half of the overlap sample through their cell phone and one half through their landline. This would call for weighting the portion of the overlap sample reached through cell phone up by a very large weight to bring their share of the overlap to 50%, which could potentially have distorted the results and also increased the ‘design effect’ in the study, reducing the precision of the estimates. We decided to apply a weight of 2.0 to the cell phone cases in our overlap sample, allowing the weight on the landline cases in the overlap sample to take a value that would result in an overall overlap percentage in the weighted sample of 71.75%. Table B-9 shows these weights that were applied to the completions in the final sample.

**Table B-9: Final estimates of the phone-service segments in Danville**

	Cell phone sample		Landline sample		Combined samples		Est. true	Weight	Weighted N	
<b>Cell only</b>	47	30.3%	0	0.0%	47	4.6%	11.84%	2.5841	121	11.8%
<b>Overlap:</b>										
Cell	107	69.0%	0		107	10.4%	<b>20.86%</b>	2.0000	214	20.9%
<b>Overlap :</b>										
LL	0		630	72.3%	630	61.4%	50.89%	0.8288	522	50.9%
<b>LL only</b>	1	0.6%	241	27.7%	242	23.6%	16.41%	0.6958	168	16.4%
	<b>155</b>		<b>871</b>		<b>1026</b>	<b>100%</b>	<b>100%</b>		<b>1026</b>	<b>100%</b>

*Listed status weighting.* We also weighted the results to accurately represent unlisted landline cases. These are somewhat underrepresented because the directory-listed sample has only a small percentage of unlisted households. To correct for this, we weighted all unlisted landline households reached on either the RDD or EWP (listed) samples so that, in total, they represent 13.8 percent of the landline completions.

The final step in the weighting process was “raking,” a statistical procedure used to produce combined weights for the four weighting factors: gender, race/homeownership, phone service type, and listed versus unlisted telephone status. The percentages for geographical areas in Table B-7 were used along with the weights for phone usage from Table B-9 in an iterative process that produced a final weight for each of the 64 design cells (4 phone-service segments × 2 gender × 4 race/homeownership × 2 listed statuses [unlisted landline versus all others]) that would best fit with the given marginal population distribution for each weighting factor. This procedure necessarily treats the distribution of phone-service segments as being equal across the geographic areas and demographic groups.

A more complete description of the cell phone estimation procedures used here, along with algebraic formulas needed to calculate and apply the response rate ratios, is available upon request.<sup>11</sup>

<sup>11</sup>Thomas M. Guterbock. “Estimating Phone Service and Usage Percentages: How to Weight the Data from a Local,

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## Sampling Error and Statistical Testing

Our final sample includes 1,026 respondents. If these cases had been drawn by simple random sample, the survey would have a margin of error of plus or minus 3.06 percent. However, in addition to sampling error there is a design effect that impacts the total margin of error which we calculate by introducing the weights derived by the “raking” process described above into the Complex Sampling module of SPSS statistical software. This tool allows calculation of a “design effect” for each question in the survey. The design effect shows how the variance of sample estimates is increased by the effect of post-stratification weighting. We base our estimate of the overall margin of error on a key survey question, the respondent’s rating of their community on a 1 to 10 scale (QUALITY). For that question, the design effect is 1.464, meaning that the margin of error in our sample of 1,026 cases is equivalent (because of the weighting) to the margin of error we would have obtained from a simple random sample of 701 (1,026/1.464). The margin of error is increased by the square root of the design effect, a factor in this case of 1.21. The final margin of error is 3.70%. This means that in 95 out of 100 samples of this size drawn from Danville, the results obtained in the sample would fall in a range of  $\pm 3.70$  percentage points of what would have been obtained had every household in the Danville with a working landline or cellular telephone been interviewed. Larger sampling errors are present when analyzing subgroups of the sample or questions that were not asked of all respondents; smaller sampling errors are present when a lopsided majority gives the same answer (e.g., 80 percent of the sample are satisfied with a given service).

Statistical significance tests were used to verify the existence of satisfaction differences among various subgroups. We used the Pearson Chi-Square test of independence. We report in these pages differences that yield a “p-value” of .05 or less. A level of .05 indicates that there is only a 5 percent chance that the difference we find is due to sampling error, rather than reflecting a real relationship within the study population. In comparisons of satisfaction items, the four response categories were collapsed into two, “satisfied” and “dissatisfied.” The statistics for evaluating statistical significance were calculated using the SPSS Complex Sampling module and hence take into account the “design effect.”<sup>12</sup> However, they do not measure other sources of error, which can occur in any poll or survey, that are not related to sampling or weighting.

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Dual-Frame Sample Survey of Cellphone and Landline Telephone Users in the United States.” Paper presented at the Annual Meetings of the American Association for Public Opinion Research, Hollywood, Florida, May 14, 2009.

<sup>12</sup> When the design effect is taken into account, tests of significance become more conservative, requiring a somewhat larger difference between groups (or change between years) to achieve significance at the 95% confidence level.

**Table B-10: Sample Disposition Report**

**Danville 2009 – Disposition Listing for All Samples**  
 [dispositions arranged for calculation of AAPOR standard rates]

<b>Disposition Code</b>	<b>Disposition Description</b>	<b>All Samples Total</b>	<b>Random Digit Dialing</b>	<b>Directory Listed</b>	<b>Cellular (Wireless)</b>
1100	Complete	1009	505	351	153
1200	Partial	17	9	6	2
2110	Eligible: Refusal	762	312	306	144
2120	Eligible: Break-off	94	54	34	6
2210	Eligible: Resp Never Avail	372	135	74	163
2221	Eligible: Ans Mach, No Mess	583	373	146	64
2222	Eligible: Ans Mach, Message	425			425
2310	Eligible: Dead	1	1		
2320	Eligible: Phys/Mentally Unable	66	38	27	1
2330	Eligible: Language Unable	12	5	3	4
2340	Eligible: Misc. Unable	3	3		
3120	Busy	78	19		59
3130	No Answer	318	204	26	88
3140	Ans Mach (Don't Know if HU)	127	32	6	89
3150	Technical Phone Problems	92	16	5	71
3210	HU, Unknown Eligible: No Scnr	903	461	282	160
3220	HU, Unknown Eligible: Other	0			
4100	Out of Sample	131	27	15	89
4200	Fax/Data Line	141	132	9	
4310	Non-working Number	1110	254	49	807
4320	Disconnected Number	517	356	117	44
4410	Number Changed	30	7	1	22
4420	Cell Phone	N/A			
4430	Call Forwarding	0			
4510	Business/Govt/Other Org	253	205	30	18
4520	Institution	1	1		
4530	Group Quarter	0			
4700	No Eligible Respondent	18	7	7	4
4800	Quota Filled	0			
<b>Total</b>		<b>7063</b>	<b>3156</b>	<b>1494</b>	<b>2413</b>

**Table B-11: Sample Disposition Report****Danville 2009 – AAPOR Standard Rates Calculation**

[Dispositions summary for all Telephone Samples]

<b>AAPOR Standard Rates and Dispositions Summary</b>	<b>OVERALL Ave</b>	<b>Random Digit Dialing</b>	<b>Directory Listed</b>	<b>LANDLINE Ave</b>	<b>Cellular (Wireless)</b>
<i>Estimated Residency 1*</i>	0.421	0.194	0.833	0.399	0.465
<i>Estimated Residency 2</i>	0.938	0.968	0.972	0.970	0.834
Response Rate 1	0.214	0.236	0.281	0.253	0.118
Response Rate 2	0.217	0.241	0.286	0.257	0.120
Response Rate 3 *	0.227	0.265	0.284	0.271	0.139
Response Rate 4 *	0.231	0.270	0.289	0.276	0.140
Response Rate 5	0.315	0.359	0.377	0.366	0.185
Response Rate 6	0.321	0.366	0.384	0.373	0.187
Cooperation Rate 1	0.514	0.545	0.483	0.518	0.494
Cooperation Rate 2	0.522	0.554	0.491	0.527	0.500
Cooperation Rate 3	0.536	0.574	0.504	0.543	0.502
Cooperation Rate 4	0.545	0.584	0.512	0.552	0.508
Refusal Rate 1	0.176	0.169	0.269	0.206	0.105
Refusal Rate 2 *	0.191	0.192	0.275	0.219	0.136
Refusal Rate 3	0.256	0.255	0.359	0.296	0.156
Contact Rate 1	0.404	0.428	0.574	0.482	0.217
Contact Rate 2 *	0.429	0.479	0.581	0.512	0.270
Contact Rate 3	0.587	0.646	0.768	0.694	0.250
Complete Interview	1009	505	351	856	153
Partial Interview	17	9	6	15	2
Refusal and Break-off	856	366	340	706	150
Non-contact	1380	508	220	728	652
Other eligible but unable	82	47	30	77	5
Unknown if household	615	271	37	308	307
Unknown if other	903	461	282	743	160
Ineligible Numbers	2201	989	228	1217	984
Total Dialed Attempts	24695	10273	6758	17031	7664
<b>TOTAL</b>	<b>7063</b>	<b>3156</b>	<b>1494</b>	<b>4650</b>	<b>2413</b>
<b>% of Landline</b>		67.9%	32.1%	100.0%	
<b>% of Overall</b>	100.0%	44.7%	21.2%	65.8%	34.2%

\*Contains CSR adjustment rate for Virginia residency for RDD portion of the sample.  
 Estimated residency rate for cellular (wireless) sample derives from Landline assumptions.  
 No adjustment estimates available for cellular samples at this time.