

An Independent Analysis of the Nielsen Meter Nonresponse Bias Study

A Report to the Council for Research Excellence

Robert M. Groves

Ashley Bowers

University of Michigan and Joint Program in Survey Methodology

Frauke Kreuter

Carolina Casas-Cordero

University of Maryland and Joint Program in Survey Methodology

Peter V. Miller

Northwestern University, Department of Communication Studies

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Executive Summary

- The design of the Nonresponse Bias Study for the Nielsen People Meter Panel made use of innovative research methods (e.g., follow up of respondents and nonrespondents, multiple modes of data collection, and different incentives for different groups); it followed state-of-the-art practices.
- The Michigan-Maryland team used a variety of statistical analytic techniques to explore the potential for nonresponse bias in the Nielsen Meter Panel. We did several sensitivity analyses to test the robustness of our assumptions. We tried different coding of the analytic variables, different target populations, and different forms of the estimators. Multivariate analyses were used to model the effect of Nielsen poststratification adjustments. Overall, we feel comfortable with the robustness of our conclusions.
- We found no evidence of nonresponse bias in viewing estimates for 13 of the 14 dayparts we analyzed. We found no evidence of nonresponse bias in viewing estimates for 14 of the 16 channels we analyzed.
- In studying the likely effect of Nielsen poststratification adjustments we focused on the three viewing estimates that showed nonresponse bias in the bivariate analyses. These were household prime-time viewing, CNN viewing, and HBO viewing. We conclude that the Nielsen poststratification adjustments would successfully dampen nonresponse bias for CNN viewing.
- For the remaining two estimates, we modeled the effect of using additional adjustment variables in an attempt to remove the nonresponse bias. Our preliminary results indicate that while there appear to be promising adjustment variables for prime-time viewing, a more careful evaluation is needed.
- The use of Nielsen's poststratification adjustment and the addition of several other covariates does little to remove nonresponse bias for HBO viewing. Further research is needed to determine how to reduce nonresponse bias for HBO.
- We performed an initial evaluation of whether the above conclusions from the NRB study themselves might be subject to problems due to low response rates to the NRB survey in some groups. Overall, we see little evidence of problems arising from this.

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1. Overview of the Study

1.1 Description of the Study Rationale and the Role of the Michigan-Maryland Team

The Nielsen sample survey utilizing installed meters has been a key component of audience measurement for several decades. As is true for almost all major sample surveys in the western world, response rates in the Nielsen survey have fallen in recent years. These lower response rates have raised concerns about potential nonresponse biases.

Nonresponse rates measure the percentage of eligible sample units that provide usable data. If the Nielsen Meter nonrespondent houses have different viewing behavior than respondent homes, then Nielsen viewing estimates might be subject to over- or under-estimation. Nonresponse rates alone, however, do not indicate that such estimation problems exist. Hence, the special Nonresponse Bias Study (NRB) was mounted to determine whether respondents and nonrespondents to the meter survey might differ on key statistics. This is a report on the results of that study.

It is important for the reader to note that this study focused almost exclusively on nonresponse bias issues. Nonresponse is only one quality dimension of the Nielsen estimates. Additionally, measurement errors due to the failure to report accurately the viewing that took place for each television set can affect Nielsen estimates. A full picture of the quality of Nielsen estimates requires attention to these and other issues simultaneously. Thus, while the nonresponse bias study targets an important property of the meter survey, the nonresponse issue needs to be considered within the context of all of the quality dimensions of survey data.

This is a report to the Council on Research Excellence. It summarizes work done for the Council by a team from the University of Michigan (Groves, Bowers) and University of Maryland (Kreuter, Casas-Cordero), with assistance from Professor Peter Miller of Northwestern University. This group was employed to provide an independent examination of the results of the Nonresponse Bias Study. That study was designed and conducted by Nielsen, with ongoing input from the Michigan-Maryland group. However, all data collection and data file preparation tasks were the responsibility of the Nielsen staff. The designated role of the Michigan-Maryland group was to:

1. Report to the Council nonresponse subcommittee on key issues in the design (power analysis for the NRB study, sample design, questionnaire design, neighborhood observation forms and call record forms),

2. Observe the training of Nielsen and RTI interviewing staffs,
3. Participate in many telephone conference calls with Nielsen staff during the data processing and analysis planning stages,
4. Replicate Nielsen analyses as an auditing of their findings, and
5. Conduct an independent analysis seeking insights into the magnitude and character of nonresponse bias in viewing estimates.

1.2 Overview Judgments of the Michigan-Maryland Team

In response to a request by the nonresponse subcommittee of the Council, the Michigan-Maryland team provides the following statement of our key judgments about the Nonresponse Bias Study.

1. We believe the NRB was a state-of-the-art implementation of a nonresponse bias study design; while the NRB did not succeed in measuring all of the Nielsen nonrespondents sampled, there do not appear to be severe weaknesses of the study because of that.
2. The key statistical results suggest that, for a large set of estimates of audience behavior, there are only small nonresponse bias magnitudes.
3. There are, however, some estimates that appear to underestimate viewing due to nonresponse bias; these biases seem robust to alternative ways of estimating them.
4. We did find that the Nielsen poststratification adjustment was successful in reducing nonresponse bias but we also found estimates for which the traditional adjustment is ineffective.

2. Oversight and Replication

2.1. Study Implementation

Our work primarily involved analysis of data collected by Nielsen during the course of the Nonresponse Bias Study (Tables 1 and 2). These data included responses to the NRB Meter questionnaire and a number of auxiliary datasets. UMI-UMD developed fluid communication with the CRE and the Nielsen group. The data cleaning and file preparation process took longer than expected. This led to a delay in receiving the final Meter questionnaire dataset. However, the delivery of auxiliary datasets was timely for: the original call records (Meter Sample Management system extract), the geographic data (Claritas and Prizm files), and the NRB data collection files (Tracking file, Call Records file, Neighborhood Observations file).

A complete list of major activities is summarized in the appendices. See Appendix A for tables summarizing major project activities and response rates. See Appendix B for memoranda and presentations sent to the CRE and Nielsen.

Table 1. Delivery of Documentation to the CRE and Nielsen, File Format.

Documents	Delivery Date
<i>Sent to CRE</i>	
Power Analysis 1, DOC	10/04/06
Power Analysis 2, DOC	10/20/06
Preliminary Analysis Plan UMI-UMD, PPT	06/15/07
Analysis Plan UMI-UMD, PPT	01/14/08
Summary of Visit to People Meter Training School, DOC	02/11/08
Summary of Observation of People Meter Recruitment, DOC	04/10/08
Preliminary Analysis Meter, PPT	10/13/08
Subgroup Analysis Meter, PPT	01/26/09
Draft Analysis Report Meter, DOC	03/31/09
<i>Sent to Nielsen</i>	
Questionnaire Content, DOC	10/15/06
Review Result Codes (In Person mode), DOC	07/17/07
Neighborhood Observation Form (In person mode), DOC	Jun-Aug07
Call Record Form (In Person mode), DOC	Jun-Aug07
Refusal Report Form (In Person mode), DOC	Jun-Aug07
Review First Version of Meter Questionnaire Dataset, DOC	07/16/08

Note: PPT = Power Point Presentation, DOC = Word Document.

Table 2. Tally of Datasets for Analysis of the Meter, Dates When Nielsen Delivered the Datasets.

Datasets	Date Nielsen delivered to UMI-UMD
<i>Meter Questionnaire</i>	
Questionnaire, version 0 (preliminary - mail and web)	03/31/08
Questionnaire, version 1	06/26/08
Questionnaire, version 2	09/05/08
Questionnaire, version 3	10/01/08
Comments (open questions), version 1	06/26/08
Comments (open questions), version 2	09/05/08
Comments (open questions), version 3	10/01/08
Other stations (open question)	08/20/08
<i>Weighting variables</i>	
Selection weights, version 1	03/31/08
Selection weights, version 2	06/06/08
Respondent weights	08/20/08
Poststratification Total weights	12/10/08
Poststratification Cooperator weights	12/10/08
<i>Geographic Data</i>	
Geographic identifiers, version 1	09/27/08
Geographic identifiers, version 2	12/11/08
Claritas	03/31/08
Claritas (additional variables)	03/09/09
PRIZM	12/11/08
County & Territory	09/27/08
<i>NRB Data Collection</i>	
Tracking File (all modes)	10/22/08
Case Control File (In Person)	06/10/08
Neighborhood Observations File (In Person)	06/10/08
<i>Contact History from Meter Recruitment</i>	
Meter Sample Management System Extract File	01/12/09
<i>Meter Data</i>	
Demographics and TV Equipment	03/20/09
<i>Faulting Data</i>	
Tabulated Faulting Levels by Demographic and TV Equipment Characteristics	03/11/09
Case Level Faulting Dataset	TBD

There are many follow-up studies of survey nonresponse that attempt to contact and measure samples of nonrespondents, after the survey is complete. By measuring the nonrespondents and comparing their characteristics to respondents, estimates of nonresponse bias in the original survey can be derived. A key issue in such follow-up studies is how successfully the original nonrespondents can be contacted and measured.

In our judgment the Nielsen nonresponse bias study implemented a successful method for recruiting participants with elaborate follow up strategies, high monetary incentives, and multiple

modes of data collection. We observed quite high quality training for In-Person follow-up data collection.

The study reached a very high response rate (95.02%) for Cooperators and a response rate among Refusers (62.44%) that is quite high for a group that has refused a prior survey request. See Table 3. We note that 76% of the 1,758 NRB respondents completed the survey by mail followed by 13% by in-person interview and 11% by web.

Table 3. Sample Distribution and Response Rates by NRB Strata.

NRB Strata	Number of Cases		Response Rates	
	NRB Sample	NRB Respondents	Unweighted (1)	Weighted (2)
Cooperators	1,000	945	94.50	95.02
Refusers	1,300	813	62.54	62.44
Total	2,300	1,758	76.43	77.81

Notes: (1) Unweighted response rates reflect the ratio (NRB respondents/NRB sample) for each strata. (2) The Weighted response rate weights each case by its corresponding selection probability. See a description of the calculation of these response rates in Appendix A.

2.2. Replication of Nielsen Analysis

Nielsen presented their analysis in two steps (see Nielsen presentation of results). We were able to replicate the first step without any discrepancies from their findings.

The second step of the Nielsen analysis asked how the postsurvey adjustments for nonresponse and coverage that Nielsen implements routinely for their published data affect estimates of nonresponse bias from the NRB. Nielsen statisticians use data from Claritas (often based on Census provided estimates of population characteristics) to weight respondent cases to reproduce the population aggregate distribution on those variables. Post-survey adjustment is a standard practice in sample surveys. Adjustments can be performed in a variety of ways.

The Michigan-Maryland team raised three concerns about the Nielsen postsurvey adjustments. In order to weight the respondent sample, the Census variables must be measured on all respondent cases. When there is item missing data on a poststratification variable on a respondent case, it is often imputed or the case is assigned to a poststratum in some other fashion. Rarely, if ever, in practice, are poststratified estimates based on small subsets of the respondent pool because poststratification variables are missing. Nielsen chose to drop many respondent cases from the poststratified estimation because of missing data. In the judgment of the Michigan-Maryland team, this raises serious issues about the interpretation of the poststratified estimates.

Second, poststratification generally requires putting cases into groups sharing values on the poststratification factors. When the sample size is small (as is the case for the NRB meter sample), some of the poststratification cells may have only a few cases in them or even no cases. Common practice in such instances is to combine adjacent poststrata in order to preserve population totals. Currently we do not have enough information to evaluate whether this collapsing was done and, if so, how it was carried out by Nielsen.

Third, it is standard practice to let the share of poststratification weights be determined by the multivariate raking process. Currently we do not understand Nielsen's decision to force the share of the poststratification weights in NRB selection strata to conform to the share of the selection weights in those strata.

For these three reasons, the Michigan-Maryland team did not replicate the second step in the Nielsen analytic plan.

3. Independent Analysis

The Michigan-Maryland team conducted an independent analysis of the NRB study data, seeking insights into the magnitude of and character of nonresponse bias in the Nielsen viewing estimates. The five parts of this independent analysis are presented in this section.

- Section 3.1 offers tests for differences on key statistics of TV viewing between *Cooperators* and *Refusers* from the original Nielsen People Meter Panel recruitment. By “Cooperators”, we mean basics that agreed to participate and completed their time in the panel. “Refusers” are basics that either were never installed or had been installed but decided they did not want to participate at some point in the panel. The results from this analysis should signal potential for nonresponse bias in the TV viewing measures.
- Section 3.2 provides estimates of nonresponse bias in the TV viewing measures given the differences between Cooperators and Refusers found in 3.1.
- Section 3.3 tests for differences between Cooperators and Refusers on several demographic measures. The results from this analysis should signal whether differences between Cooperators and Refusers in the covariates can explain any observed viewing differences.
- Section 3.4 tests for differences on TV equipment and TV viewing behavior measures between Cooperators and Refusers. The results from this analysis should signal whether differences between Cooperators and Refusers in the covariates can explain any observed viewing differences.
- Section 3.5 further examines the results of 3.1. Here estimates are provided for the differences on key statistics between Cooperators and Refusers after controlling for multiple covariates. This analysis gives insights into the potential effectiveness of poststratification weights for removing the nonresponse bias in Nielsen viewing estimates.

To guard against interviewing different households than those initially recruited for the People Meter Panel, the NRB study questionnaire included two questions about the length of time the household members have lived at the current address (Questions 108 and 109) and a question on whether or not respondents remember someone visiting the household to ask if they wanted to be part of the People Meter Panel. In our analyses, we included only those cases that had

- (1) at least one household member living at the current address for at least 2 years; this includes the time of the People Meter participation request (see Nielsen report), or those that
- (2) declared remembering having someone from Nielsen visit the household to ask if they wanted to be part of the People Meter Panel, resulting in ~1,650 cases that comply with either or both of these two conditions. Nielsen employed a smaller case base based only on criterion (1).

We should also point out that the NRB study questionnaire was to be completed by the head of the household, defined as someone living in the household who owns, is buying or rents the home (see Nielsen report). Throughout the report we will point out which TV viewing measures refer to reports about the entire household and which ones are respondent level measures.

A complete list of the development of the analytic variables, the weighting variables, and the variance estimation procedures is summarized in Appendix C. The standard errors were estimated using Jackknife Repeated Replication (20 replicates). All analyses used the nonresponse adjusted selection weights (referred to as “Respondent Weight” in the appendices). All of the analyses presented here were conducted with SAS Version 9.13 and SUDAAN Release 9.0.3 (SAS-Callable version).

3.1. Comparison of Cooperators versus Refusers on Viewing Measures

We analyzed two measures of TV viewing: the percentage of households that reported watching TV during a given daypart yesterday (“Dayparts”), and the percentage of households responding that they typically watch a given station daily or weekly (“Stations”). We used yesterday rather than typical weekday viewing which was also included in the questionnaire because we expected that respondents would be able to more easily and accurately report about yesterday. It may be difficult to answer questions about viewing on a typical weekday if there is not a “typical” weekday or if they do not usually watch on weekdays.

Before presenting the results, we note sources of variation in sample size across the analyses. For broadcast stations, the estimation sample consists of ~1,650 cases. For non-broadcast stations, the estimation sample includes only those households that reported subscribing to cable or satellite service, resulting in ~1,360 cases for analysis. The variation in sample size (n) observed in some of the tables is explained by missing data particular to each measure.

Dayparts

- At the household level, we found a difference between Cooperators and Refusers in 1 of the 7 Dayparts under study. Refusers were more likely to report watching TV during Prime Time (8pm-11pm). See Table 4.
- At the person level, we did not detect a difference between Cooperators and Refusers in any of the 7 Dayparts.

Table 4. Percentage of Households Watching TV Yesterday.

Daypart	Cooperator		Refuser		n	p-value
	%	SE	%	SE		
5am-9am	41.9	2.05	45.8	2.07	1,649	0.1135
9am-4pm	56.1	1.66	56.3	1.78	1,649	0.9436
4pm-8pm	67.4	2.07	69.7	1.86	1,649	0.4612
8pm-11pm	71.2	1.42	76.2	1.35	1,649	0.0395
11pm-2am	39.3	1.62	39.7	2.17	1,649	0.8863
2am-5am	10.2	1.15	12.3	1.34	1,649	0.1823
12am-12am	91.5	0.89	90.1	1.10	1,649	0.4124

Table 5. Percentage of Persons Watching TV Yesterday.

Daypart	Cooperator		Refuser		n	p-value
	%	SE	%	SE		
5am-9am	30.8	1.84	30.9	1.51	1,652	0.9784
9am-4pm	41.2	1.88	36.1	2.65	1,652	0.1475
4pm-8pm	55.8	1.82	55.0	2.43	1,652	0.7968
8pm-11pm	65.4	1.42	66.7	1.78	1,652	0.5176
11pm-2am	29.9	1.60	31.5	2.15	1,652	0.6001
2am-5am	7.0	0.70	7.5	1.25	1,652	0.7358
12am-12am	86.4	1.49	83.9	1.62	1,652	0.2269

Stations

In the NRB study, station viewing was only measured at the person level (Question 31, see Nielsen report). Thus all results presented here are at the person level.

- Differences between Cooperators and Refusers were found for 2 of the 16 stations included in the questionnaire. See Tables 6 and 7.
- Refusers were more likely to be viewers of CNN and HBO.

Table 6. Percentage of Persons Watching Broadcast Stations Daily or Weekly.

Station	Cooperator		Refuser		n	p-value
	%	SE	%	SE		
ABC	70.3	1.54	73.7	1.64	1,652	0.1895
CBS	68.7	1.45	73.2	1.92	1,652	0.1201
FOX	68.4	1.46	72.7	1.51	1,652	0.1135
NBC	71.2	1.39	73.3	1.99	1,652	0.3806
UNIVISION	7.6	0.77	6.7	1.03	1,652	0.5213

Table 7. Percentage of Persons watching Non-Broadcast Stations Daily or Weekly.

Station	Cooperator		Refuser		n	p-value
	%	SE	%	SE		
A&E	36.22	1.54	35.50	2.14	1,362	0.7485
AMC	23.42	1.58	27.09	2.67	1,362	0.1528
BET	11.30	1.48	12.53	1.55	1,362	0.5242
CARTOON	20.29	1.83	23.08	1.71	1,362	0.2423
CNN	37.72	2.01	45.19	2.33	1,362	0.0046
ESPN	38.25	2.18	41.05	2.48	1,362	0.3370
HBO	17.40	1.62	27.86	1.92	1,362	0.0006
MTV	15.46	1.27	19.06	1.87	1,362	0.0943
TLC	34.00	1.73	33.19	2.40	1,362	0.7951
TNT	49.44	1.76	47.01	2.07	1,362	0.3899
USA	47.39	2.34	43.05	1.98	1,362	0.1694

We ran sensitivity analyses using different estimation samples and different reporting periods for the station measures, e.g., daily, daily/weekly, daily/weekly/monthly. The main results for the most part hold. See Appendix D for more detailed discussion of the sensitivity analyses.

3.2. Estimates of Nonresponse Bias on Viewing Measures

A difference between Cooperators and Refusers as presented in 3.1 merely indicates the potential for nonresponse bias. Thus, in this section, we examine estimates of nonresponse bias for viewing

estimates using the following estimator $\hat{\theta} = (\hat{y}_{coop} - \hat{y}_{total})$, where \hat{y}_{coop} is the estimate of the key statistic estimated from responding Cooperators, and \hat{y}_{total} is the estimate based on all responding cases (Cooperators and Refusers). An estimate of zero for $\hat{\theta}$ indicates the absence of nonresponse bias when using the Cooperator sample to make inferences to the Total sample. A significant positive value indicates that the Cooperator sample overestimates the viewing of the Total sample. A significant negative value indicates that the Cooperator sample underestimates the viewing of the Total sample.

In addition, we used two alternative nonresponse bias measures: A relative nonresponse bias measure expressed as $RelBias = (\hat{y}_{coop} - \hat{y}_{total}) / \hat{y}_{total}$, and a ratio measure expressed as $\hat{R} = (\hat{y}_{coop} / \hat{y}_{total})$; results from these analyses are provided in Appendix D. We obtain nearly identical results when using different estimators.

Dayparts and Stations

- Across all 30 key statistics examined here, evidence for nonresponse bias can be found for 3. Table 8 presents the estimates for these 3 viewing measures.
- Figure 1 illustrates the estimates of nonresponse bias for all 30 viewing measures.

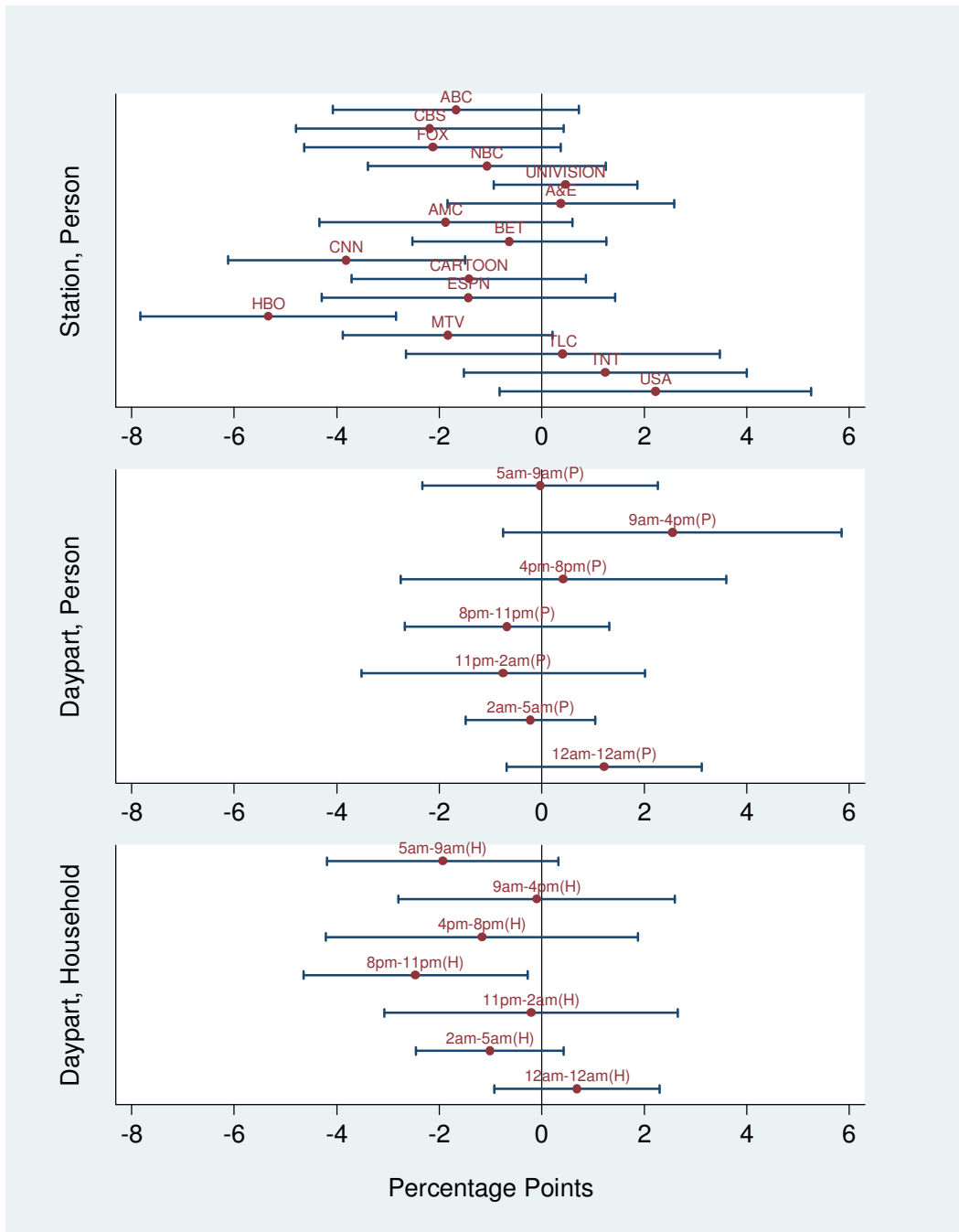
Table 8. Estimates of Nonresponse Bias in Viewing Estimates for Meter Sample (Bias = Cooperator-Total).

Daypart & Stations	Cooperator		Total		Bias		n	p-value
	%	SE	%	SE	%	SE		
8pm-11pm_HH	71.22	1.42	73.68	0.79	-2.46	1.11	1,649	0.0271
CNN	37.72	2.01	41.53	1.86	-3.81	1.18	1,362	0.0013
HBO	17.40	1.62	22.74	1.29	-5.34	1.27	1,362	0.0000

Conclusions:

Cooperator households are less likely to watch TV in prime time than All households – 71.2% as compared to 73.7%. Measured at the respondent level, Cooperator estimates of viewing of CNN and HBO are also lower than estimates based on All cases. For example, as seen in Table 8, the percentage of respondents that reported watching HBO daily or weekly among Cooperators is 5.3 percentage points lower than that for the Total sample. Estimates derived from the Cooperator cases only, underestimate the percentage of respondents who watch HBO daily or weekly.

Figure 1. Estimates of Nonresponse Bias in Percentage Points for all TV Measures Under Analysis



3.3. Comparison of Cooperators versus Refusers on Demographic and Geographic Characteristics

In addition to estimating potential nonresponse bias in the key viewing statistics, we examined differences in the demographics between Cooperators and Refusers. These differences might not result in nonresponse bias in the TV viewing estimates but can signal the potential for nonresponse bias in demographic estimates and other measures that are correlated with these demographic variables. In this section, we compare Cooperators and Refusers on 20 binary measures of demographic characteristics and 9 categorical measures of demographic and geographic characteristics. To the extent possible, we followed Nielsen’s National Audience Demographics Report when selecting variables and creating categories (see Appendix C).

Household Level

- At the Household level, Cooperators and Refusers show statistically significant differences in 3 of the 7 demographic characteristics studied. See Table 9.
- Compared to Cooperators, Refuser households tend to be higher income. Refusers also tend to have larger households.

Table 9. Household Demographic Characteristics by Meter Cooperation Status; Binary and Categorical Variables.

Demographic variables	Cooperator		Refuser		n	p-value
	%	SE	%	SE		
Has Child<18	37.6	2.39	41.0	2.10	1,601	0.2650
Has Child<6	15.7	1.47	19.0	2.07	1,599	0.2039
Has Income<\$40k	40.3	1.94	32.8	1.89	1,520	0.0088
Has Income<\$80k	75.8	1.34	66.1	1.94	1,520	0.0006
Owens housing unit	75.9	1.54	77.7	1.94	1,632	0.4886
<i>Household Size</i>						
0 HH members	0.2	0.16	0.1	0.07	1,624	0.1174
1 HH member	23.1	1.78	18.7	1.95	--	--
2 HH members	33.2	1.86	30.0	1.70	--	--
3 HH members	17.3	1.19	20.1	2.11	--	--
4 HH members	13.6	1.07	14.3	1.45	--	--
5 or more HH members	12.5	1.30	16.8	1.67	--	--
<i>Household Size</i>						
1 HH member	23.2	1.78	18.7	1.95	1,620	0.0498
2 HH members	33.3	1.86	30.1	1.71	--	--
3 or more HH members	43.5	1.95	51.3	2.21	--	--

Household Level (cont'd)

- We found differences between Cooperators and Refusers on the two geographic variables. These are among the most striking differences between Cooperators and Refusers in this study. Refusers are more likely to live in counties in the largest metropolitan areas (County Size A). They are also more likely to live in the Northeast. These geographic differences are consistent with prior research on household survey nonresponse. See Table 10.

Table 10. Geographic Characteristics by Meter Cooperation Status; Categorical Variables.

Geographic variables	Cooperator		Refuser		n	p-value
	%	SE	%	SE		
<i>County Size</i>						
A	30.4	0.89	43.9	1.63	1,652	0.0000
B	33.9	0.67	24.7	1.51	--	--
C	17.2	0.76	15.5	1.37	--	--
D	18.5	1.01	15.9	1.37	--	--
<i>Territory</i>						
Northeast	15.9	0.53	23.5	1.21	1,652	0.0000
East Central	16.0	0.65	12.4	0.92	--	--
West Central	17.8	0.57	15.4	1.09	--	--
Southeast	21.1	0.62	21.5	1.38	--	--
Southwest	11.8	0.58	9.5	0.93	--	--
Pacific	17.4	0.64	17.7	1.29	--	--

Person Level

- We did not detect any differences between Cooperators and Refusers in the Person level demographic characteristics that we examined. See Tables 11-13.

Table 11. Percentage of Respondent Demographic Characteristics by Meter Cooperation Status; Binary Variables.

Demographic variables	Cooperator		Refuser		n	p-value
	%	SE	%	SE		
Has 50+ yrs	52.2	1.97	50.0	2.27	1,614	0.4627
Male	41.9	1.36	41.0	2.27	1,629	0.7462
Has Hispanic Ancestor	12.1	0.82	10.5	1.25	1,635	0.3065
Hispanic	11.7	0.81	9.0	1.13	1,635	0.0805
Race Asian	1.8	0.41	2.9	0.55	1,605	0.1241
Race Black	11.6	1.30	14.5	2.07	1,605	0.2584
Race Hawaiian	0.7	0.35	0.1	0.08	1,605	0.1079
Race Native American	3.1	0.75	3.8	0.88	1,605	0.5225
Race Other	6.5	0.90	6.2	0.89	1,605	0.8302
Race White	80.0	1.38	76.2	2.23	1,605	0.1533
Non-Hispanic and Non-Black	77.2	1.42	77.8	2.25	1,599	0.8058
Has Cuban origin	4.0	2.09	10.7	4.10	184	0.1922
Has Mexican origin	60.8	6.13	44.6	6.63	184	0.0910
Has Other origin	29.2	4.53	32.9	6.29	184	0.6148
Has Puerto Rican origin	10.1	2.92	16.2	4.07	184	0.1974

Table 12. Distribution of Respondent Demographic Characteristics by Meter Cooperation Status; Categorical Variables.

Demographic variables	Cooperator		Refuser		n	p-value
	%	SE	%	SE		
<i>Age Categories</i>						
<=34 years	14.4	1.39	18.3	1.91	1,614	0.3322
35-49 years	33.4	1.70	31.7	2.22	--	--
50-64 years	29.9	1.82	29.1	1.87	--	--
>=65 years	22.3	1.66	21.0	1.71	--	--
<i>Marital Status</i>						
Married/Cohabiting	58.2	1.39	60.5	2.20	1,640	0.6853
Divorced/Separated/Widowed	28.0	1.42	25.7	2.22	--	--
Single/Never Married	13.7	1.12	13.8	0.99	--	--
<i>Education Respondent</i>						
Less than HS	10.2	1.14	8.4	0.87	1,631	0.2672
HS Diploma	22.4	1.45	25.0	1.89	--	--
Some College	27.9	1.48	24.5	2.09	--	--
Associate/Bachelor's	25.0	1.31	27.9	1.96	--	--
Graduate/Professional	14.5	1.42	14.2	1.45	--	--

Table 13. Distribution of Respondent Demographic Characteristics by Meter Cooperation Status; Categorical Variables.

Demographic variables	Cooperator		Refuser		n	p-value
	%	SE	%	SE		
<i>Occupation Respondent</i>						
Working full-time/Vacation, sick, etc.	50.8	2.05	51.5	2.15	1,643	0.8914
Working part-time	10.8	1.38	9.9	1.32	--	--
Retired	22.8	1.33	21.7	1.69	--	--
Unemployed/Other	15.6	1.63	17.0	2.02	--	--
<i>Occupation Respondent</i>						
Working full-time/Vacation, sick, etc.	61.9	2.08	62.1	3.28	958	0.4061
Working part-time	10.5	1.15	7.6	2.04	--	--
Retired	16.4	1.44	18.1	2.08	--	--
Unemployed/Other	11.3	1.39	12.2	1.68	--	--

3.4. Comparison of Cooperators versus Refusers on TV Equipment, Respondents' TV Viewing Behavior

The NRB study questionnaire contained a series of questions about household ownership of TV equipment, as well as questions about the respondent's TV viewing behavior. We compared Cooperators and Refusers on these items, using a total of 12 binary measures of TV Equipment, 12 categorical measures of TV Attitudes and Behavior, and 8 measures of hours spent at home or on leisure activities.

Household Level

- Cooperators and Refusers differ in 6 of the 12 measures of TV equipment (Table 14).
- Refusers are more heavily equipped than Cooperators. Refusers are more likely to have a big screen TV, have cable, have digital cable, have a DVR, have DVR service that is provided through cable/satellite, and have three or more TVs. These differences are some of the largest differences between Cooperators and Refusers that we observe in this study. One explanation could be that it is more burdensome for heavily equipped households to be set up and maintained as Meter households and this may make them less likely to participate.

Table 14. Percentage of Households with TV Equipment by Meter Cooperation Status.

TV Equipment variables	Cooperator		Refuser		n	p-value
	%	SE	%	SE		
Has Big Screen	22.6	1.44	41.2	1.87	1,638	0.0000
Has Cable	61.9	1.82	69.1	1.68	1,643	0.0034
Has Digital Cable	48.5	1.84	60.4	2.25	1,059	0.0009
Has Satellite	24.7	1.49	28.5	2.22	1,636	0.1794
Has DVD	88.2	1.33	85.3	1.25	1,632	0.0595
Has DVR	9.7	1.22	20.1	1.77	1,635	0.0007
Has DVR provided through Cable/Satellite	15.1	1.54	26.3	1.95	1,268	0.0016
Has Computer at home	76.7	1.54	76.9	2.09	1,626	0.9324
Has High speed Internet	72.9	1.81	75.3	2.09	1,255	0.3045
Can watch TV over the Internet	63.6	2.60	69.5	2.60	918	0.1459
Has 3+ TVs	46.1	2.27	60.2	2.24	1,650	0.0003

Household Level (cont'd)

- We also found differences between Cooperators and Refusers in 3 of the 6 measures of TV behavior (Table 15).
- Cooperators are more likely to have the TV on only when some is watching, rather than all the time.
- Refusers are more likely to have had visitors watching TV at their home in the last 30 days.
- Refusers are more likely to have had visitors bringing TV equipment into their home in the last 30 days.
- These findings suggest that Refusers may have TV behavior patterns that make it more burdensome for them to record their viewing and to have their TV equipment set up and maintained to track viewing.

Table 15. Mean Score on TV Behavior and Attitudes by Meter Cooperation Status; Household Level.

TV Behavior and Attitude variables*	Scale	Cooperator		Refuser		n	p-value
		mean	SE	mean	SE		
Household won't miss watching TV for 1 week (=5)	(1,5)	2.28	0.04	2.23	0.06	1,623	0.5102
TV only on when someone watching (=7)	(1,7)	5.01	0.07	4.67	0.10	1,615	0.0103
Household watches TV in groups at night (=1)	(0,1)	0.55	0.01	0.59	0.02	1,625	0.1514
Has moved TV equipment around the house last 30 days (=1)	(0,1)	0.10	0.01	0.10	0.01	1,636	0.9257
Has had visitors watching TV at home last 30 days (=1)	(0,1)	0.53	0.02	0.63	0.02	1,636	0.0033
Has had visitors bringing TV equipment into home last 30 days (=1)	(0,1)	0.02	0.00	0.04	0.01	1,634	0.0252

Note: (*) For each statement, the number in parenthesis indicates the end point of the scale that the statement endorses. For the first statement, for example, a value of “5” indicates that “Household won't miss watching TV for 1 week”, whereas a value of “1” indicates the opposite end point - “Household will miss watching TV for 1 week”.

Person Level

- At the Person level, we found statistical differences between Cooperators and Refusers in 3 of the 6 measures of attitudes towards TV (Table 16).
- Refusers were less likely to plan TV watching in advance.
- Refusers were less likely to do other things while watching TV.
- Refusers were more likely to turn the TV on for company.

Table 16. Mean Score on TV Behavior and Attitudes by Meter Cooperation Status; Respondent Level.

TV Behavior and Attitude variables*	Scale	Cooperator		Refuser		n	p-value
		mean	SE	mean	SE		
Person doesn't plan watching TV in advance (=7)	(1,7)	3.55	0.07	3.76	0.10	1,634	0.0422
Person watches whatever is on TV (=7)	(1,7)	3.12	0.06	3.20	0.09	1,634	0.3206
Person also does other things while watching TV (=7)	(1,7)	4.08	0.06	3.83	0.07	1,639	0.0078
Person switches between several programs at same time (=7)	(1,7)	3.19	0.08	3.28	0.09	1,640	0.4321
Person unlikely to turn TV on for company (=4)	(1,4)	2.68	0.05	2.46	0.04	1,644	0.0010
Person won't miss watching TV for 1 week (=5)	(1,5)	2.64	0.04	2.58	0.06	1,642	0.4324

Note: (*) For each statement, the number in parenthesis indicates the end point of the scale that the statement endorses. For the first statement, for example, a value of "7" indicates that "Person doesn't plan watching TV in advance", whereas a value of "1" indicates the opposite end point - "Person plans watching TV in advance".

- We found a difference between Cooperators and Refusers in 1 of the 8 leisure activity and time spent at home measures (Table 17).
- Cooperators spend more time listening to the radio than Refusers.

Table 17. Mean Hours of Leisure Activity and Time Spent at Home by Meter Cooperation Status; Respondent Level.

Leisure Activity and Time Spent at Home variables	Cooperator		Refuser		n	p-value
	mean	SE	mean	SE		
Personal Hrs on Internet at home per day, last 7 days	2.17	0.14	2.36	0.21	1,599	0.4334
Personal Hrs reading paper Newspaper per day, last 7 days	1.20	0.08	1.21	0.07	1,623	0.9584
Personal Hrs reading paper Magazines per day, last 7 days	0.83	0.05	0.88	0.07	1,622	0.5106
Personal Hrs hearing Radio per day, last 7 days	2.78	0.13	2.38	0.13	1,617	0.0109
Personal Hrs spent at Home Mon-Fri per day, last 7 days	9.52	0.16	9.71	0.23	1,607	0.5346
Personal Hrs spent at Home most recent Saturday	9.16	0.19	9.59	0.21	1,616	0.1289
Personal Hrs spent at Home most recent Sunday	9.80	0.15	10.18	0.26	1,618	0.2381
Personal Hrs spent at Home Yesterday	8.73	0.17	9.15	0.19	1,600	0.0979

Conclusions

Refusers are more heavily invested in TV equipment than Cooperators.

- If the availability of TV equipment is associated with certain patterns of viewing, then this could be an indicator of nonresponse bias. This could be the case, for example, if people with big screen TVs are more likely to watch sports events than those with regular screens or if households with a DVR tend to differ in their viewing habits from those who do not have a DVR.

Refusers exhibit irregular patterns of TV viewing behavior. They are more likely to report visitors watching TV or bringing TV equipment into their home in the last 30 days. They are more likely to have the TV on all the time – e.g., while doing other things, for company, without planning in advance.

- It is possible that households with these complex TV viewing behaviors view Meter participation as too burdensome. If these behaviors are associated with viewing measures, then this creates the potential for nonresponse bias.
- Another concern is that households with these behavior patterns may find it difficult to accurately record their viewing and thus may be more prone to faulting.

3.5. Nonresponse Bias Analysis Using Multivariate Approaches

The key statistical results in the sections above suggest that, for a large set of estimates of audience behavior, there are only small nonresponse bias magnitudes. There is, however, a subset of three estimates that appear to suffer from nonresponse bias (Table 8 in section 3.2); these biases seem robust to alternative ways of estimating them. However, given the differences between Cooperators and Refusers found on demographic, geographic and TV equipment variables (sections 3.3-3.4), some of the biased estimates might be reduced by adjusting the Cooperators on these variables. The analyses presented in this section will address this point. In particular, we will examine to what extent variables used in the Nielsen post-survey adjustment procedures at the national level successfully reduce the estimated nonresponse bias found in the NRB study and explore additional covariates that could improve such endeavors.

Multivariate Models

In this exploratory analysis, we run four logistic regression models for each key TV viewing statistic for which there was evidence of nonresponse bias in the NRB study. The models are nested within each other. Model 1 is the baseline model, and the rest are built by adding additional covariates.

Model 1 is a simple binary logistic regression with the TV viewing measure as the dependent variable and Cooperator status as a covariate. Thus, the regression coefficient in each of the models indicates how Cooperators differ from Refusers on that particular viewing measure. Model 1 resembles the bivariate analysis presented in section 3.1.

Model 2 adds the Nielsen Meter poststratification weight as a covariate in the logistic regression model. This model attempts to mimic the effect of the post-survey adjustment typically implemented by Nielsen at the national level. A successful poststratification would reduce the coefficient of Cooperator status towards zero.

Model 3 adds additional covariates that our exploratory analyses suggested as candidates for adjustment variables. These are demographic and geographic variables as well as TV equipment measures. This model mimics the effects of poststratification on this set of covariates. A successful poststratification on these variables would reduce the coefficient of Cooperator status towards zero.

Model 4 adds interaction effects of Cooperator status and selected variables as additional covariates. The interactions in this more complex model serve the purpose of identifying potential for

violation of the missing at random (MAR) assumption, and thus signaling the potential for nonresponse bias. This model serves as a check for Model 3. A significant interaction effect between Cooperator status and the covariates indicates that in the subgroups formed by the covariates Cooperators and Refusers differ in their viewing. Hence caution should be exercised when considering these covariates as additional adjustment variables.

All of these models are weighted logistic regressions. We used the “Respondent Weight” as the weighting variable. We used Jackknife Repeated Replications (20 replicates) to estimate the standard errors of the regression coefficients.

We should also note that the use of the Nielsen poststratification weights in this exploratory analysis reduces the size of the estimation sample to roughly 1,450 cases. These are the cases in the NRB study that have complete information on all 15 covariates necessary for the Nielsen poststratification weight. With this reduced case base, two of the measures for which we found significant differences – household prime-time viewing and CNN viewing – now only show a marginally significant difference between Cooperators and Refusers (see Appendix D). Since this is an exploratory analysis and the selection of a 0.05 significance level is arbitrary, we decided to include these differences as significant ones to be investigated in the multivariate models. We caution that the results of these analyses may look different if they had been run with the larger original case base and appropriate poststratification weights.

One final technical note before we interpret the multivariate models: The selection of covariates for Model 3 was done in two steps. First we identified 16 variables that we expect to be associated with TV viewing: 10 demographic (Owner, Income>40k, Children<6, Children 6-17, Household Size, Hispanic, Race Black, Education, Age, Gender), 4 TV equipment (Number TVs, Big Screen, Cable/Satellite, DVR) and 2 geographic (County Size, Territory). Then we ran stepwise Logistic Regressions of the binary variable Cooperation Status on the 16 covariates (subgroups) mentioned above. We also ran stepwise Logistic Regressions for each of the viewing measures: household prime-time viewing, daily/weekly CNN viewing, and daily/weekly HBO viewing. For parsimony, we selected a maximum of 5 covariates for our multivariate models. From the regression on Cooperator Status we had proposed to select the 3 covariates that were also retained in the majority of the viewing models, but since there were only 2 covariates that were significant in both the Cooperator Status model and any of the viewing models, we decided to only include those two. From the regression on each Station (or Daypart) we selected the 3 most significant covariates (lowest p-values). The rationale

behind the selection of covariates was to include covariates that are correlated with the response propensity (Cooperator status) and the TV viewing measure of interest (Station/Daypart models). See Appendix C for a detailed methods explanation and Appendix D for the results of the Stepwise Regression models.

Results

Nonresponse bias is likely to be removed after applying Nielsen's poststratification adjustments for CNN.

- Table 18 illustrates this case. The bias levels of the CNN viewing was small enough that the sample size could barely detect it reliably. Thus, cooperator status is marginally significant in Model 1. When the Nielsen poststratification weight is introduced as a covariate in Model 2, any evidence of nonresponse bias disappears (even though the coefficient on the weight itself is negligible). Our conclusion from this modeling is that the likely differences between respondents and nonrespondents on CNN viewing is indeed rather small, not stable enough to be a serious issue meriting further exploration of adjustment techniques.

Nielsen's poststratification adjustment has the potential to introduce nonresponse bias.

- Table 19, addressing household prime time viewing, illustrates this case. While only marginally significant in Model 1, the effect of Cooperator status is larger and statistically significant in Model 2 when the Nielsen poststratification weight is introduced in the model. Additional analyses are needed to determine whether other viewing estimates may be negatively affected by Nielsen's poststratification adjustment.

While additional covariates appear promising for reducing nonresponse bias in Household Prime Time Viewing, a more thorough evaluation is needed.

- Table 19 again illustrates this. With the addition of covariates in Models 3 and 4, Cooperator status is no longer significant, which would suggest that these covariates may be useful candidates for nonresponse adjustment. However, as shown in Model 4, there is a significant interaction between one of the covariates – has cable/satellite – and Cooperator status. This means that the relationship between the weighting variable, cable status in this case, and household prime time viewing is different for respondents and nonrespondents.

- This is a violation of the basic assumption underlying post-survey adjustments. For an adjustment to effectively reduce bias, Cooperators and Refusers must have the same viewing patterns within each cell. The significant interaction indicates that this is not the case.
- The use of additional covariates for adjustment must be carefully evaluated given this preliminary result.

Nonresponse bias is unlikely to be removed for HBO, even after controlling for additional covariates.

- Table 20 illustrates this. Cooperator status remains statistically significant after controlling for the main effects of poststratification weight (Model 2); and after including additional covariates, i.e., having a big screen TV, having a DVR, male respondent, cable/satellite status, and black respondent (Model 3). Additional work is needed to determine how to reduce nonresponse bias for HBO viewing.

Table 18. Weighted Logistic Regression of Daily/Weekly CNN Viewing on Subgroups; Households with Cable or Satellite.

Predictors	Model 1			Model 2			Model 3		
	B	SE(B)	p-value	B	SE(B)	p-value	B	SE(B)	p-value
<i>Cooperator</i>									
Yes	-0.27	0.13	0.0508	-0.24	0.13	0.0827	-0.20	0.15	0.1925
<i>PS weight</i>				0.00	0.00	0.6566	0.00	0.00	0.6450
<i>Has Big Screen</i>									
Yes							0.19	0.17	0.2862
<i>Has DVR</i>									
Yes							0.01	0.17	0.9697
<i>Male</i>									
Yes							0.52	0.13	0.0011
<i>Has Cable/Satellite</i>									
Satellite only							-0.15	0.18	0.4286
Cable & Satellite							-0.60	0.21	0.0094
<i>Race Black</i>									
Yes							0.34	0.23	0.1601
<i>Constant</i>	-0.24	0.11	0.0465	-0.30	0.15	0.0569	-0.59	0.16	0.0017
N	1,192			1,192			1,174		

Notes: The reference categories for the categorical covariates are: Refuser (Cooperator), No (Has Big Screen), No (Has DVR), No (Male), Cable only (Has Cable/Satellite), and No (Race Black).

Table 19. Weighted Logistic Regression of Household Prime Time Viewing on Subgroups; All Households.

Predictors	Model 1			Model 2			Model 3			Model 4		
	B	SE(B)	p-value	B	SE(B)	p-value	B	SE(B)	p-value	B	SE(B)	p-value
<i>Cooperator</i>												
Yes	0.26	0.13	0.0643	0.38	0.14	0.0127	0.17	0.14	0.2394	0.48	0.33	0.1571
<i>PS weight</i>				-0.00	0.00	0.0471	0.00	0.00	0.9246	0.00	0.00	0.8333
<i>Has Big Screen</i>												
Yes							0.16	0.15	0.3166	0.14	0.15	0.3817
<i>Has DVR</i>												
Yes							0.38	0.14	0.0161	0.35	0.15	0.0316
<i>Household Size</i>												
1 HH member							0.92	0.22	0.0004	0.92	0.22	0.0005
2 HH members							0.44	0.20	0.0401	0.45	0.19	0.0321
<i>Has Children<6 yrs</i>												
Yes							0.42	0.23	0.0829	0.40	0.23	0.1016
<i>Has Cable/Satellite</i>												
Cable only							0.73	0.22	0.0039	1.22	0.38	0.0047
Satellite only							0.80	0.27	0.0078	1.35	0.49	0.0133
Cable & Satellite							0.35	0.31	0.2701	0.57	0.44	0.2152
<i>Has Cable/Satellite*Cooperator</i>												
(Cable only)*Cooperator										0.88	0.35	0.0203
(Satellite only)*Cooperator										0.95	0.52	0.0824
(Cable & Satellite)*Cooperator										0.20	0.57	0.7302
<i>Constant</i>	1.23	0.08	0.0000	1.52	0.16	0.0000	1.02	0.22	0.0002	0.62	0.33	0.0738
N	1,447			1,447			1,430			1,430		

Notes: The reference categories for the categorical covariates are: Refuser (Cooperator), No (Has Big Screen), No (Has DVR), 3+ HH members (Household Size), No (Has Children< 6 yrs), and Neither cable nor satellite (Has Cable/Satellite).

Table 20. Weighted Logistic Regression of Daily/Weekly HBO Viewing on Subgroups; Households with Cable or Satellite.

Predictors	Model 1			Model 2			Model 3		
	B	SE(B)	p-value	B	SE(B)	p-value	B	SE(B)	p-value
<i>Cooperator</i>									
Yes	-0.56	0.14	0.0010	-0.94	0.15	0.0000	-0.53	0.17	0.0061
<i>PS weight</i>				-0.00	0.00	0.0003	-0.00	0.00	0.0007
<i>Has Big Screen</i>									
Yes							1.05	0.13	0.0000
<i>Has DVR</i>									
Yes							0.56	0.15	0.0017
<i>Male</i>									
Yes							0.46	0.22	0.0491
<i>Has Cable/Satellite</i>									
Satellite only							-0.52	0.25	0.0484
Cable & Satellite							0.16	0.27	0.5611
<i>Race Black</i>									
Yes							0.83	0.19	0.0003
<i>Constant</i>	-0.94	0.10	0.0000	-0.02	0.19	0.9292	-1.16	0.25	0.0002
N	1,192			1,192			1,174		

Notes: The reference categories for the categorical covariates are: Refuser (Cooperator), No (Has Big Screen), No (Has DVR), No (Male), Cable only (Has Cable/Satellite), and No (Race Black).

4. Nonresponse Bias in the Nonresponse Bias Study Itself

The NRB study was conducted to assess the potential for nonresponse bias in Nielsen viewing estimates but estimates from the NRB study as survey estimates themselves are subject to nonresponse bias and other sources of survey error. Five major sources of survey error are:

- Sampling Error – Error due to only observing a sample of the population rather than the entire population. This error is quantified in the standard error estimate included for each mean, percent and regression coefficient in this report.
- Coverage Error - Error that may be introduced when the list used for sampling does not include persons who should be included (target population) or includes persons who should not be included (not part of the target population)
- Nonresponse Error – Error that may be introduced when not all persons sampled for the survey participate (unit nonresponse) or not all survey items are answered (item nonresponse) by a respondent
- Measurement Error – Error due to the measurement process; that is, error introduced by the survey instrument, mode of data collection (e.g., face-to-face, telephone), the interviewer, or the respondent.
- Processing and Adjustment Error – Error that may be introduced in the editing, data entry, data cleaning and post-survey adjustment (e.g., weighting, imputation) phases

Errors due to the survey process may affect the conclusions that have been presented in this report. These possible error sources should be carefully evaluated and quantified to the extent possible. The potential for nonresponse error was of particular concern to the CRE. We have investigated nonresponse bias in the NRB study using Nielsen geography and Census block level demographics and present our findings in this section.

Less than one-quarter (542) of the 2,300 Meter cases that were sampled for the NRB study were nonrespondents. As noted earlier, Nielsen used a well-designed survey protocol to achieve a level of cooperation which is comparable or better than what would have been expected in a study that includes a substantial percent of nonrespondents from a previous study. Nonetheless, it is possible that those who did not respond may be different from those who did and this could introduce nonresponse bias in the estimates presented in this report. A variety of approaches have been used to study nonresponse bias, with the following being some of the most common:

- comparing respondents and nonrespondents on sampling frame variables, interviewer observations, or Census data
- taking a random sample of nonrespondents, gathering data on key variables and making inferences about all nonrespondents based on data from the subsample
- examining data on key variables for the respondents who require the most effort under the assumption that these respondents who do not participate until later in the survey period are like those who never participate.

The approach we used was to first examine overall differences between NRB respondents and nonrespondents on Nielsen geography variables (Table 21) and Census block group level demographics (Table 22). A Census block group is a group of about 40 Census blocks on average. For the block group level measures, we calculated the percent of households in that area with a particular characteristic (e.g., 1 person household) and then analyzed this variable using quartiles. We note that Nielsen geography variables and Census block group level demographics were available for all 2,300 sampled Meter cases.

As seen in Table 21, there were some overall differences between NRB respondents and nonrespondents. NRB nonrespondents were more likely to live in the largest metropolitan counties (Size A), and in the Northeast or Pacific regions. Nonrespondents were more concentrated in areas with larger minority populations (see Table 22). About 34% of nonrespondents lived in a block group with 10% or more Hispanic households while only 23% of respondents lived in these more heavily Hispanic areas. These differences are consistent with prior research on nonresponse in household surveys.

However, since most of the analyses from the NRB study involved comparisons of Cooperators and Refusers, the question was not whether there were *overall* differences between respondents and nonrespondents but rather whether Cooperator versus Refuser differences (as presented in section 3 of this report) held if NRB nonrespondents were included. To address this question, we ran a series of regression models (multinomial logistic or linear model with selection weights) with the following variables:

- Dependent variable: each of the Nielsen geography variables and Census block level demographics (% of households with a demographic characteristic, e.g., 1 person household, was entered as a continuous dependent variable)

- Independent variables: NRB study participation status (respondent, nonrespondent), Meter cooperation status (cooperator, refuser), and interaction between NRB study participation status and Meter cooperation status.

A non-zero interaction term between NRB study participation status and Meter cooperation status meant that the relationship between Meter cooperation status and the Nielsen geography or Census block level variable was different for NRB respondents and nonrespondents. In other words, by not including NRB study nonrespondents, we would have failed to obtain an accurate assessment of the difference (or lack of difference) between Cooperators and Refusers on the Nielsen geography or Census block level variable. The last column of Tables 21 and 22 indicates whether there was a non-zero interaction term between NRB study participation status and Meter cooperation status.

As seen in Tables 21 and 22, there was evidence of potential nonresponse bias in the comparisons between Cooperators and Refusers for four variables:

- territory
- percent of households that are 2 person households in the Census block group
- percent of households of “Other” race in the Census block group
- percent of households with a child less than 18 in the Census block group.

Whether nonresponse bias on these measures portends nonresponse bias on the viewing measures that were presented in this report depends on the magnitude of the correlation between the geography or Census demographic measure and viewing.

Overall, we find that for most geography and Census demographic variables shown in Tables 21 and 22, there is little evidence of nonresponse bias. That is, any difference between respondents and nonrespondents did not appear to affect the comparison of Cooperators and Refusers on that measure. This lends confidence to the findings from the NRB study. However, it is important to keep in mind that the geography and Census demographic measures that were available for our nonresponse bias analysis are likely only weakly correlated with viewing. Thus, we can only infer that the variables available on NRB respondents and nonrespondents do not suggest our conclusions about the NRB study findings are themselves tainted by nonresponse error.

Table 21. Distribution of Nielsen Geography Variables by NRB Study Participation Status.

Geography variables	NRB Study Participation Status				N	Potential Nonresponse Bias in Comparing Cooperators and Refusers?
	Respondent		Nonrespondent			
	%	SE	%	SE		
<i>County Size</i>						
A	36.2	1.22	47.2	2.44	2,300	N
B	30.3	1.31	28.2	2.40		
C	16.7	1.07	14.1	1.88		
D	16.8	1.08	10.5	1.68		
<i>Territory</i>						
Northeast	19.0	0.99	23.2	1.94	2,300	Y
East Central	14.3	0.99	12.6	1.72		
West Central	16.7	1.03	15.9	1.86		
Southeast	21.0	1.14	11.9	1.72		
Southwest	11.1	0.87	14.2	1.81		
Pacific	17.8	1.02	22.1	2.02		

Table 22. Distribution of Claritas Block Group Demographics by NRB Study Participation Status.

Block Group variables (by Quartile)	NRB Study Participation Status				N	Potential Nonresponse Bias in Comparing Cooperators and Refusers?
	Respondent		Nonrespondent			
	%	SE	%	SE		
<i>% of HHs - 1 Person</i>						
<=18.2%	24.3	1.13	27.2	2.18	2,300	N
18.3 - 24.8%	25.0	1.19	25.2	2.18		
24.9 - 32.6%	25.4	1.20	23.3	2.14		
32.7%+	25.2	1.19	24.4	2.09		
<i>% of HHs - 2 Person</i>						
<=28.3%	24.3	1.13	27.6	2.14	2,300	Y
28.4 - 32.7%	25.0	1.16	24.7	2.14		
32.8 - 36.7%	26.1	1.21	21.2	2.05		
36.8%+	24.6	1.20	26.4	2.25		
<i>% of HHs - 3 or More Persons</i>						
<=32.4%	24.8	1.19	25.7	2.17	2,300	N
32.5 - 40.7%	25.8	1.22	22.2	2.13		
40.8 - 49.0%	25.0	1.18	24.6	2.17		
49.1%+	24.3	1.12	27.5	2.13		
<i>% of HHs - American Indian</i>						
<=0.34%	24.5	1.16	27.0	2.18	2,300	N
0.35 - 0.71%	25.9	1.19	22.1	2.06		
0.72 - 1.4%	25.4	1.18	23.0	2.08		
1.5%+	24.1	1.18	28.0	2.25		
<i>% of HHs - Asian</i>						
<=0.33%	26.0	1.23	21.5	2.13	2,300	N
0.34 - 1.2%	25.8	1.21	22.3	2.10		
1.3 - 3.5%	25.4	1.19	23.6	2.12		
3.6%+	22.8	1.06	32.6	2.24		
<i>% of HHs - Black</i>						
<=0.67%	25.1	1.20	24.6	2.21	2,300	N
0.68 - 2.6%	25.4	1.18	23.5	2.09		
2.7 - 10.5%	24.2	1.15	27.9	2.21		
10.6%+	25.3	1.17	24.0	2.06		
<i>% of HHs - Hawaiian/Pacific Islander</i>						
0%	60.8	1.32	57.1	2.44	2,300	N
0.01 - 0.25%	20.3	1.08	18.7	1.91		
0.26%+	18.9	1.04	24.2	2.08		
<i>% of HHs - White</i>						
<=71.1%	24.0	1.12	28.6	2.14	2,300	N
71.2 - 90.2%	24.7	1.17	26.0	2.18		
90.3 - 96.7%	25.6	1.20	23.2	2.13		
96.8%+	25.7	1.22	22.3	2.16		
<i>% of HHs - Other Race</i>						
<=0.39%	26.6	1.23	19.1	2.04	2,300	Y
0.40 - 1.4%	26.5	1.21	19.7	1.96		
1.5 - 5.0%	24.0	1.14	29.0	2.24		
5.1%+	22.9	1.11	32.2	2.28		

Table 22. Distribution of Claritas Block Group Demographics by NRB Study Participation Status (cont'd).

Block Group variables (by Quartile)	NRB Study Participation Status				N	Potential Nonresponse Bias in Comparing Cooperators and Refusers?
	Respondent		Nonrespondent			
	%	SE	%	SE		
<i>% of HHs - White, Non-Hispanic</i>						
<=60.3%	23.5	1.11	30.5	2.21	2,300	N
60.4 - 85.3%	24.3	1.16	27.4	2.22		
85.4 - 94.6%	26.1	1.20	20.9	2.04		
94.7%+	26.1	1.23	21.2	2.12		
<i>% of HHs - Hispanic</i>						
<=1.0%	26.3	1.23	20.2	2.07	2,300	N
1.1 - 3.1%	27.0	1.22	18.2	1.91		
3.2 - 9.9%	24.1	1.14	28.1	2.20		
10.0%+	22.6	1.11	33.5	2.33		
<i>% of HHs - With Child < 18</i>						
<=27.9%	24.4	1.17	27.2	2.19	2,300	Y
28.0 - 35.0%	25.3	1.20	24.0	2.16		
35.1 - 42.0%	25.3	1.19	23.9	2.12		
42.1%+	25.0	1.15	24.9	2.11		
<i>% of HHs - With Head of HH 15-34</i>						
<=14.0%	24.1	1.13	28.4	2.21	2,300	N
14.1 - 19.1%	25.1	1.19	24.3	2.17		
19.2 - 25.4%	25.6	1.20	23.5	2.10		
25.5%+	25.3	1.18	23.8	2.11		
<i>% of HHs - With Head of HH 35-44</i>						
<=16.4%	24.6	1.20	26.0	2.23	2,300	N
16.5 - 19.8%	25.6	1.21	22.9	2.13		
19.9 - 23.2%	25.3	1.18	23.9	2.10		
23.3%+	24.4	1.12	27.2	2.13		
<i>% of HHs - With Head of HH 45-64</i>						
<=33.0%	25.0	1.18	24.7	2.13	2,300	N
33.1 - 37.9%	25.0	1.19	24.9	2.15		
38.0 - 43.2%	25.7	1.20	22.8	2.09		
43.3%+	24.3	1.14	27.6	2.22		
<i>% of HHs - With Head of HH 65+</i>						
<=14.3%	24.2	1.13	27.6	2.18	2,300	N
14.4 - 20.2%	25.1	1.18	25.0	2.16		
20.3 - 26.2%	25.1	1.19	24.8	2.18		
26.3%+	25.6	1.20	22.7	2.07		

5. Appendices

Appendix A. Meter Nonresponse Bias Study Design and Implementation

Appendix B. Memoranda from Michigan-Maryland Team to Council for Research Excellence and Nielsen

Appendix C. Analytic Methods

Appendix D. Detailed Result Tables

Appendix E. Nielsen Meter Nonresponse Bias Study Proposal and Analytic Plan