USING AN EXPERIMENT TO DESIGN AN RDD SURVEY[1]

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Introduction

Achieving high response rates in sample surveys has become increasingly more difficult in recent years. Atrostic, Bates, Burt, and Silberstein (2001) show that the rates of nonresponse were increasing at the end of the twentieth century for in-person household surveys conducted by the U.S. Census Bureau. The issue is of even greater concern in random digit dial (RDD) telephone surveys. Curtin, Singer, and Presser (1999) and Steeh et al. (2001) examine changes in response rates in RDD surveys. Although no response rates for RDD surveys conducted after 1999 are given in these articles, steep declines in RDD survey response rates after 1999 have been reported in professional meetings hosted by both the American Statistical Association (ASA) and the American Association for Public Opinion Research (AAPOR).

This article describes a large experiment conducted in the 2003 National Household Education Surveys Program that was designed to examine the effect of different monetary incentives in combination with various mailing conditions. The goal of the experiment was to determine if monetary incentives should be used in future surveys, and what combination of mailing conditions and incentives would be most effective.

National Household Education Surveys Program

The National Household Education Surveys Program (NHES) was developed by the National Center for Education Statistics (NCES) to collect information on important educational issues through telephone surveys of households in the United States. NHES uses list-assisted RDD and computer-assisted telephone interviewing (CATI). The number of screened households has ranged from about 32,000 to about 64,000, depending on the design for a given survey administration. The study design includes matching sampled telephone numbers to addresses and conducting mailings to respondents. NHES has been conducted by Westat in 1991, 1993, 1995, 1996, 1999, 2001, and 2003.

The 2003 administration was conducted from January through April of 2003. In the NHES:2003 Screener, household members were enumerated and demographic and educational information that determined eligibility for two topical surveys was collected. The NHES:2003 topical surveys were the Parent and Family Involvement in Education Survey and the Adult Education for Work-Related Reasons Survey.

NHES Screener Response Rates

Figure 1 shows the Screener response rates for NHES data collections from 1991 to 2003. The response rates are weighted by the base weights of the sampled telephone numbers to account for differential selection probabilities used in the surveys.

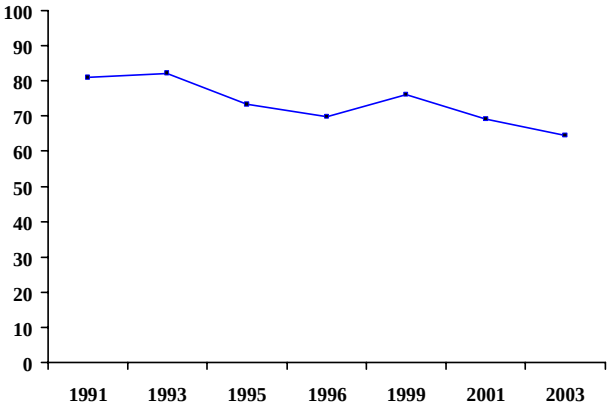

Figure 1. Trend in NHES response rates 1991-2003

The Screener unit response rates in the first two administrations were more than 80 percent, but then fell in 1995 and 1996. Brick and Collins (1997) show that much of this decrease was due to changes that increased the length and content of the screening interview. In

[1] This paper is intended to promote the exchange of ideas among researchers and policy makers. The views expressed in it are part of ongoing research and analysis and do not necessarily reflect the position of the U.S. Department of Education.

1999, the length and content of the Screener was revised to be more consistent with the earlier surveys and the response rates rose to 76 percent. The Screener response rates for 2001 and 2003 declined rather sharply despite the fact that the length and content of the Screener were very similar to 1999.

This decrease in Screener response rates occurred despite increases in the levels of effort used in NHES over the years, such as increasing the number of calls made to numbers before finalizing the case as a non-contact, increasing the number of cases that are contacted for second refusal conversions, etc. Methods to encourage participation in NHES include the use of letters, messages left on answering machines, refusal conversion attempts, additional call attempts for different types of outcomes, special interviewer training, and monetary incentives.

NHES:2003 Incentive Experiment

The overall objective of the experiment in 2003 was to determine if there were economical alternatives for improving unit response rates in NHES. The experiment focused primarily on the Screener because this is where most nonresponse occurs. The design of the Screener portion of the experiment is described below.

Experimental groups were developed to permit the examination of the following effects on response rates:

- The effect of varied incentives in the advance letter ($0, $2, and $5);
- The effect of varied incentives in the refusal conversion letter ($0, $2, and $5); and
- The effect of Priority Mail versus first class mail for the refusal conversion letter.

Because previous research indicated the relative effectiveness of prepaid incentives, all incentives used in the Screener experiment were prepaid. In addition, mailing an official NHES brochure has been considered a possible method for improving response rates. A test of the effectiveness of the brochure was also considered a treatment.

NHES:2003 Experimental Groups

The three variable treatments were combined to form 10 experimental conditions that were included in the Screener experiment. The sample sizes for each of the conditions and for the nonmailable cases (which were excluded from the experiment) are given in Table 1. The sample sizes were designed to allow detection of at least 3 percentage point differences in initial cooperation rates across the conditions. A total of 59,365 telephone numbers with mailable addresses (numbers for which an address could be found) were in the experiment. Because the experimental treatments all involve mailings, telephone numbers for which an address could not be found were not included in the experiment. The sample included 50,435 telephone numbers without mailable addresses.

Table 1. NHES:2003 experimental groups

Experimental group		Sample size (advance)
Advance mailing	Refusal mailing	
1. 1st class, $0, brochure	1st class, $0	5,765
2. 1st class, $0	1st class, $2	5,700
3. 1st class, $0	1st class, $5	5,700
4. 1st class, $0	Priority, $0	6,850
5. 1st class, $0	Priority, $2	5,700
6. 1st class, $2	1st class, $0	6,850
7. 1st class, $2	Priority, $0	5,700
8. 1st class, $2	Priority, $2	5,700
9. 1st class, $5	1st class, $0	5,700
10. 1st class, $2	1st class, $2	5,700
Total, groups 1-10		59,365
No address		50,435

SOURCE: U.S. Department of Education, National Center for Education Statistics, National Household Education Surveys Program 2003.

The fact that all numbers cannot be mailed to will depress the effectiveness of any strategy that involves mailing letters, but the effect is not as great as might be expected. In NHES:2003, 90 percent of all numbers that could be determined to be residential numbers were mailable (85 percent when the numbers are appropriately weighted by the inverse of the probability of selection). For most of this presentation, the focus is on the mailable cases that were included in the experiment.

Group 1 is essentially a control group, but every mailable case in this group contained a treatment that was not included in any other group to determine the possible effectiveness of a brochure for increasing response rates. Along with the advance letter, the Group 1 cases were sent a short color brochure describing NHES. The brochure was not included in any other advance mailings. All refusal conversion mailings included brochures.

Group 4 is the condition that was used in NHES:2001. This condition includes no incentive in either the advance letter or the refusal conversion letter, and a refusal conversion letter sent by Priority Mail, although in 2001, FedEx was used rather than Priority Mail. Larger sample sizes were assigned to Groups 4 and 6 because they were hypothesized to be the most economical ways of substantially improving unit response rates and the larger sample sizes improved the ability to detect differences between these two groups.

Note that these sample sizes are for the initial mailing; fewer cases received the refusal treatment, because only a subset of households refused. Of the 59,365 telephone numbers in the experiment, Screener refusal conversion letters were sent to 20,259 (34 percent).

Advance letters were mailed with or without incentives according to the plan. If the household refused to participate, refusal conversion letters were sent with the appropriate incentives. If the household refused a second time, they were subject to a second refusal conversion call. To boost response rates, a sample of 75 percent of the households that had not received a Priority Mail letter previously (Groups 1, 2, 3, 6, 9, and 10) was sent a Priority Mail letter prior to the second refusal conversion call. Only 75 percent were sent by Priority Mail so that the effectiveness of the special mailing could be evaluated. The sampling to determine which numbers were assigned to the special mailing was done randomly within the experimental groups.

The next several sections give findings from the NHES:2003 experiment. Please note that adjustments were made to the statistical tests to adjust for multiple comparisons.

Screener Ever-Refusal Rates

The advance incentive condition affected the percentage of respondents who ever refused to participate in the survey. Ever-refusal rates give the (weighted) percentage of cases in the group that refused the Screener divided by the percentage that either completed or refused the Screener. The ever-refusal rate is the complement of the rate that AAPOR (2000) calls the cooperation rate. The term "ever-refusal rate" is used because cooperation and response rates are often confused.

In Table 2, groups with a similar advance mailing treatment are combined. Group 1 is included with the other groups with no incentive even though the advance mailing had the NHES brochure, because the brochure did not lower the ever-refusal rates. The ever-refusal rates for the three groups differ, with the highest refusal rates associated with no incentive and the lowest refusal rates for the $5 incentive group. One way of thinking about the relationship is that adding the $2 incentive reduces the refusal rate by 2.4 percentage points for each dollar relative to no incentive [(46.6-41.8)/$2)], while adding $5 reduces the refusal rate by 1.5 percentage points for each dollar relative to no incentive [(46.6-38.9)/$5]. While the $5 incentive reduces refusal rates more than the $2 incentive, the relative reduction per incentive dollar spent is better with the $2 incentive.

Table 2. Effect of advance incentives in NHES:2003

Advance incentive	Ever-refused rate (%)
No incentive	46.6
$2 incentive	41.8
$5 incentive	38.9

SOURCE: U.S. Department of Education, National Center for Education Statistics, National Household Education Surveys Program 2003.

First Refusal Conversion Rates

The other treatments in the Screener experiment were applied only if a household refused to complete the Screener. The two mailing conditions included first class mail in a U.S. Department of Education envelope and Priority Mail in a U.S. Postal Service mailer. The incentive conditions included $0, $2, and $5.

With the exception of groups 6 and 7, there were no statistically significant differences detected between the results for first class mail and Priority mail within the same incentive conditions in terms of first refusal efforts (called the first refusal conversion rate). This is contrary to Westat experience in the 1997 National Survey of America's Families. It may be that the mailing in a U.S. Department of Education envelope is effective in conveying legitimacy and encouraging participation. Also, the percentage of telephone numbers with mailable addresses has increased substantially since 1997. Thus, the types of households that could have been treated in 1997 may have been different.

Table 3 shows the 10 incentive groups classified into three groups by the amount of incentive given in the conversion letter ($0, $2, or $5). For example, groups 2, 5, 8, and 10 were grouped together because these groups were the ones sent $2 conversion incentives. The mean first conversion rate for those in the $0 group is 31.4 percent; the mean for those in the

$2 group is 35.7 percent; and the mean for those in the $5 group is 38.8 percent. The groups with $2 and $5 conversion incentives have significantly higher first conversion rates than those with no conversion incentives. There was no difference detected between the $2 and $5 groups.

Table 3. Effect of refusal incentives in NHES:2003

Refusal incentive	First conversion rate (%)
No incentive	31.4
$2 incentive	35.7
$5 incentive	38.8

SOURCE: U.S. Department of Education, National Center for Education Statistics, National Household Education Surveys Program 2003.

Response Rates After First Refusal Conversion

Table 4 shows the response rates computed after completing calls associated with the first refusal conversion attempts. (If a Screener was completed in the second refusal conversion attempt, it is classified as a refusal for this table in order to assess the results of the initial refusal treatment.) This table provides direct evidence of the combined effects of the advance mailing treatments and the first refusal conversion treatments, that is, without the effect of the second refusal conversion treatment. The two groups that did not include any payment have the lowest response rates.[2] The response rates for Groups 3, 7, 8, 9, and 10 are all close to 65 percent. Of these five groups, only Group 7 involved sending the household less than $4 (between advance and conversion incentives), and Group 7 had a priority mailing at refusal conversion. These findings are consistent with previous research in that they show these monetary incentives do improve response rates and the higher levels of payment are typically more effective.

Second Refusal Conversion

Priority Mail was used for the second refusal conversion in order to examine whether its use improved the conversion rates. At the second refusal conversion stage, letters were sent by Priority Mail to a 75 percent subsample of cases in the groups that had not previously been sent Priority Mail. Those that had received a letter by Priority Mail during initial refusal conversion were not sent another letter at this stage; this strategy pertained to six of the 10 experimental groups.

Table 4. NHES:2003 response rates after first refusal conversion

Experimental group		Response rate (%)
Advance mailing	Refusal mailing	
1. 1st class, $0, brochure	1st class, $0	57.9
2. 1st class, $0	1st class, $2	61.9
3. 1st class, $0	1st class, $5	64.6
4. 1st class, $0	Priority, $0	59.9
5. 1st class, $0	Priority, $2	62.4
6. 1st class, $2	1st class, $0	63.4
7. 1st class, $2	Priority, $0	65.0
8. 1st class, $2	Priority, $2	65.6
9. 1st class, $5	1st class, $0	65.3
10. 1st class, $2	1st class, $2	65.4
Nonmailable cases		45.6

SOURCE: U.S. Department of Education, National Center for Education Statistics, National Household Education Surveys Program 2003.

For all six groups, the differences in the conversion rates for households sent the Priority Mail letter and those not sent any letter range from 4 percentage points to 15 percentage points (Table 5). Though many of the apparent differences are not detectably different within each experimental group, when the treated groups are aggregated, the difference between those sent a letter by Priority Mail and those not sent any mail in the second refusal conversion is statistically significant.

Table 5. Second refusal conversion rates by use of Priority Mail, NHES:2003

Experimental group	No priority mail rate (%)	Priority mail rate (%)
1. 1st class, $0/1st class, $0	10.5	25.2*
2. 1st class, $0/1st class, $2	18.9	23.1
3. 1st class, $0/1st class, $5	16.8	23.7
6. 1st class, $2/1st class, $0	13.3	20.8*
9. 1st class, $5/1st class, $0	15.6	21.1
10. 1st class, $2/1st class, $2	16.9	21.4

* $p < .05$

SOURCE: U.S. Department of Education, National Center for Education Statistics, National Household Education Surveys Program 2003.

Thus, sending a priority letter after a second Screener refusal does improve response rates in NHES,

[2] The rate for Group 4 was not detectably different than the rates for Groups 2 and 5 after adjusting for multiple comparisons.

but the difference is not uniformly large and depends on previous treatments. Also, notice that the difference is between sending a Priority Mail letter and sending no mail, where in all the other situations considered the differences were between two different types of mailings. Since only about 7 percent of the completes for those cases with a mailable address are obtained in the second refusal conversion attempt, the evidence suggests that using priority mailing at the second refusal conversion if there are no previous priority mailings seems likely to improve response rates, but not by very much. Because no first class letters were sent at the second refusal stage, it is not possible to ascertain whether a first class mailing would have affected the conversion rates.

Selecting Effective Strategies

In order to evaluate the cost-effectiveness of the various approaches tested in this experiment, it is necessary to consider another factor: survey costs. In addition, it is important to consider response rates for an entire sample, and not only the mailable cases that could be treated in this experiment. Including the numbers that cannot be mailed to in the evaluation is important because the overall effect on the response rates of treating the mailable numbers is diminished because of their presence. Increases in overall Screener unit response rates, not rates for just the mailable sample, are the ones that must be judged to be substantial in order to support the use of the various mailing and incentive treatments.

Taking into account both costs and response rates, the next step is to eliminate approaches that result in low response rates and those that carry higher costs for response rates comparable to lower-cost options. This is discussed below, but we first enumerate the cost assumptions.

Cost Assumptions for Strategies

In order to compare the costs of the various approaches, some assumptions were required. We assumed that the percentage of cases that would be mailable would be the same as in NHES:2003–about 90 percent of the sample (85 percent weighted by the base weight). Second, we assumed that the refusal and conversion rates for each group would be the same as in NHES:2003. A direct cost of 50 cents per case was allocated to first class mailings to cover both postage and packaging. For Priority Mail, $4 was allocated for postage and packaging. The cost calculations assumed that those who refused a second time would be sent a conversion letter using Priority Mail if the household had not already received material through Priority Mail in response to an initial refusal. The possible costs of the approaches considered did not take into account possible changes in interviewing costs that might occur as a result of the mailings and incentives.

Estimated Response and Cost

The estimated response rate for the entire sample was calculated for each group, based on the observed rates in NHES:2003. Direct costs for incentives, postage, and packaging were calculated and are shown in table 6. To facilitate comparisons between groups, costs are expressed as ratios to the Group 1 rate, which includes first class advance and refusal mailings with no incentives, and Priority Mail for second refusals. Costs for the various approaches tested in NHES:2003 range from 1.26 times the base Group 1 cost to 3.53 times the base cost. The higher costs are associated with conditions that have advance incentives (groups 6 through 10) and Group 3, which involves a $5 refusal conversion incentive.

Table 6. Estimated response rates and relative costs, by experimental group

Experimental group (advance/refusal)	Projected response rate	Cost ratio*
1. $0, brochure/1st class, $0	62.8	1.00
2. $0/1st class, $2	64.9	1.42
3. $0/1st class, $5	66.9	2.09
4. $0/Priority, $0	61.5	1.26
5. $0/Priority, $2	64.0	1.72
6. $2/1st class, $0	65.5	1.96
7. $2/Priority, $0	65.9	2.26
8. $2/Priority, $2	66.1	2.72
9. $5/1st class, $0	66.9	3.53
10. $2/1st class, $2	67.1	2.41

* The cost ratios reflect incremental increases over the group 1 condition.

SOURCE: U.S. Department of Education, National Center for Education Statistics, National Household Education Surveys Program 2003.

Groups 1 and 4 are eliminated first because the response rates for these are relatively low compared to the others. Of the remaining groups, Groups 7, 8, and 9 are eliminated because they have higher costs than other groups with roughly the same response rate. Group 5 is eliminated because Group 2 has at least as high a response rate and a lower cost. Group 6 has higher costs than Group 2 and lower response rates than Groups 3 and 10. For this reason, Group 6 is eliminated from further consideration.

The groups remaining are 2, 3, and 10. If the incremental costs are a major concern, then experimental Group 2 is attractive. Both Groups 3 and 10 are attractive for NHES because they result in the highest response rates for relatively low costs. Groups 2 and 3 are also appealing because they can be combined with a strategy of subsampling refusal cases for subsequent conversion attempts to further reduce costs while maintaining high response rates. Strategies for groups 2 and 3 are relatively inexpensive because they do not require sending incentives in the advance mailing; incentives are sent only to those who refuse to do the screening interview.

The alternatives must also be evaluated in the context of the survey costs as a whole. For some studies, the use of incentives may represent an increase in cost that is quite small proportional to the entire data collection effort, whereas for other studies the increased cost may be proportionately large. Absolute dollars as well as proportional cost should be considered against the benefit in unit response.

Summary

Declining Screener unit response rates in the NHES led to the design and execution of an experiment examining the effects of respondent incentives as a means to improve response. Previous experience in NHES had demonstrated the effectiveness of an advance mailing (Hagedorn et al., 2003), contrary to the findings of Singer, Van Hoewyk, and Maher (2000). One possible reason the advance mailing is effective in NHES is that the U.S. Department of Education envelope and letterhead convey a level of legitimacy and salience that other forms of mailings do not.

The results of this experiment indicate that small cash incentives are effective in improving NHES Screener unit response. The NHES:2003 experiment also showed that respondent incentives were effective in obtaining cooperation at the refusal conversion stage for the Screener. In addition, the advance incentive treatments and refusal incentive treatments combined to yield higher response rates after the first refusal conversion stage for those who had received payments of $4 (two payments of $2) and those who had received $5 (in either the advance or refusal incentive payments). The use of Priority Mail did not substantially improve initial refusal conversion rates, contrary to expectations. Sending a Priority Mail letter after a second refusal improved the rates of refusal conversion for these groups slightly, but the overall effect on the response rate is marginal.

Future Research

Results from this experiment will also be published in an upcoming technical report being prepared for the National Center for Education Statistics within the U.S. Department of Education's Institute of Education Sciences. In addition to providing additional detail about the effectiveness and costs of the various strategies discussed here, the report will address two other important topics. First, it will provide information about other key costs, primarily interviewer time, which might be affected by the different mailing and incentive strategies. This will be operationalized by looking at the average number of calls necessary to complete a case in each of the experimental groups. Second, the report will be used to study possible response biases that might be introduced by the various strategies.

References

The American Association for Public Opinion Research (AAPOR). (2000). *Standard Definitions: Final Dispositions of Case Codes and Outcome Rates for Surveys*. Lenexa, KS: AAPOR.

Atrostic, B.K., Bates, N., Burt, G., and Silberstein, A. (2001). Nonresponse in U.S. Government Household Surveys: Consistent Measures, Recent Trends, and New Insights. *Journal of Official Statistics*, **17**, 209-226.

Brick, J.M., and Collins, M. (1997). *An Overview of Response Rates in the National Household Education Survey: 1991, 1993, 1995, and 1996*. U.S. Department of Education, National Center for Education Statistics. NCES 1997-948. Washington, DC.

Curtin, R., Singer, E., and Presser, S. (1999). The Effect of Response Rate Changes on the Index of Consumer Sentiment. *Public Opinion Quarterly*, **64**, 413-428.

Hagedorn, M., Montaquila, J., Nolin, M.J., Kim, K., Kleiner, B., Waits, T., Chapman, C., and Chandler, K. (2003). *National Household Education Surveys of 2001: Data File User's Manual, Volume I*. U.S. Department of Education, National Center for Education Statistics. NCES 2003-079. Washington, DC.

Singer, E., Van Hoewyk, J., and Maher, M.P. (2000). Experiments with Incentives on Telephone Surveys. *Public Opinion Quarterly*, **64**, 171-188.

Steeh, C., Kirgis, N., Cannon, B., and DeWitt, J. (2001). Are They Really as Bad as They Seem? Nonresponse Rates at the End of the Twentieth Century. *Journal of Official Statistics*, **17**, 227-247.