Augmenting the BRFSS RDD Design with Mail and Web Modes: Results from a Multi-State Experiment

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1. Introduction

Willingness to participate in random-digit dialing (RDD) telephone surveys has been declining for at least the past decade (de Leeuw and de Heer 2002). Nonresponse, combined with differences in measures of interest, such as attitudes, behaviors, and beliefs, for respondents and nonrespondents threatens the validity and reliability of data reported in probability sample surveys; it may decrease the degree to which samples represent the general population and may increase the bias associated with estimates made from these data (Babbie 1990; and Dillman et al. 2002). Use of multiple modes of questionnaire administration is one potential approach to this problem (Dillman 1999).

Mixing survey modes can potentially extend the reach of a survey, because it encourages participation across a broader mix of the population. Research has shown that some sample members prefer and respond more readily to different survey modes (Groves and Kahn 1979). Different modes have also been shown, however, to produce different results even when questions are asked of the same persons in the sample (de Leeuw 1992; Dillman et al. 1996; and, Dillman 2000). In this respect, use of alternative modes may increase response rates, but they can also increase measurement differences. Moreover, although a relatively large body of literature has examined multimode surveys involving combinations of telephone, mail, and face-to-face surveys, our understanding of the role of Web surveys is quite limited.

As the largest, state-based RDD telephone health survey, the Behavioral Risk Factor Surveillance System (BRFSS) is confronted with the issue of declining response rates and the associated questions of reliability and validity of the data collected. BRFSS is administered by the state health departments with support from the Centers for Disease Control and Prevention (Link 2003). The surveillance is designed to measure behavioral risk factors in the noninstitutionalized adult population ages 18 years or older and is conducted monthly in all 50 states, the District of Columbia, Puerto Rico, Guam, and the Virgin Islands. This study reports on a set of experiments conducted in four states (Arkansas, Indiana, New York, and North Dakota) to test the effectiveness of Web and mail surveys used in conjunction with telephone follow-up of nonrespondents to increase participation in BRFSS surveys.

2. Methods

The two experiments were conducted in October and November 2003. In the first experiment, invitations to complete the BRFSS survey via the internet were sent by mail. In the second, questionnaires were mailed to persons in the sample and they were asked to complete and return the survey. In both experiments, nonrespondents to these self-administered modes had follow-up by interviewers approximately 10 days later and were asked to complete the survey by telephone. The experiments were conducted in parallel with the regular, monthly BRFSS data collection in each of the states, providing a baseline for comparison.

We drew separate state-specific monthly samples for the Web and mail experiments by following CDC approved and monitored RDD sampling protocols for BRFSS. These telephone numbers were cross-referenced with a database of known addresses. We retained only those households with telephone numbers that could be matched with a valid mailing address in the samples. In the mail experiment, all nonrespondents were followed up using CATI. In the Web survey, a subsampling strategy was used for nonrespondents for CATI follow-up. The initial Web sample was much larger than that of the mail survey to allow for the fact that not all households have internet access. Subsampling of nonrespondents helped to minimize the cost of the CATI follow-up for these participants. When appropriate, we used weighting adjustments to account for subsampling.

We used only the BRFSS core questionnaire in the Web and mail surveys. The BRFSS core consists of a set of questions asked by all states without modification in order or wording. The Web and mail versions of the BRFSS were developed with questions worded identically to that of the CATI version. Greater detail on the methodology used in this study is provided elsewhere (Link and Mokdad 2004; Link and

Mokdad forthcoming). Data collection procedures were approved by Research Triangle Institute's Institutional Review Board.

3. Results

In this research effort, 3,108 completed interviews were conducted for the CATI-only data collection (2,101 address-matched subjects and 1,007 nonaddress-matched subjects), 1,785 for the Web experiment (1,150 Web surveys and 635 CATI follow-ups), and 1,156 for the mail experiment (834 mail surveys and 322 CATI follow-ups).

3.1 Response Rates

In the address-matched sample, the response rates for the baseline data collection with CATI only ranged from 31.3 percent (New York) to 49.5 percent (North Dakota); the average rate was 40.1 percent across the four states (Table 1). [1]

Compared with response rates for CATI alone across the four states, rates for the Web survey with follow-up averaged 8 percentage points higher and rates for the mail survey with follow-up averaged nearly 20 percentage points higher. On average, 15.4 percent of respondents completed the Web survey across the four states. An additional 32.5 percent were interviewed in the telephone follow-up. The percentage of completed interviews from the mail survey was greater than the percentage from the baseline telephone interviews in three of the four states (Indiana, New York, and North Dakota). On average, the response rate for the mail survey was 43.6 percent, compared with 40.1 percent for the CATI baseline.

The multimode approaches out performed (in terms of response rates) the telephone-only approach in the address-matched sample. However, the more pressing question is whether use of multiple modes can produce higher rates of participation overall. A primary restriction on the use of Web and mail as alternatives to telephone in an RDD survey is that the surveys are generally limited to households that can be reached by mail. Such surveys require household addresses, which can be obtained only by reverse-matching of telephone numbers to lists of known addresses or by making telephone contact with the household to get mailing information.[2] Households for which an address could not be obtained would not be able to participate in the Web or mail surveys. The same is true of the experiments conducted here.

We used the baseline data to simulate the effects of including nonaddress-matched households in the sample to estimate overall response rates. Assuming that the final disposition for the nonaddress-matched households would not have been significantly different if they had been contacted by telephone according to BRFSS protocols as part of the Web or mail surveys, these baseline data can be used in simulation of the expected overall response rates for the Web and mail experiments.

Inclusion of non-address-matched households reduced differences in response rates among subjects selected for the baseline CATI, Web, and mail surveys in each state (Table 3).[3] In each state, the Web and mail mixed-mode approaches produced higher response rates than CATI only, but the impact of the alternative approaches was tempered. On average, the Web with CATI follow-up resulted in response rates that were 5 percentage points higher than the baseline rates; mail with CATI follow-up resulted in response rates that were an average of 13 percentage points higher than baseline rates.

3.2 Respondent Demographics

Do increases in response rates for the mixed-mode approaches lead to a different mix of respondents who completed interviews? More importantly, can the use of the alternative modes lead to increased participation among subgroups that are traditionally

[1] Response rates were calculated by using the American Association for Public Opinion Research (AAPOR) response rate formula #4 (AAPOR 2004). The numerator was the sum of all complete interviews and the partially completed interviews in which at least 50 percent of the core questionnaire items were answered. The denominator was the sum of known eligible subjects and the number of subjects with unknown eligibility that represented a proportion equal to the proportion of subjects of known eligibility that were eligible.

[2] As an alternative to mailing, households could be contacted by telephone and asked to participate. Then they could be (1) provided with a user name and password for the Web by telephone or mail, or (2) sent a questionnaire if an address was provided. This approach has the advantage of allowing contact with both address-matched and nonmatched households. One significant obstacle, however, is the difficulty of obtaining cooperation from households in RDD-based telephone studies, let alone cooperation enough to explain the study, elicit participation, and obtain mailing addresses for the purposes of sending additional study information to the sample member. This approach should be tested, but was it not part of this study.

[3] A weighting adjustment was used to ensure comparability across the groups by adjusting the proportion of address-matched households to match the proportion of address-matched households in the baseline sample.

underrepresented in telephone studies (e.g., men, nonwhites, and younger individuals). We examined this question, comparing selected demographic characteristics of respondents across the baseline group and two experimental groups. For reference, we also compared population estimates for these groups, as determined by the U.S. Census Bureau's 2002 American Community Survey (ACS).

Compared with population-based estimates from the ACS, higher percentages of respondents to the CATI-only mode were women, were white (non-Hispanic), had higher levels of education, and had higher family income than the adults in the general populations in these four states (Table 2). Additionally, the subset from address-matched households tended to overrepresent these groups to an even greater extent than the non-address-matched sample. Moreover, the address-matched group also had a higher percentage of subjects ages 65 or older and a lower percentage of those ages 18 to 34 years than is seen in the general population; age variances are not seen among the non-address-matched subgroup.

Because respondents to the Web survey and the mail survey were drawn only from the address-matched households, it is not surprising that they tended to overrepresent the same demographic groups that tend to be overrepresented in RDD surveys generally (Table 2). Moreover, for some characteristics, the percentage of particular subgroups among the Web or mail survey (or both) respondents was significantly higher than the percentage of subjects in the baseline address-matched subgroup. For instance, respondents to the Web survey with CATI follow-up were significantly more likely than baseline address-matched CATI respondents to be women, to be white (non-Hispanic), to have at least some college education, or to have family income of at least $50,000 per year. Likewise, a higher percentage of respondents to the mail survey with CATI follow-up were women and/or adults age 65 years or older than were those interviewed by CATI only.

Comparison of the two alternative approaches also showed statistically significant differences in demographic characteristics of respondents. Compared with respondents in the Web experiment, the respondents in the mail experiment had a significantly higher percentage of women and adults age 65 years or older. Compared with respondents in the mail experiment, the respondents in the Web experiment were more likely to have incomes of at least $50,000 per year. In summary, the mixed-mode designs we tested resulted in sets of respondents that were less reflective of the adult populations in these states than were those resulting from CATI alone.

3.3 Reasons for Not Participating in Self-administered Modes

Why did subjects choose not to complete the self-administered questionnaire during the first phase of data collection, and are there systematic patterns to these responses across population subgroups? Information was collected during the CATI follow-up for those who did not complete the Web or mail survey. At the start of the CATI follow-up interview subjects were asked a short series of questions about the self-administered survey. These questions included (a) whether they remembered receiving the prenotification mailings; (b) why they chose not to complete the Web or mail survey; and, (c) for Web survey sample members only, whether they have access to the internet at home or elsewhere.

Of the 635 nonrespondents to the Web survey, 37.5 percent said they did not respond because they did not remember receiving the mailings, nearly one-third (32.9 percent) indicated that they did not have access to the internet, and almost 12 percent said they had no time to complete the survey. Approximately 18 percent gave some other reason, such as not being comfortable using the Web, security concerns, transmission speed, or not being interested in surveys. These responses varied significantly across subgroups. For example, lack of access to the internet was the response given most often by women, those age 65 years or older, individuals with lower levels of education or family income below $50,000 per year, and those with no children in the household. Conversely, a higher percentage of men, respondents ages 18 to 34 years, those with some college or more or incomes of at least $50,000, and those with one or more children in the household said they did not complete the self-administered survey because they did not receive the mailing materials.

Of the 322 mail survey nonrespondents who answered the CATI follow-up, a majority (57.7 percent) said they did not remember receiving the mailings, one in five (19.1 percent) said they had no time, and nearly one-quarter (23.1 percent) gave some other response. Some of the "other" responses included losing or misplacing the questionnaire, concern over the receipt of "junk mail," and a general lack of interest in participating in surveys. A majority of respondents in all of the subgroups examined, with the sole exception of those age 65 years or older, said that not receiving the letters was the primary reason they did not complete the mail survey. Among those 65 and older, nearly 47 percent said they did not receive the letter and 14.3 percent said they had no time. However, a substantial proportion (39 percent) gave some other reason; "misplaced or lost the questionnaire" and "not interested in surveys" were the most frequently cited responses.

4. Discussion

The mixed-mode experiments show that Web surveys and mail surveys with telephone follow-up of nonrespondents are both possible alternatives to the current CATI-only approach for significantly increasing participation in an RDD sample survey of the adult population. Both Web and mail surveys in conjunction with CATI follow-up of nonrespondents produced higher response rates than the CATI-only approach. Moreover, these findings held in each of the four states examined. The mixed-mode approaches, mail in particular, generated roughly equivalent percentage point increases across the four states, even in North Dakota, which had by far the highest telephone-only response rate. This finding suggests that there is considerable room for improvement in response rates, regardless of whether state residents are typically more likely to participate.

The modest increase in the overall response rate for the Web mixed-mode approach needs to be viewed, however, with caution. Recent experiments in the use of advance letters with similar populations showed that prenotification alone can increase response rates by approximately 6 percentage points (Link et al. 2003). Thus, the 5-percent increase in response rates obtained in the Web experiments may have been due more to use of advance letters than to the addition of an alternative mode to CATI. Additionally, Web surveys completed made up a much smaller percentage of the surveys completed in the Web experiment, compared with the percentage of mail surveys completed in the second experiment. Web survey respondents accounted for one-third of the completed interviews in that experiment (15.4 percent of 47.9 percent total); mail survey respondents accounted for nearly three-quarters of the completed interviews in that experiment (43.6 percent of 60 percent total).

In contrast to use of the Web, use of a self-administered hardcopy survey appears result in substantial improvement in response rates. Overall, the mail experiment produced an improvement of 13 percentage points over the baseline CATI data collection, far exceeding the 6-percent gain reported for the use of advance letters alone. The mail questionnaire, like the Web survey, did not, however, contain the entire set of BRFSS questions typically asked in most of the states. The experiments were confined to the core component and did not include any of the optional question modules or state-specific modules. It is likely that extending the length of the questionnaire could have a negative impact on the corresponding response rates. Additional research is necessary, therefore, to determine a productive cutoff for questionnaire length. How long is too long, making the length of the mail survey detrimental to the obtainable response rates?

Although both mixed-mode approaches increased response rates, the increases were not even across demographic groups. In fact, the designs tested here actually exacerbated the problems associated with overrepresentation of particular subgroups of the population. For example, telephone surveys typically overrepresent women who completed surveys, because men are in general more difficult to contact at home and tend to be more reluctant to participate in surveys. One possibility was that given the option to respond to a self-administered at a convenient time might encourage greater participation by men. This was not the case. In this study, the percentage of women completing the Web survey or the mail survey was significantly higher than the percentage of men completing either survey. Likewise, the introduction of a Web survey mode might encourage participation by younger respondents, especially those ages 18 to 34 years. Again, this was not the case. Web respondents were more likely to be middle-aged (35 to 54 years) than were those completing either the mail survey or CATI alone. In contrast, compared with respondents to other survey modes, a higher percentage of mail survey respondents were age 65 years or older. Although neither the Web nor mail approach helped to increase participation among subjects ages 18 to 34 years, the mail survey findings could be encouraging if one considers the aging of the population in the United States. With the percentage of elderly adults steadily increasing as the baby-boom generation matures, mail surveys used in conjunction with telephone follow-up could increasingly become a viable means of collecting reliable and valid data from the general population.

Why did the use of these survey modes increase the gap in participation among certain subgroups? As with any research, study design has an important effect in determining study results. In this set of experiments, two design features appear to have influenced the outcomes, particularly in relation to the types of individuals who responded using the alternative modes. First, findings on use of reverse matching to databases to identify addresses for subjects show that the demographic characteristics of the address-matched sample tended to be less representative of the adult general population than the characteristics of the nonaddress-matched sample, but even this subgroup overrepresented a number of population subgroups. Drawing the Web and mail survey samples only from the address-matched households increased the likelihood, therefore, that these subgroups would be overrepresented by these modes as well. Future research should explore ways to offer alternative survey modes to subjects in the nonaddress matched group. As mentioned earlier, collecting address information or offering information on Web access over the telephone is one way to reach

this group. However, if cost savings is a goal, assuming the self-administered modes cost less than telephone interviewing, this approach may not be feasible. Likewise, if time in the field is an issue, as it is with BRFSS which requires monthly collection of data, then time pressure may make this approach less effective. An alternative may be to move away from reliance on RDD sampling frame for selecting potential responders for alternative modes. A number of commercial vendors offer Web-sampling frames, however, to date none are able to offer reliable probability-based frames. Likewise, questions about the completeness and representativeness of most mail survey frames have limited the widespread use of mail surveys for general population surveys. Recent studies have shown, however, that some lists (e.g., the Delivery Sequence File offered by the U.S. Postal Service) may provide coverage similar to that of telephone-based approaches (Iannacchione, Staab, and Redden 2003).

The second design feature that likely affected who participated was the method of within-household selection. By allowing households to self-select a participant, we reduced the potential confusion and frustration associated with self-administering a random-selection technique and increased participation in both mixed-mode experiments. However, this approach probably contributed to the substantial increase in participation among women and older individuals. Historically in telephone surveys, women often volunteer to complete a survey even when a man in the household is randomly selected to participate. This is likely here as well and may have contributed also to the finding that men were more likely in the telephone interviews to report never having seen the mailed materials. A similar situation may exist with younger adults, particularly those living at home with older parents. A package addressed to the household is more likely to be responded to by the parents, especially the mother, than by the younger adult. Additionally, adults ages 18 to 34 years are also more mobile, changing addresses more readily than older individuals. As a result, the increased likelihood of adults in this age group reporting that they did not see the mailed materials could also be attributable to the subject changing his or her address but keeping the same telephone number. Future studies should test ways to balance the trade-off between reduced nonresponse and the need for techniques for within-household selection of subjects that can produce a more representative group of survey respondents.

Finally, there remains the issue that some subgroups of the population choose not to participate in surveys at the same rate as other subgroups. Men, younger adults, and nonwhites have historically made this choice. Unfortunately, the use of mixed-mode approaches in our study did not help to address this issue. Lack of access to the internet is a constraint in the use of that mode, particularly in efforts to reach nonwhites and persons of low socioeconomic status. In addition to the suggestions outlined here, greater attention needs to be given to determining the types of appeals, modes, and approaches that work most effectively in motivating these underrepresented groups to participate in surveys.

In conclusion, the results of these experiments show that the use of Web surveys and mail surveys in conjunction with more traditional CATI may be viable alternatives for increasing participation rates in the BRFSS, but not without the potential for exacerbating the differences between respondents and nonrespondents and possibly increasing bias in the data collected. Considerable work will be required, therefore, before a sound recommendation can be made to use a multiple-mode approach in an on-going, telephone-based surveillance like the BRFSS. Perhaps most important is the need to recognize that issues involving the use of new methods and technologies (e.g., the internet) must continue to be studied. Technology and communications are changing at such a rapid rate that the research findings of today may not be relevant for long. Survey methods and health surveillance techniques are in a constant state of evolution, and it is incumbent on researchers and methodologists to stay abreast of these changes, embracing through a rigorous process of testing and validation the new technologies and approaches that can improve the quality of the data and estimates we produce.

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Table 1. Response Rates Among Address-Matched Sample by State and Survey Mode

	Baseline	Web survey experiment			Mail survey experiment			Significance		
State	CATI-only	*Web-only*	*CATI Follow-up*	Overall Web + CATI Follow-up	*Mail - only*	*Mail - CATI Follow-up*	Overall Mail + CATI Follow-up	(1)	(2)	(3)
State mean	40.1%	*15.4%*	*32.5%*	47.9%	*43.6%*	*16.4%*	59.0%	.001	.001	.001
	(1,378)	*(1,905)*	*(1,905)*	(1,905)	*(501)*	*(501)*	(501)			
Arkansas	41.4%	*13.7%*	*34.0%*	47.7%	*37.8%*	*21.8%*	59.6%	.001	.001	.001
	(1,314)	*(2,139)*	*(2,139)*	(2,139)	*(473)*	*(473)*	(473)			
Indiana	38.3%	*15.7%*	*32.3%*	48.0%	*43.3%*	*15.7%*	59.0%	.001	.001	.001
	(1,518)	*(1,661)*	*(1,661)*	(1,661)	*(528)*	*(528)*	(528)			
New York	31.3%	*13.1%*	*24.7%*	37.8%	*39.7%*	*12.6%*	52.3%	.001	.001	.001
	(1,833)	*(2,102)*	*(2,102)*	(2,102)	*(539)*	*(539)*	(539)			
North Dakota	49.5%	*19.2%*	*38.8%*	58.0%	*53.6%*	*15.3%*	68.9%	.001	.001	.001
	(846)	*(1,720)*	*(1,720)*	(1,720)	*(464)*	*(464)*	(464)			

Note: Significance based on Chi-square test with p values noted for the following comparisons: (1) CATI baseline vs. Web survey with CATI follow-up, (2) CATI baseline vs. mail survey with CATI follow-up, and (3) Web survey with CATI follow-up vs. mail survey with CATI follow-up. Data for the Web experiment CATI follow-up are weighted to adjust for subsampling of Web nonrespondents.

Table 2. Demographic Characteristics of Responders, by Mode of Survey Administration

Demographic Characteristics	American Community Survey 2002	Baseline CATI-Only (No Address)	Baseline CATI-only (with address)	Web + CATI Follow-up (with address)	Mail + CATI Follow-up (with address)	Significance		
	%	%	%	%	%	(1)	(2)	(3)
Sex						.05	.01	.05
Male	48.8	35.2	41.9	38.9	35.7			
Female	51.2	64.8	58.1	61.1	64.3			
(N)		(1,008)	(2,146)	(3,611)	(1,195)			
Race						.05	n.s.	n.s.
White, non-Hispanic	78.9	82.3	87.5	90.6	89.7			
Other	21.1	17.7	12.5	9.4	10.3			
(N)		(1,004)	(2,130)	(3,591)	(1,189)			
Age						n.s.	.001	.01
18 – 34	30.3	29.8	19.6	17.8	13.3			
34 – 54	39.4	39.7	39.7	40.1	38.0			
55 – 64	13.0	14.7	17.2	16.0	18.0			
65+	17.3	15.9	23.6	26.1	30.7			
(N)		(1,001)	(2,121)	(3,605)	(1,182)			
Education						.001	n.s.	n.s.
High school or less	49.8	46.7	43.9	39.9	40.9			
Some college or more	50.2	53.3	56.1	60.1	59.1			
(N)		(1,008)	(2,141)	(3,603)	(1,173)			
Income						.05	n.s.	.05
< $50,000	61.7	48.3	45.0	42.1	47.7			
$50,000+	38.3	51.7	55.0	57.9	52.3			
(N)		(875)	(1,884)	(3,208)	(1,060)			
Have Children						n.s.	.05	n.s.
None	69.2	60.2	67.0	68.9	70.5			
One or more	30.8	39.8	33.0	31.1	29.5			
(N)		(1,007)	(2,145)	(3,599)	(1,186)			

Note: Statistical significance based on chi-square test with p values for the following comparisons: (1) CATI baseline vs. Web survey with CATI follow-up, (2) CATI baseline vs. mail survey with CATI follow-up, and (3) Web survey with CATI follow-up vs. mail survey with CATI follow-up. Population estimates from the American Community Survey 2002 and sample demographics for nonaddress-matched subjects in the CATI baseline study are provided for reference.