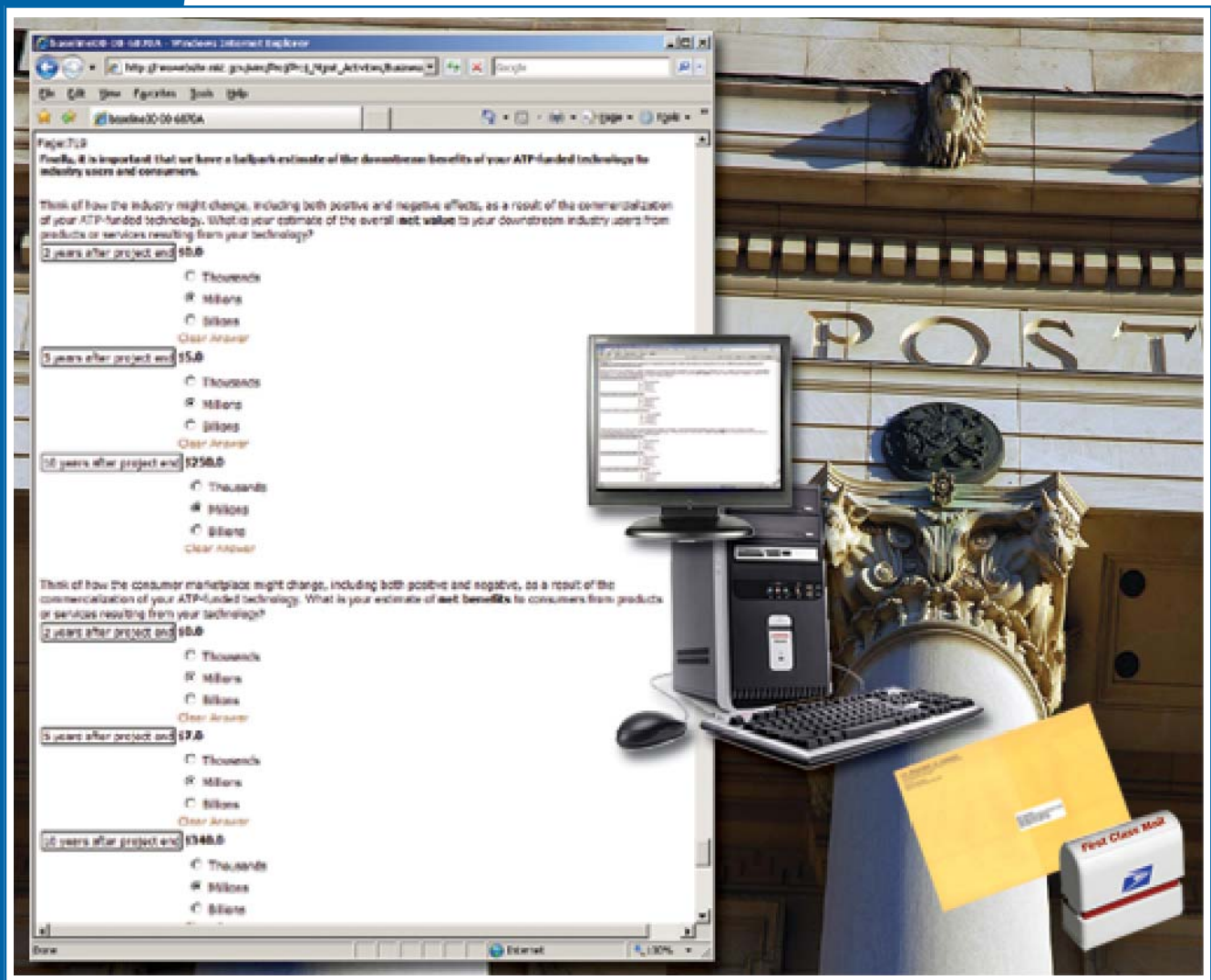




# Surveying R&D Professionals by Web and Mail: An Experiment

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# Surveying R&D Professionals by Web and Mail: An Experiment

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# Abstract

Westat and the Advanced Technology Program conducted an experiment comparing three data collection modes embedded within a survey of organizations conducting research and development (R&D) activities (i.e., the Survey of ATP Applicants 2002). The mode conditions included web, mail, and web with mail follow-up. Follow-up of nonrespondents by telephone was conducted across each condition of the experiment. Outcomes discussed include response rates before and after telephone follow-up, item nonresponse, response distributions, and length of answers to open-ended questions. Findings indicate that the web mode appeared equal or superior to a comparable mail mode on these measures. We found no advantage for the use of a mail follow-up to the web survey.

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# Introduction

Web-based surveys increasingly garner significant attention due to their potential to collect data quickly and efficiently from large numbers of respondents. Many factors contribute to this trend, including the U.S. Office of Management and Budget's encouragement that federal government surveys provide an option for responding via the web whenever feasible. Yet questions regarding the viability of web surveys in various contexts remain. Additionally, while years of research literature and experience serve to inform us about the more traditional survey modes, survey researchers are still struggling to determine the "best" techniques for web surveys, and the factors that affect their quality.

A growing number of experiments have compared surveys conducted via the web to those collected by mail. In terms of response rates, findings from these experiments present a perplexing picture. Large differences in response rates are often found between the two modes, yet there seems to be no clear advantage of one mode versus the other. For example, Cole (2005), Kwak and Radler (2002), and Leece, et al. (2004) reported response rate advantages of 10 percentage points or more for the mail mode in surveys of travel agents, college students, and surgeons, respectively. Yet, McCabe, et al. (2002), Lesser and Newton (2002), and Cobanoglu, et al. (2001) have each reported web mode response rates that were 10 percentage points or more greater than a mail mode in surveys of college students and faculty. It is noteworthy that in each of the above six studies, the web condition relied upon repeated email invitations containing links to the survey website, rather than invitations for the web survey sent by standard mail. The latter procedure presumably increases the burden of responding through the web mode, thereby lowering response rates relative to the mail mode.

Other key outcome variables for studies comparing web and mail modes concern various measures of data quality. These include response distributions, degree of item nonresponse, and length of responses to open-ended questions. Drawing clear conclusions from these studies is problematic, however. As Groves (1989) has pointed out, a survey mode is more than a medium of communication – it is also a "bundle of methodologies," since many procedures are not equally suited to different modes. For example, a web survey can be programmed to automate skip patterns, randomize the order of response categories, and even control the extent to which respondents view subsequent questions. These techniques are not available for a mail survey. Studies comparing the web and mail modes vary with respect to whether researchers attempt to make the two modes as "comparable" as possible, versus

making use of the unique advantages or best practices associated with each mode. Thus, it should not be surprising that studies comparing the mail and web modes have yielded mixed findings with regard to data quality measures. Overall, studies suggest that the web mode may yield more item nonresponse than the mail mode (Bates, 2001; Manfreda, et al. 2002; Howes and Mailloux, 2001), unless the skip patterns are automated in the web version (e.g., Kwak and Radler, 2002) or a prompt is provided specifically addressing item nonresponse (see DeRouvray and Couper, 2002). Studies tend to suggest that the web and mail modes yield similar response distributions (Cole, 2005; McCabe, et al., 2002; Cobanoglu, et al., 2001; Lozar Manfreda and Vehovar, 2002; Bates, 2001). With respect to open-ended survey items, web respondents tend to enter more lengthy answers than do mail respondents (Kwak and Radler, 2002; Kiernan, et al., 2005).

In this article, we discuss a mode experiment embedded in a survey of persons who perform research and development (R&D) for their respective companies. The survey was sponsored by the Advanced Technology Program (ATP), within the National Institute of Standards and Technology. This program awards funding for the development of innovative, high-risk technologies that have the potential to create broad social and economic benefits. Companies submit applications to ATP in response to announced competitions, and only a small proportion of applicants are awarded funding. The Survey of ATP Applicants, conducted with both those who receive funding and those who do not, is a component of ATP's economic assessment and program evaluation efforts. From January through July, 2004, Westat conducted this survey of 891 applicants to the 2002 ATP competition. The majority of applicants were surveyed by means of a web survey. The remaining respondents were randomly assigned to either a traditional mail survey or a web survey which included a mailed questionnaire to those not initially responding via the web. We know of only two other studies that have experimented with this "web+mail" approach. Lesser and Newton (2002) found that these procedures yielded a response rate that was higher than a mail mode alone, yet not as high as a web mode. But in a later study, Lesser and Newton (2005) reported that a web+mail condition yielded a lower response rate than a mail-only condition. In a related vein, Kaplowitz, Hadlock, and Levine (2005) reported that the use of standard mail contacts (postcards encouraging response) boosted response to a web survey, relative to email contact only. Thus, we thought it would be useful to include a condition in our experiment that combines data collection via web and mail modes.

Below we summarize our methods for conducting the experiment and discuss results with respect to response rates and three measures of data quality: 1) item nonresponse, 2) responses on the analytic items of interest (e.g., response distribution comparisons across modes), and 3) the length of answers provided in response to open-ended questions.

# Methods

ATP provided Westat with a list of all applicants to the 2002 award competition. The list identified the principal investigator associated with each applicant's project proposal. These individuals were the company's main point of contact during the application process, and thus served as the main contacts for the Survey of ATP Applicants. Many applicants had one or two secondary contacts as well - generally these were targeted for response only when it was learned the principal investigator was no longer with the company, or when interviewers were unable to reach the main contact during telephone follow-up of nonrespondents (discussed below).

Our mode experiment was conducted only with applicants who were not awarded funding for 2002. Six applicants were excluded from the experiment because no email address was available for them, leaving a sample of 771 applicants for this study. All were first notified of the survey with an advance letter sent by first-class U.S. mail. Applicants were randomly assigned to one of the following three conditions:

- Mail survey mode (200 applicants). These applicants were mailed a questionnaire booklet about one week after the advance letter, followed by a reminder postcard several days later. A second questionnaire was sent to nonrespondents approximately three weeks after the initial questionnaire.
- Web+mail survey mode (200 applicants). These applicants were sent an email invitation containing a URL to a website established for the survey, along with the applicant's unique login information, one week after the advance letter. A second email invitation with this information was sent several days later, followed by a questionnaire booklet mailed to nonrespondents approximately three weeks after the initial email.
- Web survey mode (371 applicants). The remaining applicants were assigned to the web mode, which allowed for up to three email invitations (each containing the website URL with the applicant's login information) spaced at intervals comparable to the two above conditions.

Email invitations that bounced back as undeliverable, along with mail surveys that were returned by the U.S. Postal Service as undeliverable, were investigated and resent if new address information was obtained. If applicants did not respond to the survey by means of their assigned mode within an eight week period, Westat interviewers attempted data collection by means of telephone interviews. This telephone follow-up of nonrespondents occurred across all three conditions of the experiment.

The survey questionnaire consisted of a total of 85 items (ignoring skip patterns), organized by topic into seven sections. Most questions were closed-ended with three to five response categories, though several questions requested a numeric (e.g., dollar amount) entry. Two items were open-ended. The web version, designed with Active Server Pages Script software, devoted a single web page to each section. Respondents to the web version were able to save partially completed surveys and resume responding at a later time. The mail version was a professionally printed booklet containing 21 pages of questions. The web and mail

questionnaires used similar color schemes and were identical with respect to the wording of questions, the layout of question text and response options, as well as skip instructions (the web version did not include automated skip patterns). One key difference between the versions, however, was that at the end of the web survey, a page appeared informing respondents of the number of questions they had neglected to answer (items appropriately skipped were not counted). This message appeared immediately after the respondent moved beyond the final page of survey items, and further asked respondents if they would like to go back and answer these items. If respondents clicked a “yes” button, the web version returned the respondent to the first section where a non-answered item appeared, with the particular item(s) highlighted in a distinctive color. However, respondents in the web mode were also free to select a “no” button, and immediately submit their survey.

## Results

Table 1 shows response rates for each mode condition, both prior to and after telephone follow-up. Prior to telephone follow-up, the web mode response rate was somewhat higher than that for the mail mode ( $z=1.66$ ,  $p<.10$ ). In terms of final response rates, the web mode yielded a rate somewhat higher than that for the web+mail mode ( $z=1.72$ ,  $p<.10$ ). As should be expected, telephone follow-up boosted response rates considerably across all conditions of the experiment.

But interestingly, we found that in the web and web+mail modes more applicants completed the survey over the web than by telephone – whereas in the mail mode more applicants completed the survey by telephone than by mail. A final point worth noting here concerns the surveys that were only partially completed over the web (data not shown) – there were only three such cases (0.8%) in the web mode, but seven (3.6%) in the web+mail mode ( $z=2.36$ ,  $p<.05$ ). This causes us to wonder if the procedures of the later mode may have backfired. For example, some of the applicants in the web+mail condition may have intended to return to the website to complete their survey, but were confused or otherwise put off by the receipt of a booklet version of the questionnaire in the mail.

**Table 1.**  
**Response Rates by Mode Condition**

|  | Web Mode       | Mail Mode      | Web+Mail       | Total          |
|--|----------------|----------------|----------------|----------------|
| In-Scope Sample N                          | (353)          | (194)          | (192)          | (739)          |
| Response Rate Prior to Telephone Follow-up | 33.7%<br>(119) | 26.8%<br>(52)  | 31.8%<br>(61)  | 31.4%<br>(232) |
| Final Response Rate                        | 64.3%<br>(227) | 61.3%<br>(119) | 56.8%<br>(109) | 61.6%<br>(455) |

Although we observed very little item nonresponse in the Survey of ATP Applicants, the mail version yielded substantially more missing data than did the web version. Among completed mail surveys, 47.2 percent had at least one missing data item, compared to only 22.1 percent of completed web surveys ( $z=3.83$ ,  $p<.001$ ). Mail respondents had a missing data average of 1.6 items, versus 0.8 for web respondents ( $F=8.92$ ,  $p<.005$ ).

Similar to most other studies that have compared the two modes, the web and mail versions of the survey yielded very similar responses on the analytic items of interest. The survey contained 54 such items that applied to all respondents (i.e., that could not be skipped based on a previous response). Forty-two items had closed-ended response categories, while twelve items required a numeric entry (e.g., dollar value). A comparison of the web and mail respondents on these 54 items yielded only three differences that were significant at the 5 percent level, and two differences significant at the 10 percent level. These differences were sporadic and not confined to any particular topic or type of question.

The Survey of ATP Applicants contained two open-ended questions. One item asked applicants to list any information sources about ATP (other than four sources specifically addressed in the survey) that they had found to be useful. Another item asked applicants to share any comments they might have regarding the ATP application and review process. On both questions, roughly the same proportions of web and mail respondents provided answers. However, among respondents who did provide an answer, those responding via the web entered significantly longer answers than did those responding to the mail version. On the first item above, web respondents entered answers that were 37 characters in length, on average, compared to 11 characters for mail respondents (Wilcoxon  $z=3.11$ ,  $p<.005$ ). On the second open-ended item, web respondents entered answers with an average length of 194 characters, compared to 65 characters for mail respondents (Wilcoxon  $z=3.42$ ,  $p<.001$ ). It is worth noting that these results were not due to any space limitations inherent in our mail survey: the two open-ended items provided respondents with 4 and 6 lines on which to write, with each line being 6 inches long. This is comparable with the web survey, which presented a scrolling text box with multiple lines of visual space for entering a response.

## Conclusion

This study offers another demonstration of the strong viability and appeal of web surveys. We randomly assigned applicants in the 2002 ATP award competition to be surveyed by means of either a web, mail, or a web+mail mode. The outcomes of data collection through the web mode appeared equal or superior to a comparable mail mode on a number of measures, including unit responses rates, item response rates, and length of open-ended responses. Furthermore, we detected no meaningful differences between the two modes on the analytic measures of interest to ATP. As with any methodological study, it is important to make note of the context within which the results were obtained. The target sample for the

Survey of ATP Applicants was a group of R&D professionals, who are no doubt highly educated and computer savvy. The list of applicants provided a name, an email address and an address for U.S. Mail in the vast majority of cases. Furthermore, we made an extensive effort to develop web and mail versions of the survey that were as comparable as possible in terms of visual appeal, graphic layout of question text and response options, and so forth. Any of these factors, if altered, might have affected the outcomes of this study.

Another factor was the use of an advance hard copy letter, which was sent to the full sample of applicants. The findings of Kaplowitz, Hadlock, and Levine (2005) suggest that this technique may boost cooperation for a web survey, just as it tends to do for mail and telephone surveys. However, in contrast to Lesser and Newton (2002), we found no advantage for the use of a hard copy mail questionnaire as a follow-up to a web survey. In fact, this technique resulted in more partially completed web surveys than did the web mode alone. Developing and implementing a web+mail mode is substantially more costly than either web or mail mode alone, and so should obviously be avoided if it has no benefit. But more research should be done to determine the conditions under which a web+mail mode might be effective. Indeed, survey researchers (and their clients) are increasingly interested in determining combinations of modes that optimally balance response rates, data quality, and costs. The U.S. Census Bureau even experimented in Census 2000 with providing households a choice between web and mail, as well as telephone and mail (see Schneider, et al., 2005). Although it was not varied as part of our experiment, the current study demonstrated (as many others have) the significant boost to response rates that can be achieved through telephone follow-up procedures. Yet as Dillman and Christian (2005) remind us, evidence exists that survey mode can affect respondents' answers to survey questions, even when they are worded in the same way across modes.

Our web version resulted in a substantially lower rate of item nonresponse, relative to the mail version. As discussed earlier, the web version included a feature whereby respondents were informed of the number of items to which they had failed to respond, allowing them to return to these items if they so wished. This procedure is a variation on one demonstrated by DeRouvray and Couper (2002) to be successful in reducing item nonresponse by taking advantage of the interactive features available in a web survey. We suspect this feature was responsible for the lower rates of item nonresponse obtained in the web version. However, we cannot be certain of this, as we did not implement any means of capturing the extent to which respondents returned to the previous items and answered them. We hope to evaluate this feature, and explore the importance of additional factors in responding to the Survey of ATP Applicants in future research.

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# About the Advanced Technology Program

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