Innovations in Survey Research: An Application of Web-Based Surveys

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Innovations in Survey Research

An Application of Web-Based Surveys

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The rapid expansion of Internet users has given Web-based surveys the potential to become a powerful tool in survey research. As an application of this technique for gathering data, the International Student Survey was designed to explore factors that might influence choices of college majors and the social support network system among international students at Arizona State University. Cover letters with the links to a Web-based questionnaire were sent through e-mail to the entire international students population. Given that no incentive was offered, this study received a total of 929 completed surveys for an overall response rate of 22% after three waves of solicitations. This article discusses the methodological concerns and problems that arise from using Web surveys, including noncoverage, nonresponse errors, confidentiality concerns, and technical problems. Suggestions for improving response rates also are discussed.

Keywords: Internet, web-based survey, response rate, survey research, survey methodology, international students

Recent figures estimate that there are over 423 million individual Internet users worldwide, with over 137 million users in the United States alone (U.S. Government Working Group on Electronic Commerce, 2001). The growth rate for this technology is phenomenal; in 1989 just over 15% of households owned a computer, whereas a decade later over 51% owned one or more computers (Newburger, 2001). Sheehan and Grubbs-Hoy (1999) project that because "Internet traffic doubles every 100 days, by the year 2005, one billion people worldwide may be online." Such rapid expansion of the Internet has lead many marketing agencies, public polling organizations, governmental offices, and a growing number of social science researchers to take seriously the Internet's potential as a tool for conducting scientific research.

Recent Internet studies have included research across a wide spectrum of subject matter, including a study on illicit drug dealers in 14 countries (Coomber, 1997), virtual identity construction and the presentation of self in chat rooms (Waskul & Douglas, 1997), a profiling of cyber communities (Paccagnella, 1997), a study on task uncertainty and job satisfaction among scientists (Parker, 2001), a polling of Internet technology conference participants (Slevin, 1997), and several attempts at constructing demographic profiles of typical Internet users (Boncheck, Hurwitz, & Mallery, 1996; Kehoe & Pitkow, 1996; Pradhan, 1999; Sheehan & Grubbs-Hoy, 1999). However, as with telephone and postal mail surveys at the time of their incorporation into the list of acceptable methodologies in earlier decades, Internet research is not without its methodological concerns. Low response rates, self-selectivity

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of Internet users, technological issues with the deployment of the research tool, and concerns over Internet security have troubled recent studies. Yet, for special populations that regularly use the Internet in their daily lives, the new medium has been found to be a sensible means of achieving meaningful results.

The intent of the International Student Survey research project was to employ Internet surveys for the task of studying International students at Arizona State University at both the undergraduate and graduate levels. The advantage of an Internet survey for research on this particular population is that all students at Arizona State University have e-mail accounts and have access through on-campus computing centers, libraries, dial-in options, and computers in the residence halls. Additionally, because many of the international student clubs and organizations maintain Listservs or mailing lists for disseminating information to their constituents, international students have become accustomed to using e-mail and the Internet on a daily basis.

The Web-based questionnaire covered five significant areas: (a) basic demographic information, (b) students' major concerns in their choice of major, (c) future plans for academic study in the United States, (d) career aspirations in the United States, and (e) information on the social support networks that facilitate the transition to permanent settlement in the United States. Foreign-born permanent residents were also included in the sample to provide a control group and to look at students who may have recently transitioned from a temporary status. This article concentrates on the methodological concerns and the problems that arose from incorporating Internet technology into the survey technique.

SURVEY METHODOLOGY

According to Dillman (1991), an ideal survey manages to control for error by ensuring that each member of a population has an equal chance of being included in the sample, that sample members are randomly selected in large enough numbers to assure representability, and that everyone who is included in the sample responds. Surveys, whether distributed by postal mail, telephone, or Internet, seldom achieve these ideal conditions. Similar to postal mail surveys prior to the 1970s, most e-mail and Web-based surveys have not had response rates consistently high enough to be generalizable to any population. In addition, nonrandom sampling, technological problems with delivery, inconsistencies with the medium of delivery, security issues, problems with Internet junk mail, and other factors converge to make Web-based surveys a problematic delivery method even for select populations that use the Internet in their everyday lives.

Sampling Error

Sampling error occurs when a subset of a heterogeneous population selected to represent the population as a whole does not truly fit the population. Cude and Morganosky (2000) used Web surveys to profile on-line shoppers at time of purchase. This very specific kind of convenience sample has been commonly used by marketing agencies to tailor products and services to the consumer. However, due to its nonrepresentative, nonrandom nature, it is impossible to make inferences to a general population. Among social scientists using this form of nonrepresentative sampling are Coomber (1997), studying drug dealers in 14 countries; Waskul and Douglas (1997), observing identity construction and presentation of self in chat rooms; and Paccagnella (1997), profiling cyber communities. In all of these cases, focus has been placed on the quality of the content in the responses and observations rather than on the generalizability of findings.

The largest Internet survey to date, the Georgia Institute of Technology Graphics, Visualization, and Usability World Wide Web User Survey (GSV) resulted in 55,000 respondents between 1994 and 1999 and used no form of sampling (Kehoe & Pitkow, 1996). The results, therefore, are not generalizable to a population because the self-selecting respondents replied to notices posted on Usenet groups, Web sites, and Listservs. Traditional probability sampling techniques can help to reduce these nonrandom sampling errors (Harkness, Lindstrom, Dolson, Schillmoeller, & Cook, 1996; Pradhan 1999; Sheehan & Grubbs-Hoy 1999; Smith 1997; Yun & Trumbo 2000). However, due to the fast pace of change in e-mail addresses, it was unknown if the lists used were representative of the total universe of the populations to be sampled, thus creating potential sampling error by noncoverage. Boncheck et al. (1996), Slevin (1997), and Rachmann (1999) attempted to avoid sampling error entirely by including all members of a particular group in their surveys. Such inclusion of an entire population is only possible if a current listing of a finite set of members is available. Because the cost of distributing a paperless survey to thousands (or even tens of thousands) is only slightly increased by the time required to clean data and supervise an automated bulk-mailing program, inclusion of entire populations is much easier with Web-based surveys than with traditional postal mail or telephone surveys.

The potential for Web surveys to effectively and economically survey the entire population of a given group allows the researcher to avoid or limit the effects of sampling error. Thus, in an attempt to avoid sampling error, this survey covered the entire enrolled population of foreign-born noncitizens. A query was made to the database for all currently enrolled students who were not U.S. citizens as of the 4th week of the semester (after the drop-add deadline), generating a file of 4,635 students. The database included first name, e-mail address, academic level, country of citizenship, college or division, and field of study. This descriptive data was instrumental in providing information on the nature of self-selectivity among respondents.

Noncoverage Error

Noncoverage results when the sampling frame does not cover all members of a population, and, thus, the odds of these noncovered members being selected for the sample are not equal to the odds for other members (Dillman, 1991). This is a common problem in Internet surveys because the current universe of Internet users grows daily, and even finite populations lists become outdated rapidly as users change e-mail addresses. Due to this problem, reported rates of undeliverable or "bounced" requests in Internet based surveys are as high as 28% (Swoboda, Muehlberger, Weitkunat, & Schneeweiss, 1997) and as low as 8% (Smith, 1997).

The International Student Survey had a total of 487 mailer-daemon and automated system-administrator replies that indicated respondents were not able to receive e-mails (i.e., their mail was "bounced"). Because many of these cases were due to over-quota e-mail accounts, respondents were left in the database with the hope that subsequent waves would be successful in contacting them. In all, 171 respondents (3.9%) were verifiably not able to be contacted in any of the three waves and were thus recorded as undelivered.

Nonresponse Error

Nonresponse error is the discrepancy between the observed cases (respondents) and the entire population (respondents + nonrespondents). As Dillman (1991) explains:

> Nonresponse error stems from the fact that some of the members of the sample population do not respond to the survey questions. The vast majority of research on improving mail survey methods has focused on response rates, the generally accepted indicator of nonresponse error. (p. 228)

Much of the literature on Internet survey methodology has focused on this common problem (Batagelj & Vehovar, 1998; Sheehan & Grubbs-Hoy, 1999; Slevin, 1997; Smith, 1997; Watt, 1997; Yun & Trumbo, 2000). Although Dillman (p. 228) points out that "a low response rate does not necessarily entail nonresponse error," it is clear that a reduction in sample size that is due to some form of informative censoring will result in greater sample error. On the other hand, a large sample does not ensure noninformative censoring due to nonresponse. For example, Christoffersen (1987, as cited in Dillman, 1991) noted educational bias in mail surveys even when very high response rates are obtained. Thus, self-selectivity among both survey nonrespondents and respondents may amplify sampling error.

Response rates in Internet surveys have been reported to be as high as 70% (Brennan & Hoek, 1992) and as low as 0% (Pradhan, 1999). The subject of the study and characteristics of the sample have significant effects on the response rates. For instance, a study of job satisfaction among scientists achieved an overall 37% response rate (Parker, 2001), whereas a study of the demographic composition of 18,000 White House Electronic Service users only achieved 8% and 6% response rates for the top-level and the follow-up surveys, respectively (Boncheck et al., 1996). Differences have been noted when comparing Internet and postal mail surveys of the same or similar populations. One study found higher response rates in e-mail surveys than in postal surveys (Brennan & Hoek, 1992), whereas most others have reported the opposite (e.g., Kittleson, 1995; Tse et al., 1995). Other studies have found almost equal response rates between Internet and postal mail surveys (Bachmann, Elfrink, & Vazzana, 1996; Mehta & Sivadas, 1995). Comparing Internet delivery methods, Slevin's (1997) satisfaction survey of IT conference attendees reported a 24% response rate for the Web survey and 30% for e-mail, speculating that the higher response rate for e-mail was possibly due to technological advances in HTML enabled e-mail readers.

The International Student Survey project received a total of 929 completed surveys out of a total of 4,213 sent for a modest overall response rate of 22%. Factors affecting nonresponse in this survey may have included technical problems with the Web page link in the initial batches, timing of follow-up waves, confidentiality concerns, and misidentification of the survey as Spam.

Although many respondents had migrated to a new Web-based mail reader, there were still a number who used the UNIX text-based mail reader PINE. Unfortunately, these respondents were unable to click on the URL to the Web site, and, when attempting to copy and paste the link into their Web browsers, some neglected to copy the entire link because PINE broke the link into two lines. To test for the effect of timing and to monitor the overall performance of the project, the database was divided into batches of 100, 200, 500, and then 1000, making for a total of seven batches sent in three waves over the period of 1 month. Technical problems with the server during a 2-day period may have reduced the number of responses during Wave 2, but responses were recorded on each day of the survey administration. Timing of Wave 2 mailings for Batch 6 and 7, and Wave 3 mailings for Batches 1, 2, and 3 coincided with mid-term exams, resulting in fewer than expected responses during this time frame. Wave 3 for batches 4, 5, 6, and 7 came the weekend before spring break. There was a surge in responses (possibly graduate students who continued to work during the break) on the first day of the break followed by a sharp decline in the number of responses thereafter.

Confidentiality was an issue with several respondents, as were overall perceptions of Internet security. Coomber (1997) discussed the issue of possible government subpoena of records and the lack of anonymity provided by Web surveys when compared to e-mail surveys. The International Student Survey took several measures to protect the identity of the respondents, including using separate servers for the bulk distribution of mailings and the actual recording of survey results. Each e-mail recipient received a unique password that was randomly generated prior to mailings. These databases were then merged along with the results of "bounced" mail to produce a final data set inaccessible from the Internet. Thus, although reasonably secure and confidential, this survey was not anonymous.

The perception that the survey was Internet "junk mail" or Spam also arose. Several e-mails were received with the subject line "unsubscribe," a common command for removal from automatic Listservs and bulk e-mailers. Watt (1997), Coomber (1997), Smith (1997), and Sheehan and Grubbs-Hoy (1999) all noted a concern for nonresponse due to the perception that surveys are not in keeping with "Netiquette." As Sheehan and Grubbs-Hoy (1999) explained, "researchers must recognize that unsolicited surveys may be considered aggressive by respondents and not in keeping with Internet culture."

BIAS DUE TO NONRESPONSE

Bias, introduced by nonresponse error and self-selection of Internet survey respondents, is an important issue for Internet research. Studies have reported bias due to various demographic factors, including race, gender, age, education, and income. Generally speaking, younger, better educated, and wealthier males are overrepresented in Internet-based surveys (Bonchek et al., 1996; Kehoe & Pitkow, 1996). Higher response rate among select subgroups of a sample may introduce bias as well. Rachmann's (1999) Web-based survey of tourism industry representatives, tourism-related academics, and potential tourists had much higher response rates among academics (30%) than among tourism industry workers (10%) or prospective tourists (17%). In addition, Smith (1997) pointed out "the target population must be technologically savvy enough to use [Web surveys]." Watt (1998) and Abrams and Williams (1996) also encountered problems with self-selectivity. In an attempt to statistically compensate for self-selectivity, Harkness et al. (1996) used results of the Nielsen/CommerceNet Internet Demographic Study matched with the 1995 Current Population Survey data to generate a weighting scheme for Internet survey results. The Nielsen/CommerceNet study used probability sampling of persons over 16 years old among telephone households to construct a sample for a telephone survey of Internet use, thus creating a representative demographic profile of Internet users. Yet, as we have seen, the high rate of growth among Internet users quickly leaves such a profile and weighting scheme obsolete.

The International Student Survey showed bias for upper division students from select countries and concentrated in particular majors. Although gender was unknown in the total enrollment, males represented 62% of all respondents. Students in graduate programs responded in higher percentages than undergraduates. Although masters and Ph.D. students accounted for only 45% of the enrolled foreign-born students, 65% of the respondents were in graduate programs. Self-selection by major was somewhat expected. Higher response rates were expected for computer science and engineering students, because they are the most "connected" to new technology. However, students from the MBA program exhibited noticeably high response rates as well.

Improving Response Rate

Fox, Crask, and Kim (1988) found that prior notice, follow-up, university sponsorship, and layout of surveys were significant predictors of postal mail response rates. Similarly, Yammarino, Skinner, and Childers (1991) noted prenotification, follow-ups, and sponsorship as being significant. Additionally, these authors noted that personalization of cover letter, token monetary and nonmonetary incentives, anonymity, and shortness of survey (under 4 pages) were of importance in improving responses. In his meta-analysis of mail survey reviews, Dillman (1991) added salience of the survey topic to respondent, questionnaire length, cover-letter text, and the population surveyed as further variables to consider. For Internet surveys specifically, Watt (1998) recommended incentives such as donations to charity or sweepstakes, or simply making respondents feel that their input is worthwhile by, for instance, posting survey results on a Web page. Yet, even with sweepstakes for two Palm Pilot organizers as an incentive, Slevin (1997) achieved an overall response rate of only 27%. For our project, no incentive was offered. Only one subject indicated refusal to complete a survey due to lack of incentive. Appeals were made in the cover letter that explained how statistics generated by the survey would be provided to international student clubs and organizations and would be posted in a Web-accessible summary.

Questionnaire language and length may also be important explanatory factors for nonresponse in this study. The survey instrument originally totaled over 130 questions. After e-mail pretesting for readability and for time needed to complete the entire questionnaire, the final survey was reduced to a total of 114 questions, with built-in skips and expansions to move over questions that did not apply or to expand on optional categories. Wherever possible, radio buttons, drop-down menus, and check boxes were used to reduce the time needed to fill in the survey. The final published version was six screens, or Web pages. Average self-reported completion time for those who finished the survey was 15 minutes.

The International Student Survey attempted to increase response rate by including three mailings. Each mailing addressed the potential respondent by name and explained the importance of the survey. Additionally, the opportunity to collect paper surveys from nonrespondents was presented in the form of an international student fair. Twenty-two additional paper surveys were collected during the fair. Although these surveys only raised the response rate by an additional .6%, they did indicate that some respondents were hesitant to reply to a request for participation over the Web. This may be evidenced also by six phone calls that were received during the waves from respondents who wanted to confirm that the survey was legitimate.

Attention has been given to the possibility of using multiple modes of presenting surveys to increase overall response rates while reducing costs of telephone or postal mail surveys. Of special interest was the 72% response rate achieved by Yun and Trumbo (2000), who used a mixed delivery design. They began with a presurvey notification by postal mail, followed by postal mail surveys that included a link to the Web-based survey. E-mail follow-up shortly followed, again with a link to the Web-survey, and a final follow-up postcard was sent approximately 1 month after initial prenotification. One hundred sixty-two paper surveys, 33 e-mail surveys, and 35 Web responses were received from a total of 360 randomly selected potential respondents. Yun and Trumbo make the case for mixed-mode design not only to reduce overall cost but to boost overall response and representability. They tested for statistical significance in the difference between the means of key variables of respondents across the three modes. It is not surprising that they found those who responded by electronic means

(e-mail and Web) were significantly more connected to the Web, used the Web more frequently in their daily lives, and had a higher mean education. Comley (1996), Watt (1997), and Batagelj and Vehovar (1998) also support use of Internet-based surveys as a supplement to other forms of collection (i.e., telephone, postal mail, and in-person interviews).

CONCLUSION

Internet surveys have the potential to become a practical and valuable resource for social scientists. For select populations who are connected and technologically savvy, the cost, ease, speed of delivery and response, ease of data cleaning and analysis all weigh in favor of the Internet as a delivery method for survey research. As Slevin (1997), Watt (1997), Smith (1997) Clarkson (1999), Sheehan and Grubbs-Hoy (1999), and others indicate, the design flexibility, geographic reach, anonymity, and minimized interviewer error of Internet surveys are superior to telephone and mail delivery methods. However, current low response rates, lack of generalizability, and questions of validity and reliability all diminish the utility of Internet surveys for the general population today. Additionally, because there continue to exist many technical problems such as multiple computer platforms, browsers, and e-mail readers, and poorly written software—not to mention the potential for a server to crash and destroy any data already accumulated—Internet surveys are still a few years away from becoming a common means of survey research. In the interim, Internet surveys can be very useful for studying special "technologically savvy" populations and can act as a supplemental means to traditional survey research. However, using a multimodal approach for delivery is recommended. This approach would include traditional mail prenotification followed by several waves of e-mail solicitation and, if possible, telephone follow-up.

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