Chapter Three

LITERATURE REVIEW OF WEB AND E-MAIL SURVEYS

In this chapter, we examine what has been written about Internet surveys in the literature, specifically Web and e-mail surveys. We address the topics of response rate, cost, timeliness, sources of error, and data quality.[1] We compare two conventional survey modes, mail and telephone, with Internet survey modes. The other widely used conventional mode, face-to-face interviewing, is not addressed here because little has been written about it in comparison with Web and e-mail surveys given the high cost of in-person interviewing.[2]

A BRIEF HISTORY OF ELECTRONIC SURVEYS

Beginning in the late 1980s and early 1990s, prior to the widespread use of the Web, e-mail was explored as a survey mode.[3] As with the Web today, e-mail offered the possibility of nearly instantaneous transmission of surveys at little or no cost. Unlike the Web, however, early e-mail was essentially static, consisting of a basic ASCII (text-

[1]The literature contains far more information about response rates than about any other topic related to surveying, such as timeliness or data quality. Appendix B contains a more detailed discussion of response rates in the literature and Appendix C lists the survey topic, sample size, type of sample, contact/response/follow-up mode, and response rate for each study referenced in this report.

[2]We do not address other electronic survey modes that are currently in use, such as computerized self-administered questionnaires (CSAQs), which are surveys distributed via computer diskette. Two other electronic modes, CAPI and CATI, as we noted earlier, are unrelated to the development of the Internet and therefore we do not discuss them in this report.

[3]It is worth noting that the survey literature as late as the early- to mid-1990s could not anticipate the eventual influence of the Web on the practice of surveying.

only) message that was delivered via the Internet.[4] E-mail surveys tended to resemble the linear structure of a paper survey and were generally limited in length. Furthermore, because e-mail surveys were primarily text-based, document formatting was rudimentary at best. The only significant advantage they offered over paper surveys was a potential decrease in delivery and response time and cost, although some observers also hypothesized that the novelty of the new medium might actually have enhanced response rates (Parker, 1992; Zhang, 2000).

The Web started to become widely available in the early- to mid-1990s and quickly supplanted e-mail as the Internet survey medium of choice. Whereas early e-mail was all ASCII-based, the Web offered the possibility of multimedia surveys containing audio and video, as well as an enhanced user interface and more interactive features. For convenience samples, the Web also offered a way around the necessity of having to know respondents' e-mail addresses.

RESPONSE RATES OF INTERNET SURVEYS

Response rates for Internet surveys in the literature are summarized graphically in Figure 3.1 by survey mode (more-exact numbers can be found in Appendix B). Overall, Figure 3.1 suggests that surveys using a mail response mode and surveys using both a mail and Web response mode tend to have higher response rates than those using just an e-mail or Web response mode.

Response rates range from 7 to 44 percent for Web surveys and from 6 to 68 percent for e-mail surveys. Some studies in the literature gave respondents the choice of responding by either mail or via the Web. Of the seven studies we examined, five reported that respondents

[4]Since the early days of e-mail, the ability to send attachments and executable files with e-mail has greatly expanded. Today, e-mail can be used to send a survey program to a user to run on his or her computer. The user can then return the completed survey electronically or by mail. These CSAQ surveys can be delivered via a number of different types of media, including e-mail attachments, downloading from the Web, or via diskette or CD-ROM.

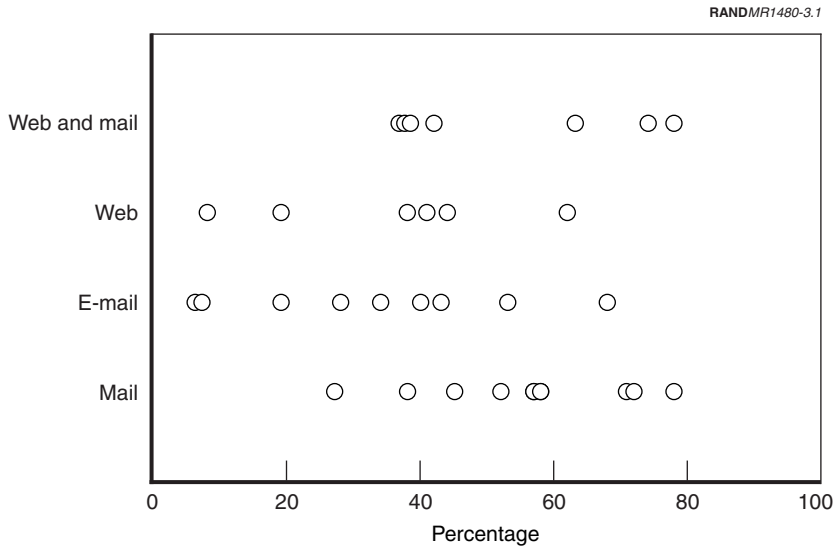


Figure 3.1—Response Rates for Internet Surveys in the Literature, by Survey Mode

more often chose to respond by mail than through the Web and two studies found just the reverse. Above all else, the context of the individual study seems to matter. For example, respondents for the study with the highest percentage of Web respondents were recruited through advertising in Internet discussion groups (Schleyer and Forrest, 2000).

Several studies in the literature involve conducting experiments to determine whether e-mail surveys have lower or higher response rates than postal mail surveys. In such studies, identical questionnaires were sent to different portions (or study arms) of the same population. The only difference between the study arms was in whether the respondent was asked to respond via e-mail or by mail. In most studies, the mail response rate was higher by as much as 21 percent. Only one study resulted in a lower mail response rate. However, that study was in many respects unusual and fell at a time when the novelty of e-mail may have influenced the results (Parker, 1992).

In one experiment (Quigley et al., 2000), it was reported that a mail response option needed to be used in addition to a Web response option because response rates were unacceptably low. The same authors also mention that giving respondents the option of requesting a mail survey (rather than mailing it out to everyone) proved unsuccessful because few respondents took advantage of the option.

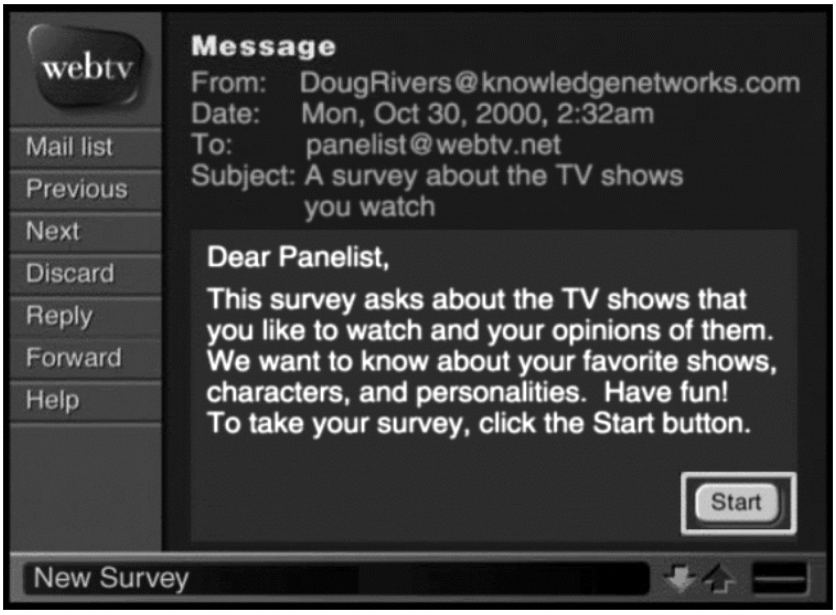
For a number of studies, survey participants were recruited through advertising in newsgroups, on Web pages, or in newspapers. It is not possible to compute a response rate for these studies. Moreover, these samples constitute convenience samples. As we mentioned previously, response rates for convenience samples may be interesting, but they are not scientifically meaningful.

Several commercial enterprises specialize in conducting Web surveys. Knowledge Networks (www.knowledgenetworks.com) and Harris Interactive (www.harrisinteractive.com) are the most prominent ones. However, the two firms use completely different approaches to fielding surveys via the Internet.

Knowledge Networks recruits panels of individuals via random digit dialing (RDD) to participate in ongoing surveys. Although Knowledge Networks does offer researchers a probability sample, the overall response rate averages only 25 to 30 percent.[5] In addition, Knowledge Networks gives researchers the option of surveying panel nonrespondents over the telephone, which increases the overall response rate to about 40 to 50 percent (Dennis, 2001) but of course also increases the cost.

A special feature of Knowledge Networks is that it installs the requisite hardware (WebTV) in respondents' homes at no charge and assumes the monthly service costs so that respondents can fill out the

[5]On average, 56 percent of the initially contacted households agree to join a panel. Of those, 72 percent allow the required WebTV hardware to be installed. Of that portion, 83 percent complete the core survey that makes them eligible for filling out future surveys. The average response rate for a Knowledge Networks Web survey is 75 percent, which yields an overall average response rate of 25 percent (Berrens et al., 2001). Mike Dennis, Knowledge Networks' vice president of government and academic relations, said that more-recent numbers are higher: The initial contact rate is unchanged, the hardware installation rate is 80 percent, the core survey completion rate is 88 percent, and the survey response rate is 75 to 85 percent. Combined, these numbers yield an overall response rate between 30 and 33 percent.



Screen shot courtesy of Knowledge Networks.

Figure 3.2—Knowledge Networks' WebTV Survey Invitation

surveys using their television sets. Figure 3.2 shows a WebTV screen shot inviting panelists to participate in a survey. Providing respondents with hardware, software, and other connectivity requirements allows Knowledge Networks to reach a broader cross-section of the population than would otherwise be possible.

Knowledge Networks' panels are similar in spirit to Nielsen survey panels used to determine television ratings. Knowledge Networks survey panelists receive three or four surveys a month, each requiring 10 to 15 minutes to complete. Sampling is controlled so that the panelists do not receive more than one survey on a given topic in a three-month period. As of August 2001, Knowledge Networks had more than 200,000 panelists enrolled, or approximately 80,000 households. The company claims that it adds about 5,000 panelists per month and projects an eventual total panel size of 250,000.

Harris Interactive constructed and maintains a database of several million volunteer Web survey participants. The volunteers are re-

cruited from a variety of sources including advertising on the Internet. Because they volunteer to be part of Harris's panel, the participants are self-selected. For any particular survey effort, a sample from the Harris panel database is asked to participate.

To generalize its survey results, Harris Interactive uses a statistical methodology called *propensity scoring* to re-weight the estimates based on the convenience sample. Propensity scoring was invented to deal with selection bias,[6] but has not traditionally been used in the context of surveys. (We present a case study in Chapter Six that involves propensity scoring.)

COST OF A WEB SURVEY VERSUS OTHER MODES

Assessing the cost of doing a Web survey versus mail or some other survey mode is difficult because different writers on the subject have defined costs in different ways. Cost estimates vary depending on whether they are given relative to the number of mail-outs or relative to the number of completed survey responses and, unfortunately, most studies in the literature omit any discussion about costs altogether. Nevertheless, the question of cost often comes down to how to best price the time spent programming a Web survey, and whether and how to price the investigator or survey coordinator's time because marginal personnel costs are almost always significantly greater than any other marginal survey cost (such as printing and postage).

Although lower costs are often touted as one of the benefits of Internet surveys, Couper et al. (1999) found no cost benefit with e-mail surveys as compared with postal-mail surveys. In a large and comprehensive survey of various government agencies, Couper et al. compared an all-e-mail survey (contact, response, and follow-up) with an all-postal-mail survey. They found that evaluating and testing the e-mail software took more than 150 hours—almost four times what they had budgeted. For the postal mail survey, costs for printing and postage were $1.60 per reply, and data editing and entry

[6]Propensity scoring is not a panacea for all selection bias. It can only adjust for so-called ignorable bias. ("Ignorable" bias is more important than the name suggests.) For more details, see Rosenbaum and Rubin (1983).

costs came to $1.81 per reply. For the e-mail survey, managing the e-mail itself cost $1.74 per completed case. In addition, in the Couper et al. study, more than 900 toll-free calls of a mostly technical nature were handled. Although the printing and mailing costs were eliminated for the e-mail survey, Couper et al. found that the cost of evaluating and testing the e-mail software, additional post-collection processing,[7] and maintaining a toll-free phone line (largely dedicated to responding to technical questions related to the e-mail surveys) offset any savings.

Another team of researchers, Schleyer and Forrest (2000), received survey responses over the Web and by postal mail and fax. Their costs included programming a 22-item survey in HTML (hypertext markup language) and in Perl, a high-level programming language (35 hours at $30 an hour); software testing (eight hours at $60 an hour); operating a bulk-mailer program (three hours at $60 an hour); and manual entry of some Web surveys ($206 total). An equivalent calculation was done for a postal mail survey, based on $1.45 per mailing and $4 for data entry per 22-item survey. Schleyer and Forrest found that the total costs for the Web survey turned out to be 38 percent lower than for the equivalent mail survey. A break-even calculation shows that a Web survey would be more economical than a postal mail survey when more than 347 people respond; the reverse is true with less than 189 responses. When the number of responses runs between 189 and 347, it is unclear which mode would turn out to be more economical.

Asch (2001) found that adding a Web response option to a mail survey was economical when about 580 responses are obtained over the Web and when the Web is used as the primary response mode and surveys are mailed out to nonrespondents only. The calculations are based on the trade-off from the expected savings in postage, printing, and labor costs to prepare survey mailing packages and code the subsequent survey returns against the expected additional costs of programming, additional management effort, and maintain-

[7]The e-mail survey was designed so that respondents would use the reply function of their e-mail program. If done properly, the resulting reply could have been automatically read into a database upon receipt. However, almost 47 percent of the e-mail surveys required some type of clerical action to prepare them for automatic reading.

ing a telephone help line for the Web survey. Asch's study did realize cost savings because it secured more than 1,000 Web responses.

In two studies that essentially disregard personnel costs, Mehta and Sivadas (1995) and Jones and Pitt (1999), the authors concluded that Internet-based surveys are less costly than mail surveys. These conclusions simply stem from the fact that Internet surveys do not incur postage and printing costs whereas postal mail surveys do. Mehta and Sivadas compared an e-mail survey to two forms of mail response surveys and concluded that the two postal mail surveys had "minimum costs" of $0.58 and $2.16 per mail out. This cost calculation reflects only the cost for postage in the first case and costs for postage and an additional dollar incentive in the second case. Jones and Pitt reported on a study with three arms: e-mail only, e-mail and Web, and postal mail. They reported the costs to be 35 pence, 41 pence, and 92 pence per reply, respectively.[8] These costs reflect the mailing costs in Great Britain and a marginal labor cost of six British pounds per hour.

For a typical survey, Knowledge Networks currently charges around $35 per completed survey with a survey questionnaire that takes about 10 to 12 minutes to complete.[9] A large number of additional demographic and other variables are available from the Knowledge Networks core survey[10] at no extra charge.

In conclusion, when considering only postage and printing costs, e-mail and Web surveys appear to cheaper than postal mail surveys. In actuality, it appears that Web surveys become more economical than postal mail surveys only when the number of responses reaches a certain threshold—somewhere between a few hundred and a thousand. However, unanticipated technical problems are likely to arise when researchers have no prior experience with Web survey

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[8]A British pound is worth 100 pence. At the time of this writing, one pound was worth $1.45 in U.S. dollars.

[9]The price varies substantially depending upon the scale of the project and the amount of subsampling and screening required for identifying the target population.

[10]Knowledge Networks requires each respondent to fill out a core survey before he or she responds to the main survey. This avoids having to include standardized questions in every survey.

programming, and these problems can easily eliminate all potential cost benefits.

COMPARING SPEED AND TIMELINESS OF INTERNET SURVEYS WITH OTHER MODES

Most studies have concluded, often with little or no empirical evidence to back up the conclusion, that Internet-based surveys are conducted more quickly than surveys sent by postal mail. This conclusion is usually based on the fact that e-mail and other forms of online communication can be instantaneously transmitted whereas postal mail must be physically delivered, which of course takes more time. However, a blanket conclusion that Internet surveys are faster than mail surveys naively ignores the reality that the total amount of time for survey fielding includes more than just the survey response time.

A total comparison must take into account the mode of contact and how long the process takes, in addition to the follow-up mode and potential multiple follow-up contact periods. For example, if the respondents' e-mail addresses are unavailable and a probability sample is desired, respondents may then have to be contacted by mail. In this case, the Web survey saves time only for the return delivery of the completed questionnaire, and not for the contact and follow-up, so the resulting time savings may be only a fraction of the total survey fielding time.

In the case of e-mail surveys, where the presumption is that the potential respondents' e-mail addresses are known and, therefore, can be used not just for delivering the survey but also for prenotification and nonresponse follow-up, the time savings can be substantial. For example, allowing for a week of delivery time with postal mail is not uncommon. With an advance letter and just a single mail follow-up, this one-week delay can telescope into a month in survey fielding time. Two weeks must then be budgeted for initial survey delivery and return time, plus an additional two weeks for delivery and response on a single follow-up reminder. In comparison, with an all-electronic process, the same operations could potentially be completed in a few days or less.

Yet, even in an all-Internet environment, it is not necessarily true that the Internet-based survey will be more timely. For example, in a comparison of response speeds with e-mail and postal mail, Tse et al. (1995) did not find a statistically significant difference in the time between delivery and receipt of a survey sent by e-mail and an equivalent survey sent by postal mail to university faculty and staff.[11] Furthermore, to achieve sufficiently high response rates, it may be necessary to keep an Internet survey in the field for an extended period of time. For example, Knowledge Networks has said that to achieve 70 to 80 percent response rates,[12] it must leave a survey in the field for about ten days. This period of time comprises one workweek with two weekends because Knowledge Networks has found that most respondents complete their surveys over the weekend.

There are, however, cases in the literature that do show more-timely response rates. Tse (1998) found a statistically significant difference in the average *initial* response time for those who received an e-mail survey versus those who received a paper survey through their university's campus mail (one day versus two-and-a-half). Further, in Tse's experiment, most e-mail survey recipients either responded almost immediately (within one day) or they did not respond at all, which raises the question of the effectiveness of nonresponse follow-up in the electronic forum. Schaefer and Dillman (1998) also document faster response rates with e-mail: From the day they sent out survey questionnaires, it took on average of 9.16 days to receive the questionnaires by e-mail versus an average of 14.39 days by postal mail.

A final note: Commercial survey firms that use prerecruited panels of volunteers can execute Web surveys extremely quickly (see Chapter Four).

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[11] Although not statistically significant, the e-mail survey had a mean response time of just over eight days, while the equivalent mail survey had a mean response of almost ten days.

[12] The response rate refers to the number of people who received a particular survey. When factoring in various other forms of nonresponse, this rate declines to about 25 to 30 percent.

SOURCES OF ERROR WITH INTERNET SURVEYS

Coverage error is the most widely recognized shortcoming of Internet surveys. Although the fraction of the population with Internet access and the skills and hardware necessary to use the Web is continually increasing, the general population coverage for Internet-based surveys still lags considerably behind the coverage achievable using conventional survey modes. But, there are some important caveats to keep in mind.

First, the coverage differential is rapidly decreasing and may become immaterial in the near future. Second, even though conventional survey modes provide the ability to reach most of the survey population, getting people to respond is becoming increasingly difficult (for example, caller ID and answering machines are routinely used to screen calls from telephone surveyors and solicitors). Third, whereas conventional modes have near universal coverage, there will always be special subpopulations that have little or no coverage with any mode. Finally, a population with less-than-universal access to the Internet can be immaterial for some studies, such as those that focus on closed populations with equivalent access or populations of Internet users.

To improve coverage, Dillman (2000) recommends a dual-mode strategy for contact—using both e-mail and postal mail for pre-notification. Similarly, using dual-response modes, such as Web and e-mail, can be used to increase coverage.

Sampling error issues with Internet surveys are generally the same as those with conventional surveys. However, as the Internet expands, collecting much larger samples becomes more feasible. In fact, we recently talked to individuals at some organizations whose entire survey populations have electronic access; these organizations are considering eliminating sampling altogether and conducting just censuses. Often, these census efforts result in much larger numbers of respondents than otherwise could have been gathered using traditional survey sampling techniques and those larger numbers give the appearance of greater statistical accuracy. However, such accuracy may be misleading if nonresponse biases are not accounted for. Researchers need to carefully consider the trade-off between smaller samples that allow for careful nonresponse follow-up and larger

samples with limited or no nonresponse follow-up. Smaller samples may result in larger standard errors but less bias, whereas the larger samples may result in much smaller standard errors but an unknown amount of bias.

Debates over whether certain sampling frames and sampling methodologies are appropriate for a given research question are not unique to Internet-based surveys.[13] Similar issues exist with conventional survey methods as well, although the inevitable decisions that must be made with respect to managing costs often require researchers to carefully weigh the pros and cons of one sampling method over another. With Internet-based surveys, it is easy to overlook these issues because the marginal cost of doing a census versus a sample *seems* to be small.

Finally, Web surveys clearly offer the opportunity to improve on other forms of self-administered surveys in terms of data validation, *skip pattern* automation,[14] and elimination of transcription errors, all of which help to minimize measurement error. Web surveys can be programmed to conduct input validation as a logical check of respondents' answers. These types of checks improve data quality and subsequently save time in the preparation of the analysis file.

Although the possibility of programming errors exists, automation of skip patterns eliminates the possibility that a respondent may skip to the wrong question. From the respondent's point of view, skip pattern automation also simplifies the process of taking the survey. And, whereas all conventional surveys require some form of conversion into an electronic format for analysis, with Web surveys, the respon-

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[13]For example, a continuing debate in preelection polling is whether it is better to sample from existing voter registration lists or use RDD. The former excludes those not currently registered that might later register and the latter is known to result in, sometimes significant, overreporting of voting behavior. The choice, of course, depends on the particular research question (see Larson, 2001).

[14]A *skip pattern* refers to a respondent taking an alternative path through a questionnaire depending on his or her answer to an earlier question. For example, if a respondent answers that he or she is a renter rather than a homeowner, then the skip pattern would direct the respondent to skip past the questions related to mortgage payments.

dents' answers are directly downloaded into a database, thus avoiding transcription errors.

DATA QUALITY IN E-MAIL VERSUS MAIL SURVEYS

Data quality is usually measured by the number of respondents who have, intentionally or unintentionally, missed at least one survey item or by the percentage of missed items on respondents' questionnaires. For open-ended questions, longer answers are usually considered to be more informative and of higher quality. For closed-ended questions, it appears that e-mail surveys may incur a higher percentage of missed items than do postal mail surveys. As Table 3.1 shows, postal mail respondents on average miss fewer than 1 percent of survey items whereas e-mail respondents miss from 0.3 to 3.7 percent of survey items.

Paolo et al. (2000) also found that 27 percent of e-mail respondents did not respond to at least one question versus 9 percent of mail respondents that did the same. Kiesler and Sproull (1986) found the opposite: In their e-mail (contact and response) study arm, only 10 percent of respondents failed to complete or had spoiled one item, compared with 22 percent in the mail (contact and response) study arm. Tse (1998) and Tse et al. (1995) found no difference in the quality of responses from postal mail and e-mail survey respondents.

For open-ended questions, the literature shows that e-mail responses are either longer than or the same length as mail responses. Comley (1996) found that for two open-ended questions, e-mail respondents gave longer answers than did mail respondents. (One e-mail respondent in the Comley study wrote what amounted to a mini-essay.) Mehta and Sivadas (1995, p. 436) found "hardly any difference" between the average completed mail and e-mail responses for both open and close-ended questions. Across all survey arms in the Mehta and Sivadas study, 95 percent of respondents completed the one open-ended question as compared with an average of 98 percent of respondents who completed the close-ended question. Kiesler and Sproull (1986) found that the total number of words written by e-mail respondents as compared with mail respondents did not significantly differ. If one takes into account that open-ended items for mail respondents are not always encoded for cost reasons,

Table 3.1

Average Percentage of Missed Items for E-mail and Postal Mail Surveys

Study	E-mail	Postal Mail	Population
Bachman et al. (1996)	3.7	0.7	Business school deans and chairpersons
Comley (1996)[a]	1.2	0.4	Names and addresses purchased from Internet magazine in the UK
Paolo et al. (2000)	1.2	0.5	Fourth-year medical students
Couper et al. (1999)[b]	0.8	0.8	Employees of five U.S. federal agencies
Mehta and Sivadas (1995)[c]	< 0.3	< 0.3	Active U.S. users of bulletin board system (BBS) news group

[a]Based on three questions.

[b]Based on 81 attitude questions.

[c]Across five different study arms, one of which allowed for both mail and e-mail responses.

it would seem that Internet-based response modes are well suited to open-ended questions.

Finally, Walsh et al. (1992) report that self-selected respondents give higher-quality responses than randomly selected respondents, as might be expected. Open-ended responses from self-selected respondents were lengthier that those from randomly selected respondents, and self-selected respondents missed an average of 5 percent of closed-ended questions versus randomly selected respondents who missed an average of 12 percent.