

Advantages and Disadvantages of Internet Research Surveys: Evidence from the Literature

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E-mail and Web surveys have been the subject of much hyperbole about their capabilities as well as some criticism about their limitations. In this report we examine what is and is not known about the use of the Internet for surveying. Specifically, we consider evidence found in the literature regarding response rates, timeliness, data quality and cost. In light of this evidence, we evaluate popular claims that Internet-based surveys can be conducted faster, better, cheaper, and/or easier than surveys conducted via conventional modes. We find that the reality of cost and speed often does not live up to the hype. Nonetheless, it is possible to implement Internet-based surveys in ways that are effective and cost-efficient. We conclude that the Internet will continue to grow in importance for conducting certain types of research surveys.

INTRODUCTION

With the advent of the World Wide Web (Web or WWW) and electronic mail (e-mail), the Internet has opened up new vistas in surveying. Rather than mailing a paper survey, a respondent can now be given a hyperlink to a Web site containing the survey. Or, in an e-mail survey, a questionnaire is sent to a respondent via e-mail, possibly as an attachment. As either an alternative or an adjunct to conventional survey modes (e.g., the telephone, mail, and face-to-face interviewing) Internet-based surveys offer unique new capabilities. For example, a Web survey can relatively simply incorporate multi-media graphics and sound into the survey instrument. Similarly, other features that were once restricted to more expensive interviewer-assisted modes, such as automatic branching and real-time randomization of survey questions and/or answers, can be incorporated into self-administered Web (and some e-mail) surveys. However, not unlike when phone and mail surveys were first introduced, concerns exist about whether these Internet-based surveys are scientifically valid and how they are best conducted.

In the late 1980s and early 1990s, prior to the widespread availability of the Web, e-mail was first explored as a survey mode. As with the Web, e-mail offers the possibility of nearly instantaneous transmission of surveys to recipients while avoiding any postal costs. Early e-mail were primarily ASCII text-based, with rudimentary formatting at best, which tended to limit their length and scope. The only significant advantage they offered over paper was a potential decrease in delivery and response

times, though some also hypothesized that the novelty of the new medium might enhance 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 because it was easy to implement, it provided an improved interface with the respondent, and it offered the possibility of multimedia and interactive surveys containing audio and video. For convenience samples, the Web also offered a way around the necessity of having to know respondents' e-mail addresses. As a result, "quick polls" and other types of entertainment surveys have become increasingly popular and widespread on the Web.

Internet-based surveys are now in vogue—those conducted via the Web in particular—because of three assumptions: (a) Internet-based surveys are much cheaper to conduct; (b) Internet-based surveys are faster; and, (c) when combined with other survey modes, Internet-based surveys yield higher response rates than conventional survey modes by themselves. Yet, does the evidence in the literature confirm these assumptions? Are Internet-based surveys faster, better, cheaper, and/or easier than surveys conducted via conventional modes? What can we conclude about the strengths and current limitations of Internet-based surveying from the facts in the literature?

In this report we synthesize the literature about the use of the Internet (e-mail and the Web) in the survey process. Other accounts of the literature include Schonlau, Fricker and Elliott (2002), Couper (2000), Dillman (2000), and Tuten et al. (2002). In addition, an extensive source of Web survey literature can be found on the Web at www.websm.org.

LITERATURE SUMMARY FOR INTERNET-BASED SURVEYS

In this section we summarize key characteristics of Internet-based surveys—that is, surveys using the Web and e-mail as a response mode—as documented in the literature. We employed a professional librarian to conduct a thorough literature search in the Social Science Database and the Conference Paper Index database. The Social Science Database indexes more than 1,500 of the most important worldwide social sciences journals since 1972. Additional articles relevant to the social sciences are also incorporated from over 2,400 journals in the natural, physical, and biomedical sciences. The Conference Paper Index provides access to records of the more than 100,000 scientific and technical papers (since 1973) presented at over 1,000 major regional, national, and international meetings each year.

The literature search yielded 57 papers that were substantively interesting and informative. Here we report on a subset of those articles of direct relevance to this discussion. (Appendix B of Schonlau et al., 2002, lists 52 papers and we have augmented the list here with an additional five that have appeared since Schonlau et al. was published.) We consider the following key characteristics of surveys: (1) response rate, (2) timeliness, (3) data quality, and (4) cost. We compare what has been published in the literature about Internet-based surveys to a natural conventional survey alternative: mail. While no survey mode is going to be optimal in all of these areas, we chose mail because both mail and Internet-based surveys are self-administered, mail surveys tend to be the least expensive of the conventional modes, and virtually all of the comparisons made in the literature are to mail surveys.

Response Rates

A standard way to summarize survey performance is by comparing response rates among various survey modes. By “survey mode” (sometimes called response mode) we mean the mode by which the survey itself is conducted: Web, e-mail, mail, etc. In this section, we compare response rates for studies classified into one of three categories: (1) Surveys employing probability sampling or conducting a census that used the Web as the only response mode; (2) Surveys in which respondents were allowed to *choose* one of several response modes, including at least one Internet-based response mode; and, (3) Surveys in which respondents were *assigned* one of several response modes, including at least one Internet-based response mode.

We begin with results for studies that used the Web as the primary or only response mode with either censuses or probability samples (Table 1). The table is ordered by year and it shows that Web-only research surveys have currently only achieved fairly modest response rates, at least as documented in the literature.

Table 1. Response Rates for Web-only Surveys Using Probability Samples or Censuses

Survey	Sample Size	Response Rate	Population
Couper et al. (2001)	1,602	42% ^d	University of Michigan Students
Asch (2001) ^a	14,150	8%	College-bound high school and college students
Everingham (2001)	1,298	44%	RAND employees
Jones and Pitt (1999)	200	19%	University staff
Dillman et al. (1998) ^b	9,522	41%	Purchasers of computer products
Dillman et al. (1998) ^c	2,466	38%	Purchasers of computer products

^a Most respondents were contacted via their parents, which reduced the response rate. A mail response mode was added late in the survey protocol.

^b A relatively plain Web survey design was used in this experimental arm.

^c A relatively fancy Web survey design was used in this experimental arm.

^d Another 5.6 percent of partially completed surveys were also received.

In fact, the results in Table 1 may overstate response rate performance for research surveys of broader populations because Dillman's results are based on participants who were initially contacted by phone *and had agreed to participate in a Web survey* and Everingham's sample was of a closed population of employees at one company. Jones and Pitt (1999) sampled staff at "10 universities whose staff directories were available on the WWW" and Couper et al. (2001) surveyed 1,602 University of Michigan students. In all of these cases, the potential survey participants were likely to be more homogeneous and more disposed to respond compared to a random sample of the general population. In addition, because university populations often tend to have greater access to the Internet, and today's college students can be expected to be more computer- and Internet-savvy.

In Table 2 we summarize the studies published in the literature that allowed the respondent to choose to respond either via the Web or through the mail, ordered in terms of the fraction that responded via the Web. Since for many populations the fraction of respondents that can or will answer via the Web may not be sufficiently large, and mail emerges as the most relevant second mode for a dual mode survey, these studies are important.

Table 2. Studies Allowing Respondents to Choose a Web or Mail Response Mode

Study	Total Sample Size	% Chose to Respond by ...		Overall Response Rate	Population
		Mail	Web		
Raziano et al. (2001) ^a	57	96%	4% ^b	77%	U.S. Geriatric Chiefs
Sedivi Gaul (2001) and Griffin et al. (2001) (American Community Survey [2000])	9,596	95%	5%	38%	U.S. households
Sedivi Gaul (2001) and Griffin et al. (2001) (Library Media Center Survey [1998])	924	95%	5%	38%	Librarians
Sedivi Gaul (2001) and Griffin et al. (2001) (Library Media Center Survey [1999])	13,440	81%	19%	63%	Librarians
Quigley et al. (2000) (DoD study)	21,805	77%	23%	42%	U.S. military and spouses
Quigley et al. (2000) (DoD study)	7,209	83%	27%	37%	Civilians
Raziano et al. (2001) ^c	57	45%	52% ^b	58%	U.S. Geriatric Chiefs
Zhang (2000)	201	20%	80%	78%	Researchers
Schleyer and Forrest (2000)	405	16% ^d	84%	74%	Dentists

NOTE: The multiple Quigley et al. and Raziano et al. entries represent multiple arms of the same study.

^a This arm of the study used mail as the contact mode.

^b Includes e-mail. The authors do not distinguish between e-mail and Web as a response mode.

^c This arm of the study used e-mail as the contact mode.

^d The response mode in this case was either e-mail or fax.

In Table 2 we see that for most of the studies respondents currently tend to choose mail when given a choice between Web and mail. In fact, even when respondents are contacted electronically it is not axiomatic that they will prefer to respond electronically, as in Raziano et al. (2001) that did not find a statistically significant difference in response rates. Zhang (2000) and Schleyer and Forrest (2000) are the only studies that contradict this conclusion and they tend to represent groups of respondents that are largely or entirely computer literate and comfortable with electronic communication. In comparison, Quigley et al. (2000) and the American Community Survey (2000) study tend to represent general cross-sections of the U.S. public in terms of computer literacy and availability and for these studies the fraction that chose Web as the response mode was quite small.

In Table 3 we present studies that compared response rates between groups assigned to one of either two or three response modes. Here we see that Internet-based mode response rates generally do not achieve response rates equal to mail surveys. (The table is first ordered from lowest to highest e-mail response rate and then by Web response rate.) Further, Sheehan (2001) concludes that e-mail response rates are declining over time (though the reason for the decline is unknown).

Table 3. Studies With Multiple Study Arms: Comparing Response Rates for E-mail, Web and Mail Response Modes

Study	Total Sample Size	Response Rate			Population
		Web	E-mail	Mail	
Tse et al. (1995)	400	--	6%	27%	University staff
Tse (1998)	500	--	7%	52%	University staff
Schuldt and Totten (1994)	418	--	19%	57%	MIS and marketing faculty
Kittleson (1995)	153	--	28%	78%	Health educators
Mehta and Sivadas (1995)	262	--	40%	45%	BBS newsgroup users
Couper et al. (1999)	8,000	--	43%	71%	Federal employees
Schaefer and Dillman (1998)	904	--	53% ^a	58%	WSU faculty
Parker (1992)	140	--	68%	38%	AT&T employees
Jones and Pitt (1999)	200	19%	34%	72%	University staff
Vehovar et al. (2001) ^c	1,800	32%	--	54%	Businesses in Slovenia
Pealer et al. (2001) ^b	600	58%	--	62%	Undergraduates at the University of Florida
McCabe et al. (2002)	5,000	63%	--	40%	University of Michigan Students

-- Indicates not applicable; the indicated response mode was not evaluated in the study.

^a An additional 5 percent that were returned by mail are not included in this number.

^b In the 2nd follow-up of both study arms respondents were contacted by both mail and e-mail.

^c An additional phone study arm achieved a response rate of 63%, an additional contact mail / response fax study arm achieved a response rate of 43%.

Parker (1992) is the only study of which we are aware in which e-mail achieved equal or higher response rates when compared to postal mail. Parker conducted a survey of 140 expatriate AT&T employees on matters related corporate policies for expatriation and repatriation, reporting a 63 percent response rate via e-mail (63 returned out of 100 sent by e-mail) compared to a 38 percent response rate for postal mail (14 returned out of 40 sent by mail). Interestingly, Parker (1992) also attributed the difference in response rates to the fact that, at the time, AT&T employees received a lot of corporate paper junk mail yet, over the internal e-mail system, they received little to no electronic junk mail. Hence, recipients of the paper survey were more likely to discount its importance compared to e-mail survey recipients. With the spread of e-mail “spam,” this situation is likely to be reversed today.

In an example more typical of the current state of affairs, and in one of the few studies to randomize respondents to mode, Couper et al. (1999) obtained an average e-mail response rate of about 43 percent compared to almost 71 percent with mail in a survey of employees in five federal statistical agencies. Couper et al. chose e-mail as the

mode for the survey over the Web because e-mail was almost universally available in the five agencies while the Web was often not available.

Turning to the Web, McCabe et al. (2002) conducted an experiment in which 5,000 University of Michigan students were randomized to receive a survey about drug and alcohol use; 2,500 potential respondents received a mail survey and 2,500 were notified of an equivalent Web-based survey. Respondents in both groups received a \$10 gift certificate incentive. In this study, McCabe et al. achieved a 63 percent Web response rate compared to 40% for mail. In contrast, however, Pealer et al. did not find a statistically significant difference between Web and mail response rates for a survey of undergraduates at the University of Florida.

The only other published study that achieved exceptional response rates with an Internet-based survey is Walsh et al. (1992) in which potential respondents were solicited by e-mail and offered the option to respond by e-mail or request a paper survey by postal mail. While they did not conduct an equivalent postal mail only survey for comparison (and thus are not listed in Table 3), Walsh et al. achieved a 76 percent overall response rate of a randomly sample of subscribers (300 out of a total population of 1,100) to a scientific computer network for an e-mail survey. In addition to providing non-respondents with two follow-up reminders, a lottery prize of \$250 was employed as an incentive.

Walsh et al. found that 76 percent of the respondents replied by e-mail and the other 24 percent responded by postal mail. They also received requests from an additional 104 subscribers (who were not chosen in the sample of 300) to participate in the survey. For the self-selected 104, 96 percent responded by e-mail. Not surprisingly, they also found a positive correlation between propensity to respond electronically and amount of network usage.

In conclusion, there is little evidence in the literature that Internet-based surveys achieve higher response rates, as a general rule, than conventional surveys. The few Internet-based surveys that have achieved higher response rates have tended to be either of university-based populations or small, specialized populations. The majority of results reported in the literature show Internet-based surveys at best currently achieve response rates equal to conventional modes and often do worse. The reasons for this difference are not yet clear and require more study.

Yet, as we have seen, there are also a few examples of Web surveys outperforming mail for some specific populations. Whether this was idiosyncratic of these few surveys,

or it is an indication that methodology is developing to achieve higher response rates in the new medium is yet to be shown.

It is important to note that, contrary to intuition, there is no evidence in the literature that concurrent fielding of a survey via a conventional mode and via an Internet-based mode results in any significant improvement in response rates. This may be because, as Table 2 shows, except in specialized populations, when given a choice between mail and Web surveys, most individuals tend to respond to the mail survey. In addition, there is no evidence that those who would normally refuse to complete a mail survey would choose to respond if the survey was Internet-based. Of course, these results are specific to the current state of the art of Internet-based surveying, existing technology, and the current state of respondent attitudes toward surveys, both Internet-based and conventional. Future developments may significantly alter these findings and more research is certainly warranted in an attempt to improve the response rate performance of Internet-based surveys.

Finally, we note that while research surveys based on probabilistic survey sampling methods are generally recognized as being necessary to conduct statistical inference to any population outside of the sample, convenience sampling can also be useful to some researchers for other purposes. For example, early in the course of research, responses from a convenience sample might be useful in developing research hypotheses. Responses from convenience samples might also be useful for identifying issues, defining ranges of alternatives, or collecting other sorts of non-inferential data. In fact, in certain types of qualitative research, convenience samples on the Web may be just as valid as other methods that use convenience samples.

There are a number of studies in the literature that used convenience samples, for which response rate comparisons do not apply (and hence precluded their inclusion in Tables 1-3), often with respondents recruited through advertising of some form. While response rates for these studies are meaningless, we present a few of the more interesting studies here to illustrate alternative ways that Web surveys can be used. In a social science study of geographic mobility and other topics Witte et al. (2000) recruit a large number of respondents: 32,688. Similarly, Vehovar et al. (1999) conducted a large-scale survey targeted at the Internet population of Slovenia, which corresponds to about 13 percent of the total population of Slovenia. In both cases, similarly sized traditional mail surveys would likely have been more complicated and very expensive to field. Coomber (1997) conducted a survey about drug dealer practices, where his target population was illicit drug-dealers throughout the world. Coomber solicited responses by e-mail and

through advertising, and collected responses on the Web hoping his respondents would be encouraged to respond more honestly because of a perceived anonymity.

Timeliness

In today's fast-paced world, survey timeliness is increasingly stressed. The length of time it takes to field a survey is a function of the contact, response, and follow-up modes. Decreasing the time in one or more of these parts of the survey process will tend to decrease the overall time in the field. However, it is important to keep in mind that the relevant measure is not average response time but maximum response time (or perhaps some large percentile of the response time distribution) since survey analysis generally does not begin until all of the responses are in.

Most studies tend to conclude, often with little or no empirical evidence, that Internet-based surveys are faster than surveys sent by postal mail. This conclusion is usually based on the recognition that electronic mail and other forms of electronic communication can be instantaneously transmitted while postal mail takes more time. However, simply concluding that Internet-based surveys are faster than mail surveys naïvely ignores the reality that the total amount of time for survey fielding time is more than just the survey response time. A complete comparison must take into account the mode of contact and how long that process will take and the mode of follow-up allowing for multiple follow-up contact periods. For example, if e-mail addresses of respondents are unavailable and a probability sample is desired then respondents may have to be contacted by mail. In this case a Web survey only saves time for the return delivery of the completed questionnaire, and not for the contact and follow-up, so that the resulting time savings may only be 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 can therefore be used not just for delivering the survey but also for pre-notification and non-response follow-up, the time savings can be substantial. For example, one is often forced to allow for a week of delivery time in the postal mail. With an advance letter and a single mail follow-up, this one week delay telescopes into over a month in survey fielding when two weeks must be budgeted for initial survey delivery and return time, plus an additional two weeks for a single follow-up reminder delivery and response time. By comparison, in an all-electronic process the same operation has the potential to be completed in a few days or less.

Yet, even in an all-electronic environment it is not necessarily true that the Internet-based survey will be timelier. For example, in a comparison of response speed

between e-mail and mail, Tse et al. (1995) did not find a statistically significant difference in the time between sending and receipt of an e-mail survey to university faculty and staff and an equivalent survey sent by mail. Furthermore, to achieve sufficiently high response rates, it may be necessary to leave an Internet-based survey in the field for an extended period of time. For example, a prominent commercial Internet survey company, Knowledge Networks, has indicated that to achieve 70-80 percent response rates they must leave a survey in the field for about 10 days. This period comprises one workweek with two weekends, because they find that most respondents complete their surveys on the weekend.

However, there are cases in the literature that did show more timely response. Tse (1998) found a statistically significant difference in the average *initial* response time for those that received an e-mail survey compared to those that received a paper survey in the campus mail (one day versus 2-1/2). 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 non-response follow-up in the electronic forum. Schaefer and Dillman (1998) also document faster e-mail response rates: 76 percent of all responses were received in 4 days or less. Pealer et al. (2001) found a statistically significant difference in the average return time between their e-mail study arm (7.3 days) and their mail study arm (9.8 days). However, the final e-mail survey was received after 24 days and the final mail survey after 25 days—a negligible difference in overall fielding time.

In conclusion, while it is certainly reasonable to conclude *prima facie* that the delivery time of an Internet-based survey is faster than the delivery of a survey by mail, it does not necessarily follow that the increased delivery speed will translate into a significantly shorter survey fielding period. Two points are relevant: (1) dramatic improvements are only possible with an all-electronic process, which is currently only possible for specialized populations; and, (2) even for populations in which all-electronic surveys are possible, the literature is not very informative as there is no information available about the length of fielding time required to achieve particular response rates.

Quality

When the primary purpose of a survey is to gather information about a population, the information is useless unless it is accurate and representative of the population. While survey error is commonly characterized in terms of the precision of statistical estimates, a good survey design seeks to reduce all types of errors, including coverage,

sampling, non-response, and measurement errors. (See Groves, 1989, for a detailed discussion of the “Total Survey Error” approach.) Indeed, even when a survey is conducted as a census, the results still may be affected by many of these sources of error.

Coverage error is the most widely recognized shortcoming of Internet-based surveys. Today the general population coverage for Internet-based surveys still significantly lags behind the coverage achievable using conventional survey modes. However, there are some important caveats to keep in mind. First, the coverage differential is rapidly closing and *may* become immaterial in the relatively near future (though this is far from a preordained conclusion). Second, even though conventional modes have the ability to reach most of the population, it is becoming increasingly difficult to get people to respond (e.g., answering machines are routinely used to screen calls these days and, hence, screen out telephone surveyors and solicitors). Third, while conventional modes have near universal coverage, there will always be special sub-populations that have little or no coverage for any mode. Fourth, in the case of Internet-based surveys, access is only one consideration. Even if the respondent in principle has Internet access (e.g. through a library), there are large portions of the population that are still computer illiterate and would have difficulty correctly responding to such a survey. Finally, access and computer literacy are necessary but not sufficient conditions for success: Respondents must also have compatible hardware and software.

However, less than universal access to the Internet can be immaterial for some studies, such as studies that focus on closed populations with equal access or Internet users, for example. In order to improve coverage, Dillman (2000) recommends a mixed-mode strategy for contact, using both e-mail and postal mail for pre-notification. Similarly, using mixed response modes, such as Web and e-mail can be used to increase coverage. However, as we previously mentioned, there is little evidence in the literature that concurrent mixed mode fielding increases response rates over what would have been achieved using a single, conventional mode.

In addition to coverage, data quality is a function of a number of other dimensions, including: (1) unit and item nonresponse; (2) honesty of responses, particularly for questions of a sensitive nature; (3) completeness of responses, particularly for open-ended questions; and, (4) quality of data transcription into an electronic format for analysis if required by the survey mode.

All other things held constant (such as pre-notification and non-response follow-up), unit and item non-response are generally smaller using interviewer-assisted modes (de Leeuw, 1992) compared to self-administered survey modes. Face-to-face interviews

have long been considered the gold standard of surveys and tend to result in the lowest unit and item non-response as well as minimizing respondent misinterpretation of questions and skip patterns. However, it has been shown that interviewer-administered survey modes, particularly face-to-face, yield more socially desirable answers than self-administered modes (de Leeuw, 1992, Kiesler et al., 1986, p. 409). This is particularly relevant for surveys of sensitive topics or for surveys that contain sensitive questions, such as questions about income or sexual practices, for example. Mail and other self-administered modes tend to be the least expensive but often have higher unit and item non-response rates. On the other hand, they tend to elicit the most accurate responses to sensitive questions.

Data quality is usually measured by the number of respondents with missing items or the percentage of missing items. For open-ended questions, longer answers are usually considered more informative and of higher quality. In those studies that compared e-mail versus mail, for closed-ended questions, it appears that e-mail surveys may incur a higher percentage of items missing than mail surveys. As Table 4 shows, for studies in the literature that reported the percentage of missed items, the percentage for mail respondents was less than or equal to the percent for e-mail respondents.

Table 4. Average Percentage of Missed Items for E-mail and Postal Mail Surveys

Study	Postal		Population
	E-mail	Mail	
Peale et al (2001)	14.2	14.2	Undergraduates, University of Florida
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 U.K.
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.

At the respondent level, Paolo et al. (2000) also found that 27 percent of e-mail respondents did not respond to at least one question versus 9 percent for mail respondents. Kiesler and Sproull (1986) found the opposite: in the e-mail (contact and response) study arm only 10 percent of respondents failed to complete or spoiled one

item compared to 22 percent in the mail (contact and response) study arm. Tse (1995, 1998) found no difference in quality of responses.

For open-ended questions, studies found that e-mail responses are either longer or of the same length as mail responses. Comley (1996) found that in the two open-ended questions e-mail respondents gave longer answers. One respondent even wrote a mini-essay. Mehta and Sivadas (1995) found that there was “hardly any difference between the average completed responses for both the open and close-ended questions” (Mehta and Sivadas, 1995, p. 436). Kiesler and Sproull (1986) found that the total number of words did not significantly differ for e-mail and mail respondents. If one also takes into consideration that open-ended items for mail respondents are not always encoded for cost reasons, it appears that Internet-based survey modes may be better suited to open-ended questions.

Other quality issues for Internet-based surveys resulting from some sort of sampling error are generally the same as for conventional surveys. However, as the Internet becomes more ubiquitous, collecting much larger samples becomes more feasible. Indeed, we have talked to some organizations recently that have electronic access to their entire population and are considering eliminating sampling and simply conducting 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 non-response biases are not accounted for and researchers need to carefully consider the trade-offs between smaller samples that allow for careful non-response follow-up and larger samples with less or no follow-up. The former may have larger standard errors but less bias while the latter may have much smaller standard errors but an unknown, and potentially very large, amount of bias.

Finally, we note that Web surveys offer the ability to clearly improve on other forms of self-administered surveys in terms of data validation, skip pattern automation, and the 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 the respondent’s answers. These types of checks improve data quality and subsequently save time in the preparation of the analysis file. As with logic checks, Web surveys can also be programmed to manage the process of skipping questions. This will eliminate errors and, from the respondent’s point of view, simplify the process of taking the survey. And, while all conventional surveys required some form of conversion into an electronic

format for analysis, for Web surveys respondents' answers are directly downloaded into a database, avoiding transcription errors.

Cost

Designing a survey fundamentally involves making trade-offs between the quality and quantity of data and cost. For smaller research surveys that are not subsidized in any way, a major component of total survey cost is frequently the researchers' time for survey design and subsequent data analysis. However, these costs vary little by survey mode. A major expense that does vary by mode is the labor cost of the personnel who actually execute the survey. Depending on the size of the survey and the complexity of the design, either researcher labor costs, survey personnel labor costs, or a combination of the two will likely dominate the survey budget.

Comparing the costs of doing a Web survey versus a mail survey or other some other mode in the literature is difficult because different authors define costs different ways. Academics frequently only consider postage and reproduction costs and often fail to account for the cost of one or more of various types of labor, including: survey design and/or programming, coding, analysis, and other such items. Estimates also vary depending on whether they are given on a per mail-out or per complete survey response basis and, unfortunately, most studies in the literature omit any discussion about costs altogether. However, the question often reduces to how to price the time spent programming a Web survey and whether and how to price the time of the investigator or a survey coordinator.

While lower costs are often touted as one of the benefits of Internet-based surveys, Couper et al. (1999) found no cost benefit in e-mail compared to postal mail surveys in their work. In a large and comprehensive survey effort of different government agencies Couper et al. compared an all e-mail survey (contact, response, and follow-up) versus an all mail survey. They found that evaluating and testing the e-mail software took over 150 hours - almost 4 times as much as they budgeted. For the mail survey, costs for printing and postage were \$1.60 per reply; and data editing and entry cost about \$1.81. For the e-mail survey, managing the e-mail cost \$1.74 per completed case. In addition, they handled over 900 toll-free calls of a mostly technical nature. While the printing and mailing costs were eliminated for the e-mail survey, Couper et al. found that the costs of evaluating and testing the e-mail software, additional post-collection processing, and the costs of maintaining a toll-free phone line which was largely dedicated to responding to technical questions related to the e-mail surveys offset any savings. (For example, while

the e-mail survey was designed so that respondents would use the reply function of their e-mail program so the resulting replies could be automatically read into a database upon receipt.) Further, almost 47 percent of the e-mail surveys required some type of clerical action to prepare them for automatic reading.

On the other hand, Raziano et al. (2001) in a small study of 110 Geriatric Chiefs across the U.S., compute the cost per respondent for their mail study arm to be \$7.70 and for their e-mail study arm \$10.50. The programming time to construct the e-mail survey is factored into this calculation. However, the total programming time accounted for, two hours, may be unrealistic for a large or complicated survey operation. Also, these estimates fail to reflect the fact that their postal arm response rate from the first mail-out exceeded the e-mail arm response rate after four contact attempts. Hence, for a given desired response rate, the difference in costs would be less as fewer mailings would be required. Similarly, Schleyer and Forrest (2000) in their study received responses over the Web, by mail, and by fax and found the total costs for the Web survey turned out to be 38 percent lower than for the equivalent mail survey.

Asch (as reported in Schonlau et al., 2002) found that adding a Web response option to a mail survey to be economical when about 620 responses are obtained over the Web when the Web is first used as the primary survey mode and surveys are only mailed out to non-respondents. Their calculations were based on the trade-off of the expected savings in postage, printing, and labor costs to prepare survey mailing packages and code the subsequent survey returns against the expected extra costs of programming, additional management effort, and maintaining a telephone help-line for the Web survey. This study did achieve a cost savings since it garnered over 1,000 Web responses.

In two studies that essentially ignore personnel costs, Mehta and Sivadas (1995) and Jones and Pitt (1999) conclude, not surprisingly, that Internet-based surveys are less costly than mail surveys. These conclusions simply stem from the fact that Internet-based surveys do not incur postage and printing costs while mail surveys do.

In conclusion, when only considering postage and printing costs, e-mail and Web surveys almost by definition are cheaper than mail surveys. However, when the total costs of a survey are considered, including labor and other costs, Web surveys may or may not be cheaper depending on whether the additional expenses incurred with that mode, such as programmer costs, are offset by savings, such as postage and data entry costs. When planning for and subsequently executing a Web survey, care must be taken that unanticipated technical problems are minimized or these problems can easily eliminate all potential cost benefits.

SUMMARIZING THE CURRENT PERFORMANCE OF INTERNET SURVEYS

In the Introduction we said that Internet-based surveys are in vogue – those conducted via the Web in particular – primarily because of three assumptions: (a) Web surveys are much cheaper to conduct; (b) Web surveys are faster; and, (c) combined with other survey modes, Web surveys yield a higher response rate than the other survey modes by themselves. That is, the usual naïve generalization about Internet-based surveys is that they can be conducted faster, better, cheaper, and easier than surveys conducted via conventional methods. How do these claims stand up when compared to what has been published in the literature?

Faster?

Web surveys are thought to be much faster than conventional survey modes. While there is no question that the delivery time of an Internet-based survey is faster than a survey sent via the mail, there is little to no evidence in the literature to substantiate whether this increase subsequently results in a shorter overall fielding period. We are aware of a couple of organizations that have implemented all-electronic survey processes by communicating with respondents via e-mail, but this is only currently possible for pre-recruited panels or specialized subsets of the population. If respondents must be contacted through mail or phone, which generally is the case if a probability sample is required by the research, then there may only be a marginal improvement in overall response times.

Better?

Response rates for Web surveys where no other survey mode is given have tended to range from moderate to poor. The reasons for this are not clear. It is possible that potential respondents simply do not respond as well to electronic solicitation or response. If true, this may improve as Internet-based communication methods continue to spread and become routine with all segments of the general population. It is also possible that the execution of the Internet-based survey experiments have been less than optimal – something that will improve with surveyor experience.

There are a few examples of Web surveys outperforming mail in some of the more recent comparisons between these two media. Whether this was a unique result for these few surveys, or whether it is a leading indicator that the field is maturing and learning how to achieve higher response rates in the new medium is not known. In either case, it

is of concern that any improvements in these areas may be offset by over-saturation of the population with other forms of commercial surveys.

Setting the question of response rate aside, Web surveys offer some advantages over conventional modes. For example, if multi-media and/or interactive graphics are required then there are few conventional alternatives (and those alternatives, such as face-to-face interviewing, would likely be significantly more costly). If a convenience sample will suffice for the research, then Web can be an excellent medium to use, particularly if the desired respondents are geographically diverse or hard to find/identify.

A major issue for Web surveys is their ease of implementation facilitates naïve misuse. The particular concern for this medium is the easy collection of large numbers of surveys can result in surveyors and survey data consumers confusing quantity with quality. There is on-going research about the effects of surveying via the Internet, the Web in particular, on unit and item non-response and on the affect the medium has on survey responses. Preliminary results have been reported at some conferences and symposia, but little has appeared in the literature as yet.

Cheaper?

The usual claim that Web surveys are much cheaper than mail surveys is not necessarily true. Web and e-mail surveys can save on some or all mailing costs, but except for very large surveys these may be small costs in the overall survey effort. Web surveys can also eliminate data entry costs; e-mail survey results may not because they often require additional manipulation before they can be downloaded into an analytical database. However, savings in data entry may be partially or completely offset against higher programming costs and additional help desk staffing requirements. The literature mostly neglects labor costs, which form the highest cost component for Web surveys. Nonetheless, adding a Web survey to a mail survey can be cost efficient if done carefully and properly.

Easier?

The implementation of Web surveys is technically more involved than mail or phone surveys. Survey designers need to specify many issues related to the technical control of Web surveys (e.g. how to move back and forward between questions, input validation, passwords, for what questions answers are not optional) that are simpler or not required with conventional survey modes. Web surveys also require more extensive

pretesting to ensure both that the questions elicit the desired information and that the program works properly across numerous hardware and software configurations.

The fielding process may or may not be made easier. Internet-based surveys have the potential to eliminate some of the more labor-intensive fielding tasks, such as survey package preparation and mailing and the subsequent data entry. Yet, if mixed modes are required to obtain sufficient population coverage and/or response rates, then these tasks cannot be completely eliminated and the fielding process may actually then become more complex since support for two or modes must be maintained and managed.

What is the Future of Internet-based Surveying?

The first Internet browser was introduced only about a decade ago and early use of the World Wide Web as a survey medium only started about five years ago. The result is that significant research results about the use of this new survey medium have only recently begun to become available in the literature. Hence, there is a great deal that is still not well known about Internet-based surveys. While some predict that Web surveys will replace other survey modes, we expect Web surveys to develop into a distinct survey mode with advantages and disadvantages that will have to be weighed against the conventional alternatives.

Little is known about Web instrument design and the effects of instrument design on how survey participants respond to a survey or a particular survey question, and what enhances response rates and response accuracy. For example, at the 2001 American Association of Public Opinion Researchers conference, some anecdotal evidence was presented that respondents taking surveys on the Web had shorter attention spans, tending to browse the survey like they browse other Web sites. If true, this would suggest that long surveys and/or surveys with complex questions may not perform as well on the Web as by mail. While many of the design principles from paper-based surveys may translate to Internet-based surveys, much more research is required.

To date, most Web surveys have been conducted on convenience samples or in organizations where a list of target populations readily exists. However, Internet-based surveys with probability samples can be fielded by using the mail or telephone for respondent contact and the Web for response. There is currently no equivalent to random digit dialing for e-mail. Even though the fraction of the population having access to e-mail will continue to grow, it is unlikely that one will ever be able to construct a random e-mail address in the same way a random telephone number is constructed. However,

large commercial e-mail lists may yet emerge that are of high enough quality to be useful in survey research.

A major challenge for researchers will be to distinguish themselves and their survey from the plethora of commercial and entertainment surveys that exist and continue to multiply on the Web. These other surveys will continue to proliferate because the financial and technical barriers are so low for Web surveys. Thus, just as telephone survey response rates have continued to decline because of telemarketers, it is likely to become increasingly difficult to achieve superior response rates in the new medium.

Nonetheless, Internet-based surveys are here to stay. The challenge for researchers is to learn to use the new medium to their best advantage.

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