Web-based Surveys: an Assessment

Allan F. Williams

Preusser Research Group, Inc.
7100 Main Street
Trumbull, CT

Introduction

Surveys are used to obtain information about people's knowledge, opinions, and behavior. Telephone surveys using random-digit dialing have been the standard survey method for many years. But telephone surveys are expensive. They also have become less representative. Persons who use only cell phones may not be contacted. Response rates to telephone surveys have dropped, perhaps due to more people screening incoming calls or to an increased reluctance to participate in a telephone survey at an inconvenient time.

Web-based methods provide an alternative. In web surveys, participants log onto an Internet website and enter their responses to the survey. The main advantage of web surveys is cost, because no survey personnel are needed to administer the survey or record the results. Their use has increased substantially in recent years.

The principal disadvantage of most web surveys is that there's no way to contact all or a random sample of the persons to be surveyed and invite them to take the survey. That's because there's no complete list of email addresses and no web equivalent of random-digit dialing from a list of telephone numbers. Persons only can be contacted in this way if the survey is directed to a group whose email addresses have been compiled, such as customers of a business. But surveys of the general public or broad groups such as licensed drivers must recruit survey participants somehow, for example through general publicity. Those who participate will be volunteers who have the interest and motivation to access and complete the survey. And, of course, they also must have access to the Internet.

A study published after this paper was written compared responses to the same questions in a web-based and a telephone survey of licensed drivers in Maryland (Beck et al. (2009), Journal of Safety Research, 40: 377-381). It found demographic differences in the respondents: for example, the oldest age group was substantially under-represented in the web survey compared to the pool of all licensed drivers and substantially over-represented in the telephone survey. It also found substantial differences in the traffic safety concerns and beliefs of the web and telephone survey respondents.

This paper provides an overview of web survey types, coverage, response rates, measurement error, and questionnaire design and lists references for further information. It concludes that web surveys can provide important information for highway safety if the information can be obtained from volunteer respondents with Internet access and if respondents are recruited carefully.

Growth in Web Surveys

There are two main reasons for this development. One is that telephone surveys, the dominant survey mode in the 1990s, have become less representative of the general population, largely because of the proliferation of cell phones and disconnection of home landlines, and the increased reluctance of people to agree to be surveyed. By late 2008 just over 20 percent of U.S. adults had replaced their landline phones with wireless service (Blumberg & Luke, 2009). Cell-phone-only people are significantly different from the general population, e.g., they are more likely to be young adults (Blumberg & Luke, 2008). In some cases calls to cell phones have been added to telephone surveys, although this is a more complicated and expensive undertaking (Lavrakas, 2007; Lepkowski et al., 2008). Response rates in general have dropped, as the growth in telemarketing has spurred many to be more wary of telephone solicitations in general, aided by answering machines, caller ID, and call blocking.

The second factor encouraging web surveys is the rapid growth in Internet access and the opportunity to readily collect large numbers of self-administered surveys, avoiding costs for interviewers, or printing/postage. The Internet also provides the capability of using a variety of stimulus material (e.g., sound, images, video) not available or too costly to implement widely in interviewer-administered surveys (Couper, 2000).

There are many ways to identify participants for web surveys, to recruit them, and to administer survey material. This contrasts with the standard random-digit-dial telephone survey. Diversity is a key characteristic of web surveys (Couper & Miller, 2008). The low costs involved allow large-scale data collection efforts to be undertaken by virtually anyone with Internet access, and there are many aids readily available, e.g., survey monkey.com, to assist in questionnaire construction. This has played a role in the proliferation of web surveys, and their variation in quality. The diverse nature of web surveys also poses a challenge to making generalizations about them, or comparisons with other data collection methods.

Goals of this Paper

All survey methods have strengths and weaknesses. Some enthusiasts have claimed that web surveys would render other data collection methods obsolete, but that is not a realistic scenario. Telephone surveys, for example, have some advantages, notably that there is an interviewer who can encourage potential respondents to cooperate and to finish the survey once begun, and can clarify questions during the process. In fact, in-person, and especially mail and telephone surveys, are still in wide use, by themselves, or in combination with web approaches in mixed-mode surveys. Clearly, however, collecting information over the Internet has become an increasingly popular survey mode. Types of web surveys will be discussed in this paper, with special consideration given to mixed-mode and panel surveys. Web surveys will be evaluated in terms of three major sources of survey errors, relating to coverage, non-response, and measurement, and recommendations concerning their use will be provided. Cost factors will not be considered, although they come into play in

decisions about how to handle survey error issues. It is important to note that the research base for web surveys is both in the process of development and expanding rapidly. This means that some important questions cannot be answered fully, and also that articles only a few years old may be dated. It is also notable that as the literature on web surveys accumulates, the growth in social networks, web applications for mobile devices, and other developments may provide opportunities for different types of surveys in the future.

Coverage and Sampling Issues

A major issue in the use web surveys is the extent to which the sample represents the general population. "Coverage error" occurs when not all members of the population have a chance of being included in the survey, and when those excluded differ from the included group on measures of interest (Groves, 1989). Whereas landline household telephone ownership peaked at around 97 percent, the percentage of the population that has Internet access is thought to be in the mid-70s as of early 2009 (Internet World Stats, 2009). That represents a remarkable increase over a limited period of time, but the speed of adoption has now slowed, as happens with most innovations after a critical mass has been reached (Horrigan & Smith, 2007). Thus a sizable portion of the U.S. population cannot participate in web surveys without special arrangements, and it is well established that those with and without Internet access differ considerably. Those without are older, less well educated, poorer, more likely to live in rural areas, and more likely to be non-Whites (Pew Internet and American Life Survey, 2007; Horrigan & Smith, 2007).

The coverage issue in web surveys is compounded by the absence of a suitable frame for selecting probability samples of Internet users. Except for some special populations, e.g., college students or employees of organizations, there are no comprehensive lists of Internet users and their contact information, and no methods similar to random-digit-dial techniques to sample them (Best et al., 2001). Thus even if everyone in the U.S. had Internet access, selecting a probability sample of this group would be impossible. Moreover, assuming a list of valid e-mail addresses existed, there are barriers to contacting randomly generated lists of such addresses because Internet service providers are private, rather than public as in the case of telephone lists. Professional survey organizations do not condone contacting individuals by e-mail unless a prior relationship exists (Dillman, et al., 2009).

Types of Web Surveys

Couper (2000) has provided a typology of web surveys, dividing them into those based on nonprobability and probability-based methods. In making this split, he notes that statistical inference is possible only with probability-based sample designs, and emphasizes that a distinction needs to be made between scientific surveys designed to permit inference to a population, and data collection efforts where the emphasis is simply on the number of respondents.

Nonprobability methods include polls that represent the opinions of those who respond; self-selected surveys in which open invitations are issued to participate; and volunteer

panels of Internet users, which creates a large database of potential respondents for later surveys. Selection of panel members for subsequent surveys may be based on quota or probability sampling, but the original sample is self-selected. In some cases involving volunteer samples, attempts are made to correct for representational biases using weighting methods such as propensity score adjustment. Propensity weighting is basically designed to adjust the distribution of the volunteer sample to a similar survey using probability methods (Lee, 2006). How adequately this reduces selection bias is not yet established.

There are two basic approaches to probability based sampling that deal with the coverage error problem and the lack of a sampling frame of web users. One is simply to restrict the sample to Internet users, generalizing to that population only. The other is to use alternative methods, e.g. random-digit-dial or mail lists, to identify and recruit from a broader sample of the population.

Couper (2000) identified five types of probability-based approaches.

1. Approaches that target visitors to a Web site, using systematic sampling to invite every *n*th person to participate. The frame here is visitors to the site, and this technique is often used in customer satisfaction surveys.
2. List-based samples of high coverage populations, e.g., university students, with invitations to participate sent by e-mail.
3. Mixed-mode designs with choice of completion method (to be discussed in more detail later)
4. Pre-recruited panels of Internet users, with potential panel members recruited using probability sampling methods such as random-digit-dial telephone surveys.
5. Probability samples of the full population. This method has potential for obtaining a probability sample not restricted to current Internet users. As in Type #4, non-Internet methods are used to elicit initial cooperation. However, in this case, those without Internet access are provided with access in exchange for their participation.

Non-Response to Surveys

The five types of probability based approaches described above are compromised if many of those recruited do not agree to participate, and that is typically the case. Non-response error, which bedevils all survey methods, is a function of both the rate of non-response, and the difference between respondents and non-respondents on critical variables (Groves & Couper, 1998). Non-response appears to be a particular problem in web surveys; a recent meta-analysis based on 45 studies indicated that web survey response rates averaged 11 percent lower than those obtained by other survey methods (Manfreda et al., 2008).

One important difference between mail and web surveys is that with mail surveys the questionnaire is delivered to potential respondents, whereas respondents to web surveys have to go and get the questionnaire themselves. This may seem like a trivial difference, but it is an extra step. Some people have difficulties in technical interactions with the computer that may inhibit them from starting or completing surveys. Many have concerns

about spam, phishing, computer viruses, spyware, stolen identities, etc. that may make them wary, especially in regard to invitations from unfamiliar sources. And many people are simply overwhelmed with e-mail and other messages, so may not take the next step in retrieving the survey.

There is evidence that highly salient surveys that are well done and are sent to specialized populations where most have computer expertise can produce high response rates (Dillman et al., 2009). However, the low response rates typical of web surveys pose a challenge. It is clear that making the retrieval and completion tasks as easy and as comfortable as possible is necessary. There is a developing literature on ways to accomplish this, on how to make web questionnaires visually attractive, and on ways to convince potential respondents to cooperate (Dillman & Smyth, 2007; Kaplowitz, Hadlock, & Levine, 2004; Porter & Whitcomb, 2003; Delavande & Rohwedder, 2008; Galesic et al., 2008; Malhorta, 2008; Schonlau et al., 2002). Dillman et al. (2009) summarized this literature, providing guidelines, based on research and common sense, for making web surveys attractive and easy to navigate and encouraging cooperation. These include: personalizing contacts with respondents to the extent possible; using multiple contacts with respondents and varying the message or mode of delivery; taking steps to ensure that e-mails are not flagged as spam; sending a token of appreciation with the survey request; keeping e-mails short and to the point; providing clear instructions for how to access the survey; establishing procedures for dealing with respondent inquiries; and creating interesting and informative welcome screens that will have wide appeal. In many cases, it has been necessary to offer financial incentives, prepayments or postpayments, to boost participation.

More research studies are needed to determine web survey features that will encourage higher response rates. Low response rates are a caution flag, a threat to inferences about the target population. However, the response rate alone does not determine if and how the sample is biased. For that it is necessary to know how respondents and non-respondents differ on variables that may relate to survey responses. The literature is not well developed here. As acknowledged in a recent article by Couper (2008), "the hard business of identifying actual nonresponse bias in web surveys is in its infancy."

Measurement Error

Measurement error occurs when a respondent gives answers that are inaccurate or imprecise. This can occur if respondents have limited comprehension or are deliberately distorting their answers, but it is commonly a problem of poor question wording or design, or other technical flaws. Measurement error is an issue in all survey modes, but there is a substantial literature on telephone survey techniques that have been developed to reduce measurement error. Switching to web surveys means changing from an aural to a visual mode, and an environment in which interviewers are not present to help in the interpretation of questions. Thus questionnaire layout and the wording of questions are essential for helping respondents to process all of the components parts of questions and comprehend them as intended, and ensuring that they give answers that are accurate and precise.

Web surveys face one particular challenge in that whereas a telephone is a telephone, the ways in which web surveys are received and displayed differ among respondents. The experience of taking a survey can vary dramatically based on such variables as connection speed, computer type, browser version, plus the technical knowledge that a given person brings to their computer experience. The same survey needs to be designed to work for a wide variety of older and newer equipment, ranging, for example, from a nine-year-old computer running Windows 98, with a dial-up connection and an older version of Internet Explorer, to an iPhone 3GS with Safari and a wireless connection. This makes it important to test out surveys using the various combinations of settings respondents may be using, to ensure that questions display similarly.

Although more research is needed to determine how question wording and layout affect measurement, there is an existing literature on mail surveys that has relevance, and a developing literature on web survey measurement issues (Dillman & Smyth, 2007; Smyth et al., 2006; Couper et al., 2001; Tourangeau et al.,2004). It is clear from the literature that visual design influences how people interpret the meaning of items, so this is a crucial issue. Guidelines for questionnaire construction, design, and wording in web surveys that are theoretically grounded and largely research-based are available and need to be consulted by those planning surveys (Best & Krueger, 2001; Dillman et al., 2009; Schaeffer & Pressor, 2003).

Mixed-mode Surveys

Data collection methods that combine survey techniques are not new. For example, the U.S. Decennial Census has for many years combined the use of mail surveys with follow-up involving in-person interviews. In recent years, however, mixed-mode surveys involving web-based methods have become increasingly popular, in response to coverage issues and low response rates. A variety of strategies and combinations of surveys have been used. For example, as a way of reducing coverage error, postal mail has been used to contact the target population, asking them to respond via the web, with questionnaires available for those without Internet access, or who choose to respond via mail. In other cases, respondents who do not respond in the way initially offered are followed up and offered a different response mode possibility. Another technique is to offer at the outset a variety of response modes. The myriad ways in which mixed-mode surveys have been constructed are discussed in detail in Dillman et al. (2009, pp. 300-330).

The extent to which mixed-mode surveys can increase response rates has not been fully established, although some guidelines are developing. A few studies have found that offering at the outset a choice between web and mail versions can actually result in a lower response rate than mail-alone (e.g., Dillman et al., 2009; Gentry, 2008). This has led Dillman et al. (2009) to state that, "As a result of these findings, we advise against letting respondents choose from among several survey modes" (p. 305). There is evidence, however, that some people prefer certain modes of response, and that assigning them that mode in advance, if known, is beneficial. The best solution appears to be offering one mode at the outset, then subsequently offering non-respondents a second or even third way of

responding. In one study of this type, Greene et al. (2007) found that compared with telephone-alone or web-alone surveys, a telephone survey with web follow-up increased the response rate by 25 percent, and a web survey with telephone follow-up increased it by 12 percent.

One issue in mixed-mode surveys is that responses may differ by survey mode, that is, a person who answers a particular question in one way by telephone may have given a different answer if responding to the same question on the web. This presents a potential problem in combining responses across modes (Link & Mokdad, 2005; Greene et al., 2007).

A combination that seems to work well is mail and web surveys. In terms of coverage of the general population via mail, telephone directories are no longer useful because of the rise in unlisted numbers, cell phones, and absence of mailing addresses. However, in recent years an address-based sample list has become available, the U.S. Postal Service DSF (Delivery Sequence File), an electronic file of all addresses to which the postal service delivers mail, and this has been used in some studies to identify target populations (Iannacchione et al., 2003; Link et al., 2008), with responses gathered by a combination of web and mail. The DSF file provides wide coverage of the general population, although misses some, e.g., people who live in multi-person dwellings, or people who pick up their mail at the post office. Having only addresses and not names is an issue, although response rates of greater than 70 percent have been reported using this technique (Dillman et al., 2008).

Initiation of the survey by mail also makes it possible to send token financial incentives, which have been found to increase response rates (Trussell & Lavrakas, 2004; Groves et al., 2006). Moreover, research has consistently indicated that comparable results can be obtained if similar layouts are used for mail and web surveys (Dillman et al, 2009).

Panel Surveys

Internet panels, in which the same people are asked to respond periodically to survey requests, is another growth area. Panel surveys have become popular in part because of the difficulties in finding and contacting Internet users, providing a pool of people who say they are willing and able to respond to surveys. Many panels are comprised of volunteer, opt-in respondents, recruited through banner ads, pop-up ads, or e-mail advertisements, and may number in the thousands. Other panels are probability based, where the recruitment is typically through mail or telephone contacts, and those without Internet access are offered it as a condition of their initial and continued participation. Panel surveys are subject to the same issues as single-surveys regarding coverage, measurement error, and non-response, and non-response over time appears to be a particular issue. In some cases completion rates for opt-in panels have dropped to the low single digits (Couper & Miller, 2008).

Two other issues with Internet panels have to do with attrition and conditioning. People drop out of Internet panels and although they may be replaced by individuals with similar characteristics, this can reduce the precision of estimates over time. Conditioning refers to

the tendency for individuals to answer questions differently over time because of their participation in previous surveys. As noted by Dillman et al. (2009), neither of these issues is well understood, and despite the fact that Internet panels have become a full-fledged industry in recent years, the research on which they rest can best be described as "thin." (p. 351).

Conclusions

There has been phenomenal growth in the use of web-based surveys in the past decade. Like all other survey modes, web surveys have their strengths and weaknesses. They start out with a cost advantage, and are superior in eliciting sensitive information (Turner et al., 1998; Link & Mokdad, 2005). However, they tend to have lower response rates than mail or telephone surveys, and there is a substantial portion of the population without Internet access or without the computer expertise to complete web surveys. Most web surveys are based on self-selected populations, but there are creative ways to conduct probability surveys (e.g., every *n*th DMV visitor), for scientific purposes. Web surveys are well suited for addressing specialized populations with high Internet access and skills, especially on topics where the subject material is attractive to respondents (Groves et al., 2004). By using telephone or mail in combination with the web, population coverage can be broadened, recognizing that available mail address lists do not cover the general population fully, and that samples obtained by random-digit-dialing of landline phones, not supplemented by cell phones, are becoming increasingly less representative of the U.S. population. Offering respondents a choice of response modes also has great potential to increase response rates. The literature is still developing on ways to reduce web survey errors, but research-based guidelines summarizing present knowledge are available. Web surveys that are carefully constructed, and addressed to well-defined populations that are artfully recruited, can provide important scientific information in the highway safety field.

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