USING THE INTERNET TO COLLECT SURVEY DATA. LESSONS FROM A SURVEY OF OLDER RIDERS IN AUSTRALIA

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ABSTRACT

Surveys have been used widely in road safety to measure people's knowledge of and attitudes to road safety issues or programs, and to gauge the extent to which people engage in risky or protective behaviours. Traditionally, surveys have been conducted by mail, telephone or face-to-face. However, the impacts of privacy legislation, the popularity of mobile phones and the growth in telemarketing are affecting the viability of these methods. The Internet is becoming a popular medium for road safety (and other) surveys because it can provide a feasible, cost-effective and potentially time saving alternative to these traditional methods.

This paper describes the anticipated and unanticipated advantages and disadvantages of using the Internet to collect survey data from motorcycle riders aged 25 and over in Australia. The survey was undertaken to find out more about the crash patterns of riders who had recently returned from riding after having held a licence but not ridden for many years. These riders are unable to be distinguished from continuing riders in licensing and crash databases. The methodological issues identified in conducting this survey will be of interest to researchers who are choosing the best survey technique to use for other road user groups.

INTRODUCTION

Surveys are among the most popular methods of primary data collection for academic research and have been used widely in road safety to measure people's knowledge of and attitudes to road safety issues or programs, and to gauge the extent to which people engage in risky or protective behaviours. Traditionally, surveys have been conducted by mail, telephone or face-to-face. However, these methods have several disadvantages. Mail surveys generally require the contact details of potential respondents, responses can be slow and the return rate is often low. For these reasons, telephone surveys have often been used in preference to mail surveys. However, the popularity of mobile telephones and the growth in telemarketing make it difficult to reach respondents, and there are privacy and confidentiality issues associated with both mail and telephone survey methods that can make it difficult to obtain accurate and or valid information. The Internet is becoming a popular medium for road safety (and other) surveys because of its potential to provide a more viable, cost-effective and potentially time saving alternative to these traditional methods.

In this paper, the term "Internet survey" is used to refer to a survey placed on the Internet that is then completed by respondents who are not directly contacted by the researchers. The term "email survey" is used to refer to a survey that has been delivered by email to a predetermined, identified population. These two types of survey have been confused to some extent in the literature.

This paper describes the range of methodological issues that need to be considered in using the Internet to collect survey data using examples from an on-line survey of motorcycle riders aged 25 and over in Australia (Haworth & Mulvihill, 2005). The survey compared the crash involvement of continuing, returned and new riders, assessed whether the factors contributing to these crashes differed, and identified the implications for the content and effectiveness of rider training and other road safety measures. While there is widespread concern about the safety of returning riders, little is known about their crashes because returned and continuing riders cannot be separated in the mass crash data or the licensing data. The survey questionnaire collected information about riding patterns and crash involvement in the past five years and details of the most recent crash including: where and when it occurred, pre-crash factors, motorcycle characteristics and how the crash occurred.

The anticipated and unanticipated advantages and disadvantages of Internet surveys are described, and suggestions are provided about how these might be optimized or overcome, respectively. Recommendations for researchers who are considering using the Internet to collect survey data for other road user groups are also presented.

ADVANTAGES OF INTERNET SURVEYS

The rapid growth and popularity of the Internet has expanded research survey opportunities over the last five years. A review of the literature on survey design methods showed that Internet based surveys can have the following advantages over mail surveys:

- Reduced time and labour costs associated with printing and compiling questionnaire forms;

- Eliminates mailing costs for questionnaires;

- Reduced time and labour costs and reduced potential for error in coding and entering data;

- Does not require contact details of potential respondents;

- Provides access to potential respondents across geographical and cultural boundaries;

- Allows a range of types of material to be presented;

- Reaches respondents in a relatively short period of time.

Efficiency and cost advantages

The decision as to whether it is appropriate to use an on-line research method should be based on an evaluation of the respective advantages and disadvantages in relation to the specific topic being investigated (Madge & O'Connor, 2004). In designing the older rider survey, a number of different methods for contacting older riders were considered. Our earlier mail survey of older riders (see Haworth, Mulvihill & Symmons, 2002) found that only about 10 percent of active riders had been involved in a crash in the last five years - and only about half of older motorcycle licence holders were active riders. This suggested that contacting a random sample of older riders (or licence holders) would not be an efficient method of finding riders who had been involved in a crash. It was anticipated that an on-line survey would provide a potentially larger sample than would be affordable by means of a random mail

survey. Although there would only be a small proportion of respondents who had been involved in a crash, the absolute number would be larger for the Internet survey.

Access to the target population

An important advantage of Internet surveys over mail surveys is their potential to reach a wide range of geographic locations relatively cheaply and over a very short period of time. Internet based surveys are also easier to deliver than mail surveys as they eliminate labour costs associated with obtaining contact details of potential respondents and compiling and sending out paper copies of questionnaires.

An Internet survey avoids some of the privacy and confidentiality issues associated with directly contacting individuals based on licensing or registration or insurance data. Consequently, there is potentially a greater likelihood that participants will respond.

In the older rider survey, the option of contacting crash involved riders directly (via a mail or telephone survey) was considered, however this would require access to personal identifying information from Police or insurance claims that could potentially violate privacy laws and or discourage responding. It was anticipated that participants would be more likely to respond to an Internet survey since it avoids some of the privacy and confidentiality issues associated with directly contacting individuals based on insurance data.

Allows a range of material to be presented

One of the strengths of Internet-based surveys over other methods is the ability to present or record information (Boyer, Olson & Jackson, 2001). Pictures, audio, or video links can also be provided along with text, and questions can be written with more complete descriptions because there are no space constraints as with printed questionnaires. In addition, researchers can use features to emphasize or draw attention to critical aspects of a question or ask a new type of question. Skip patterns can be programmed into the survey, requiring less respondent attention to the survey format and facilitating survey completion.

For example, one of the questions in the motorcycle survey asked riders who had been involved in a crash to select one of ten pictorial categories that best described their crash. To avoid providing lengthy text descriptions for each category, respondents were advised that a pop-up box with an explanation of the picture would be provided by placing the mouse over the picture. Each picture was linked to its own series of categories that popped up as a separate page once a respondent had clicked on one of them. The advantage of this feature is that it makes the survey shorter and therefore more likely to be completed than an equivalent paper version, and avoids asking questions that are irrelevant to some respondents.

In addition to presenting questionnaire items, Internet surveys can provide feedback, if requested, to participants at relatively low cost and without breaching confidentiality or annoying respondents who do not want feedback.

Data checking

One of the benefits of using Internet based surveys is that they can be programmed to perform a logic check of respondents' answers. This helps to improve data quality by minimising

errors such as item non-response (not answering questions), making illogical responses, and answering inappropriately or incorrectly.

Our ability to minimise item non-response in the current survey was somewhat limited by the University's ethics requirement that participants should not be required to answer any questions they do not wish to. However, we attempted to prevent implausible responses where possible by placing limits on answers that required dates and times (e.g., the space available to enter a year date is limited to 4 digits only). Multiple responses to questions requiring single answers were avoided with the use of radio buttons. This advantage of this feature was particularly noticed when entering data for those respondents who had completed paper copies of the questionnaire. For one particular question, about 70% of paper questionnaire respondents provided multiple responses where only single answers were requested. This prolonged the data entry process, and precluded combining these responses with the on-line data.

Data entry and analysis

An advantage of Internet based surveys is that data can be saved automatically in electronic form reducing costs in storage space, paper, equipment mailing costs, and labor. Once programmed, data can be also be stored in a form ready for analysis, saving costs associated with data coding and entry into a database (Birnbaum, 2004). Automatic data entry also reduces the types of errors that may occur with manual data entry.

However, there are several potential drawbacks of electronic data storage and automatic data entry that need to be considered. There is a potentially higher risk of lost data. Researchers should keep regular back-up copies of the data file. We found that for a small number of questions, respondents' data was not recorded.

Another often-overlooked disadvantage is that automatic data entry minimizes the opportunity for researchers to become aware of certain types of inconsistencies that might otherwise be detected via manual data entry. As discussed earlier, electronic data checking can be used to improve data quality by eliminating multiple responses or item non-response for example, but it cannot eliminate all types of errors or inconsistencies. For example, we found that some respondents did not answer certain sections of the survey such as the section on demographic details. A small number of non-crash involved respondents answered crash related questions despite the fact that the skip function built into the survey omitted presenting crash related questions to those participants who answered 'none' to 'have you had a crash in the last five years?' These problems made the task of data cleaning more labour intensive and seemed to offset some of the advantages of reducing costs and labour associated with manually entering data.

Timeliness

Telephone surveys are generally preferred when timeliness of results is paramount. Internet surveys are often considered to be faster than mail surveys because questionnaire printing and postage and return postage times are avoided. However, Fricker and Schonlau (2002) review earlier studies that report mixed results with email surveys. While some responses to email surveys are received very quickly, it is the total time that the survey must remain open that determines the total time. In addition, formatting an Internet survey is at least as complicated as formatting a mail survey.

The timeline for our Internet survey of older riders was as follows. Ethics approval for the study was granted by the Monash University Standing Committee on Ethics in Research on Humans on 14th February 2005. A draft questionnaire was posted on the Internet on 23rd February 2005 and piloted until 9th March 2005. The revised questionnaire was posted on the Internet on 9th March 2005. The closing date for the survey was mid-June 2005.

DISADVANTAGES OF INTERNET SURVEYS

Potentially, the advantages discussed in the previous section make Internet surveys less expensive, more accurate, and generally more feasible than conventional mail surveys. However, using the Internet to collect survey data introduces a range of potential disadvantages, most of which are characteristic of computers and the nature of the Internet environment. These include:

- The need to make potential respondents aware of the survey and how to access it;
- Selection bias due to lack of Internet access, computer illiteracy or unwillingness to use Internet;
- Inability to access or complete questionnaire due to incompatible computer hardware or software systems;
- Difficulties in measuring the response rate; and
- The potential for multiple responses from the same participant, misuse or hacking.

Publicizing the survey

For an Internet survey, there is a need to ensure that the target population is aware that the survey is being conducted. Unlike traditional survey methods, potential respondents will not know that the survey is being conducted unless it has been publicized. Failure to adequately inform the target population defeats the advantage of having access to a large sample of potential respondents.

Harrison and Christie (2004) note that anti-spam software can block attempts to publicize surveys through the Internet itself. They recommend the use of non-Internet methods to access potential respondents.

Publicising the survey in places likely to have the largest reach into the target population is important for encouraging and maximising responses. In the current survey, riders were informed about the survey through five main avenues:

- Two advertisements and an article in "Australian Motorcycle News",
- An advertisement in "Two Wheels",
- An article in the Royal Automobile Club of Victoria (RACV) magazine,
- Meetings, newsletters and websites of motorcycling clubs, and
- Links or other information about the survey on websites likely to be visited by riders.

Multiple avenues were used to maximise the potential for both enthusiasts and non-enthusiasts to become aware of the survey. The motorcycle magazines were chosen because they are Australia's biggest selling motorcycle publications with a current total readership of around 141,000 per issue. A record of the frequency of responses over the period of data collection showed sharp increases immediately after release of the magazines.

The article in the RACV magazine sought to reach non-enthusiast motorcyclists. This magazine is distributed to about 1 million Victorian drivers and most Victorian motorcycle riders are also drivers. Thus, this article presented the survey to a very large number of non-enthusiast riders. Another peak in responses was observed after the article appeared in the RACV magazine.

The ability to publicize successfully may depend on the nature of the target population. Motorcyclists are generally very active in the public arena and consider any issues relevant to motorcycling as being very important. While advertising costs were unavoidable, we found that interested organizations such as motorcycle clubs were helpful in publicizing the survey free of charge. However, the extent to which this is likely to be available for other road user groups is not known.

It may be difficult to publicize surveys that focus on relatively small or hard to reach target populations. For example, consider where would be the most effective place to publish an advertisement for an on-line survey of disqualified drivers.

Accessing the survey

The survey was placed on the Monash University Accident Research Centre's (MUARC) web site. The Internet address of the survey was included in all advertisements and articles and links were provided on the motorcycling-related websites. Respondents were able to access the survey by typing the web address into the URL bar or clicking on the link and therefore were not required to access the MUARC home page first. Alternatively, respondents could also access the survey by clicking on the link on the MUARC home page.

The survey was placed on the MUARC web site largely for reasons of convenience. However, it was hoped that the public profile of MUARC would help to reassure riders that information was not being collected for commercial or fraudulent purposes. In addition, the large number of hits on the MUARC web site provided an opportunity for some riders to find out about the survey from the web site itself. Being on the University server, the web site is relatively well protected from hacking and other potential damage.

However, researchers should consider the likely impact that the chosen site will have on response biases and response rate. It is possible that participants who found out about the survey whilst accessing the MUARC web site for reasons other than to complete the survey are biased towards being particularly interested in road safety issues and, therefore, not highly representative of the general motorcycle rider population.

Making surveys easily accessible is particularly important for on-line surveys. Unlike traditional methods such as telephone surveys where a respondent is passively involved in the recruitment process and needs only to decide to continue a telephone interview started by the interviewer, the respondent in a web based survey must make an active decision to view the site and then must make an additional decision to perform the activities required to complete the survey (Harrison & Christie, 2004). This active role in participation underlines the importance of minimising the effort required by potential respondents to complete the survey. Apart from some unintended disadvantages such as incompatible software systems (as discussed later), our survey was easily accessible and did not require any time-consuming activities such as downloading the survey or installing a particular software package.

We anticipated that some riders would not have access to the Internet and or a computer or may not be computer literate. We attempted to minimise these problems by providing the option to contact us to obtain a paper copy of the survey that could be returned to us via the post. This option was written into all of our advertising materials.

In general, it may not be possible to know in advance whether accessing the target population will be difficult; however, it is likely that certain populations will be more avid Internet users than others. For example, young drivers are probably more likely to use the Internet than older drivers, and probably change addresses more often and are less likely to have landlines, thus making postal and telephone interviewing more difficult.

Selection bias

Despite the appeal of using the Internet to collect survey data, it is important to consider whether this method will reach a large and representative sample of the target population. A critical concern for Internet surveys is that they present serious sampling problems for a study based on the quantitative tradition (Madge & O'Connor, 2004). Selection bias is a major factor limiting the generalisability of results and occurs due to:

- The non-representative nature of Internet users

- The self-selection of participants, also called the 'volunteer effect' (Eysenbach & Wyatt, 2002).

Non-representative nature of Internet users

It is important to consider whether the target population have access to and or are willing and able to use the Internet. In the past, research has shown educational, economic, racial and gender disparities among those who have access to, or use the Internet (Rhodes, Bowie & Hergenrather, 2005). In US studies, younger, more educated, higher income, white men had greater access to the Internet while those with lower educational levels, lower incomes, living in rural areas and black were under-represented. These biases suggest that the on-line environment may not be representative of the general population. However, Internet use is becoming more widespread and it is possible that as the number of Internet users increases, the extent of bias in Internet surveys will potentially decrease (Roztocki, 2001). However, despite these potential changes, it is likely that Internet users still differ from the general population in ways that make any survey results not truly representative of the general population.

Discussions with representatives of the Motorcycle Riders Association of Australia (MRAA) and other motorcycling clubs indicated that riders are actively involved in Internet forums and clubs have web sites, so using the Internet as a survey medium would be likely to attract a reasonable number of respondents. However, riders who access these sites may be more committed riders than the general population of riders.

The study attempted to maximize the representativeness of the sample by directing publicity to avenues likely to reach both enthusiasts and non-enthusiasts and by providing the option of completing a printed questionnaire.

Self-selection bias

As there is no master database or central registry from which to create an accurate sampling frame, construction of sampling frames is not possible and most Internet surveys are self-selecting. Self-selection originates from the fact that people are more likely to respond to questionnaires because they are interested in the particular topic under investigation or because they are attracted by the incentives offered for participating. As people who respond almost certainly have different characteristics than those who do not, the results are likely to be biased to at least some extent (Eysenbach & Wyatt, 2002). Madge & O'Connor (2004) note, however, that self-selection occurs in many conventional surveys and is not unique to on-line research. The extent of bias resulting from self-selection can sometimes be assessed by comparing the characteristics of the participants to information about the population that is derived from another source (e.g. an earlier survey or registration or licensing data).

Hardware and software issues

One of the challenges of Internet surveys lies in creating and programming the questionnaire for use on-line. Depending on the type of features required, this process can be relatively time consuming. Unlike for paper and pencil surveys, researchers also need to consider whether the survey will work across different browsers and with different hardware or software systems (Fricker & Schonlau, 2002).

We aimed to improve coverage by providing a link in the on-line questionnaire to a 'tips' page which respondents could access if they were experiencing difficulty accessing the survey due to problems of incompatible hardware or software systems. One of the unanticipated disadvantages of the motorcycle survey was that a small number of respondents were unable to access it because they had a relatively out-dated Internet browser or were using an Apple Macintosh computer and our survey was IBM-compatible. In cases where this was reported, we sent respondents a paper-based copy of the questionnaire. It is possible that many more respondents encountered these difficulties but did not report them.

It is also important to know in advance whether the survey appears the same way on different types of servers and hardware systems. Factors to consider are the size and colour of the text, type of font and layout. It can be very frustrating to lose potential respondents because they are unable to read questions or instructions that are difficult to read or partly cut off the screen.

For these reasons, it is critical to pilot test the survey across a range of browsers and servers to avoid problems with access or presentation. Boyer, Olsen and Jackson (2001) recommend developing Internet surveys with the 'lowest common denominator' in mind because many respondents may have computer equipment that is old and outdated and will not be able to handle programs developed on newer software.

Difficulties in measuring response rates

It is difficult to measure response rates for Internet surveys and so comparisons of response rates between this and other methods are not straightforward. Email surveys (where the survey is directly emailed to identified recipients) at best achieve response rates equal to conventional modes, and often fare worse than conventional surveys (Fricker & Shonlau, 2002). Fricker and Shonlau also found no evidence that concurrent fielding of a survey via a

conventional mode and via an Internet-based mode results in any significant improvements in response rates.

In the email surveys reviewed by Fricker and Shonlau (2002), the study population was quite well defined (e.g. all of the employees of a company) and therefore the response rate could be calculated. One of the limitations of most Internet-based surveys is that it is difficult to estimate a response rate because the number of people who become aware of the survey but decide not to complete it is not always known. Placing a counter on the website allows the number of times the site was accessed to be compared with the number of responses received, but this underestimates the response rate because a respondent may access the site several times before completing (or not completing) the survey.

In our survey of older riders, we attempted to calculate the "response rate" of site visitors. Two counters were placed on the website for the final questionnaire. The first counter recorded that the introductory pages of the questionnaire (the Introduction and Explanatory Statement) were accessed 2,343 times. The second counter recorded 1,842 instances of someone accessing the questionnaire. Some of the discrepancy between the counters may have represented potential participants who were ineligible because they responded "No" to the filter questions relating to being 25 years or over and having ridden in Australia in the past five years.

Questionnaires were submitted by 1,290 respondents. The number of submitted questionnaires was thus 55% of Counter 1 and 70% of Counter 2. However, it is possible that individuals accessed the introductory pages of the questionnaire more than once before completing the questionnaire (e.g. read the introductory material and then decided to complete the questionnaire at a later time). Therefore these percentages are likely to be underestimates of the percentage of riders who accessed the questionnaire who then went on to complete it.

Multiple responses, misuse or hacking

Web researchers consider that the issue of respondents making multiple submissions has not been a real problem. According to Birnbaum (2004), multiple submissions are rare and easy to detect. They typically occur inadvertently when a participant scrolls to the bottom of the questionnaire, clicks the submit button, reads the "thank you" page, and uses the "back" button on the browser to return to the study. It is recommended that a survey include identifiers to identify each record of data and then sort by such identifiers to detect multiple submissions from the same person.

The Internet Protocol (IP) address can be used to identify multiple submissions. The IP address represents a particular computer. Although IP addresses do not uniquely identify a person, when two submissions arrive in a short period from the same IP, they are likely to represent multiple submissions from the same person. Reips (2000, cited in Birnbaum, 2004) recommends that a conservative procedure is to remove records coming from the same or similar IP addresses even if they are separated in time.

A complication with IP addresses is that they are now mostly "dynamic", which means that two different users from an Internet service provider might receive the same IP on different days, because the Internet service provider will assign IP addresses to users as they come and go. This also means that the same user might come to a study from two different IP addresses on two occasions. Therefore, it is useful to obtain additional identifiers.

Instead of checking data for multiple submissions and removing them, it is possible to program the server to refuse to accept multiple submissions from the same ID (or other identifier). A CGI script could be used to check the identifiers and refuse to save subsequent submissions by the same ID, if this were deemed necessary.

One can use passwords to identify each participant and use a CGI script to monitor admission to the study, or one can use passwords in the data file to identify each record of data. Cookies (data stored on the participant's computer) can also be used to keep track of how many times a person at that computer has participated. However, this procedure would not prevent a person from participating from different computers or from erasing the cookie, which some people do as a general protection of their privacy.

CGI scripts can be used to check for the referring page that sent the data. The referring page is the WWW document that sent the data to the CGI. One can find not only what uniform resource locator (URL) (i.e., Web page) called the CGI (sent data), but one can also detect what URL referred the participant to that Web page. It is a good policy to check the referring page (that sent the data) as a general security measure. If that page is not located on the home server (the server that housed the study), it might mean that a hacker is sending data from some other site.

We considered the possibility that some respondents would try to influence the outcome of the research by, for example, sending back large numbers of on-line replies from the same individual. This was checked by recording the last 6 digits of the (IP) address. We found no evidence that this occurred.

Like most surveys, Internet surveys generally gather self-reported data and the ability to validate the data is limited. While confidentiality and privacy is maintained, the downside of this approach is that the identity of respondents cannot be verified, thereby increasing the likelihood that responses may be received from those who are not part of the population of interest for the survey (e.g. riders whose crash occurred more than five years ago, or riders aged under 25 or even non-riders). While it was possible to identify and exclude those who crashed more than five years ago or who were aged under 25, it was not possible to identify and exclude non-riders. The total number of respondents who were excluded was very small.

CONCLUSIONS

The decision to use an on-line research method should be based on an evaluation of the respective advantages and disadvantages in relation to the specific topic being investigated and an assessment about whether the Internet is likely to be more effective than other survey techniques for that particular population.

Using the Internet as a survey medium does have efficiency and cost advantages, and can be very useful if privacy issues prevent the researchers having access to, or using, contact details of potential respondents. The ability to present a range of type of items and to have built-in data checks are also advantages of this medium. While timeliness has been identified as a potential advantage, this benefit may not always occur.

Despite the appeal of using the Internet to collect survey data, there are a range of potential disadvantages, most of which are characteristic of computers and the nature of the Internet

environment. Considerable effort is needed to ensure that potential respondents are aware of the survey and can access it. Lack of Internet access or computer literacy among some parts of the target population may limit the representativeness of the sample of respondents. Computer hardware and software issues that prevent access to the survey need to be carefully addressed. While multiple responses from the same participant can occur, most of this is inadvertent and can be identified and removed from the data. Misuse or hacking are unlikely but need to be prevented or identified.

Internet surveys can be a valuable method for collecting information about road safety-related attitudes and behaviours. However, there is a need to weigh up any potential time and cost saving advantages against the limited representativeness and inability to measure response rates that are characteristic of Internet surveys. The utility of a survey is limited if the chosen method does not permit valid inferences to be made about the population from which the sample is drawn.

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