Principles for Constructing Web Surveys

By

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There can be little doubt that the number of surveys being conducted over the World Wide Web is increasing dramatically. The ability to collect large amounts of data without interviewers, stationery or postage, and to process answers without separate data entry, makes the cost of doing web surveys very attractive (Witt, 1998).

The prospects of moving into an era of web surveying are in other respects, quite sobering. Although the number of individuals with web access is increasing rapidly, in October, 1997, only 37% of U.S. households reported owning a computer, up from 24 % in 1994. A total of 17% had e-mail connections, compared to only 3% in 1994. (National Telecommunications and Information Administration, 1998)[2]. Therefore, substantial coverage problems exist for most household web surveys. Access is higher when considered without reference to households. For example, a series of five CBS News/New York Times Polls conducted by telephone from March to November 1998 reported that 67% of respondents had "access to a computer" and 31% "had an e-mail address through which you can send or receive electronic mail messages by computer." (Frankovich, 1998). Even these higher numbers are much too small to facilitate general public surveys. Although certain survey populations have nearly 100% access to e-mail, e.g. employees of certain organizations, most do not. And, among those who do have such access, means must be found to ensure a known probability of selection for each potential respondent.

Unfortunately the challenges do not end here. Computer literacy varies greatly among people, as does the processing power of their computers. Screen configurations and connection speeds also influence how people can access and respond to web surveys. In addition, the means of displaying survey questions on computer screens may have a profound effect on whether some people are able and/or willing to answer survey questions accurately.

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[2] These household data are from the U.S. Current Population Survey, face-to-face interviews with 48,000 households, and therefore includes U.S. homes without telephones (about 7%). Not surprisingly these estimates are somewhat lower than estimates obtained by other means. An example is Intelliquest's survey that estimated for late 1997, based on telephone surveys, that 21% of the U.S. Population 16 and over is on line from their homes (Intelliquest, 1998).

Our purpose in this paper is to identify principles for the construction of respondent-friendly web questionnaires. By respondent-friendly, we mean designs that reduce the occurrence of sample survey errors through improvement of the motivational aspects of responding, as well as the technical user-interface between computer and respondent. We identify and elaborate 11 proposed principles for the design and layout of respondent-friendly web questionnaire surveys that are offered as hypotheses for future research. Our emphasis in this paper is not on the technical aspects of programming web surveys; instead, we emphasize features of questionnaire designs that encourage respondents to connect and respond to such surveys.

Criteria for Respondent-Friendly Design of Web Questionnaires

The ability to estimate the distribution of a characteristic in a population from surveying only a sample of that population, which is the usual purpose of conducting a survey, depends upon overcoming four potential sources of error (Groves, 1989). These sources of error include:

Coverage error: The result of all units of a population not having a known probability greater than zero of inclusion in the sample that is drawn to represent the entire population. Thus some units in the population may have no chance of selection, some units may have multiple chances, and some units may not even qualify for the survey.

Sampling error: The result of only surveying a portion of the survey population rather than all of its members.

Measurement error: The result of inaccurate answers to questions that stem from poor question wording, poor interviewing, survey mode effects, and/or the answering behavior of the respondent.

Nonresponse error: The result of not getting some people in the sample to respond to the survey request who, had they done so, would have provided a different distribution of answers than those who did respond to the survey.

When designing sample surveys with the aim of generalizing sample results to a defined population, all four sources of error must be kept low. Placing a special emphasis on the reduction of one type of error will not compensate for ignoring other error sources. However, the ease of collecting hundreds, thousands, or even tens of thousands of responses to web questionnaires at virtually no cost, except for constructing and posting, appears to be encouraging a singular emphasis on the reduction of survey error. A necessary means of reducing sampling error is to increase the number of respondents. However, obtaining large numbers of completed questionnaires under the condition of letting anyone respond who wants to fill out a questionnaire is no different than a 1-800 call-in survey, as frequently used on television news programs. Even though some will erroneously calculate sampling error in this situation such results cannot be generalized to the general public or any other survey populations. Not only are the conditions for small or minimal coverage error (a requirement of giving each member of a defined population a known chance of being surveyed) not met, but one cannot even calculate sampling error since the underlying assumption behind this calculation requires knowledge about the probabilities of selection.

The main purpose of respondent-friendly design principles for web surveys is to decrease the occurrence of measurement and nonresponse error in surveys. However, such principles may also have coverage benefits by helping to assure an equal chance for people with various types of browsers and computer equipment to receive and be able to complete web questionnaires.

We define respondent-friendly design as the construction of web questionnaires in a manner that increases the likelihood that sampled individuals will respond to the survey request, and that they will do so accurately, i.e., by answering each question in the manner intended by the surveyor. Under this definition we include aspects of access and motivation, as well as cognition, as it has been applied to the design of paper questionnaires (Jenkins and Dillman, 1995, 1997). People must be able to download the questionnaire and answer it. In addition, they must be able to comprehend what is expected of them, know what actions are required for responding, and be motivated to take those actions. Questionnaire design features that are difficult to understand, take excessive time for people to figure out, embarrass people, and are uninteresting to complete, are expected to decrease people's likelihood of responding to web questionnaires.

Therefore, respondent-friendly design aims to present a questionnaire to respondents in such a way that each person to whom it is sent has an equal chance of receiving and responding to it. The questions must be presented in a way that they can be understood and answered accurately by all recipients. And, the likelihood of responding should not be affected by people's lack of computer skills or other factors that are related to the study variables of interest. These concerns with reducing measurement, nonresponse, and coverage error in surveys lead to specification of three criteria for the development of principles for the design of web surveys.

Criterion 1: Respondent-friendly design will take into account the inability of some respondents to receive and respond to web questionnaires with advanced programming features that cannot be received or easily responded to because of equipment, browser, and/or transmission limitations.

HTML (Hypertext Mark-up Language) is used to create web pages on the Internet. Like many other computer languages, it is continuing to evolve. The original HTML language was developed in 1989. A second version of HTML emerged in 1994, followed by HTML 3.2 in 1995-96. The continued development of this language has increased the ability of designers to use color, innovative question displays, spilt screens, embedded programs (applets), animation, sound tracks, and other advanced design features that are impossible to achieve in a paper questionnaire (e.g., Nichols and Seva, 1998; and Dillman et al., 1998). However, most of these advancements require more powerful computers, better software, and longer transmission times for sending questionnaires to respondents. The wide variety of browsers and software available to potential respondents means that some people cannot receive or respond to web surveys written with advanced techniques. For others, responding may be slow and therefore frustrating. Both of these problems, i.e., technical problems and frustration, increase the likelihood of nonresponse error.

It appears that an unintended consequence of using such advanced features is to actually decrease response to web surveys. An experiment by the Gallup Organization recently compared completion rates for two experimental questionnaires. One questionnaire, labeled fancy, used

bright colors with a constantly changing figure/ground format, HTML tables for constructing the questions, and had answer categories located to the extreme right of each screen (Dillman, Tortora, Conradt, and Bowker, In Press). The practical result was that it took longer to transmit this questionnaire to respondents, and the format was less conventional than that used for the other questionnaire. That questionnaire, labeled plain, used no graphics, was printed in a consistent black print on a white background, and placed answer categories in the traditional left-hand position used for most paper questionnaires. The questionnaire was 173 pages long, but involved a large number of skips so that only about one-fourth of most respondents would see the number of pages.

The fancy version of the questionnaire required more computer memory. Specifically, whereas the plain version represented about 317k, the fancy version consisted of 959k. The required time for transmission on a 14.4 modem was at least 225 seconds for the plain version compared to 682 seconds for the fancy one. Individuals whose browsers had less power were likely to spend a longer time receiving the questionnaire. Also, slower browsers were somewhat more likely to bring in the questionnaire with disabled response features or even to become overloaded and crash.

Recipients of the plain version completed significantly more pages, more write-in boxes, and were less likely to quit before reaching the last page. It took less time to complete the plain version, and respondents were less likely to have to return to the questionnaire at least once in order to complete it. Whereas 93.1% of those who logged into the plain version completed all of it, only 82.1% of those entering the fancy version finished. The fact that respondents were less likely to respond to the fancy version suggests that state-of-the-art advanced construction techniques that require much greater computer memory for their use should be avoided in web surveys.

Similarly, Nichols and Sedivi (1998) found that the use of a high-level programming language known as Java for a U.S Bureau of the Census survey of businesses made it impossible for many members of the survey population to access the survey. In addition, many of those who thought they had adequate equipment and agreed to respond encountered problems in doing so; perhaps for the same reason as that encountered in the Gallup experiment. Whereas 84% of those asked completed equivalent paper questionnaires, only 68% of the experimental group submitted completed web questionnaires. It appears that respondents' browsers were not compliant with the level of technology used to construct the questionnaire.

Applying this criterion of designing within the limits of what the computers, browsers, and transmission lines to respondents can handle, means that designers of web questionnaires face an unusual challenge. Instead of designing at the cutting edge of their evolving science, there is a need for them to hold back on the incorporation of advanced features, creating simpler questionnaires that require less memory.

Criterion 2: Respondent-friendly design must take into account both the logic of how computers operate and the logic of how people expect questionnaires to operate.

The task of responding to a web questionnaire requires that respondents think simultaneously about how to answer a questionnaire and how to operate their computer. An effective bridge must be developed between the skills needed for sending commands to their computer and the cultural expectations that one brings to the questionnaire answering process.

The challenge of connecting these two kinds of logic is illustrated by results from an e-mail survey conducted by Schaefer and Dillman (1996). After the survey was dispatched, several telephone calls were received from people who explained that for some reason the questionnaire would not accept their answers, making it impossible for them to respond. A series of questions quickly identified the problem; much to the chagrin of some respondents they had forgotten to click the reply button before trying to enter their answers! The respondents had utilized top-down processing (Jenkins and Dillman, 1997), recalling from previous experience how to fill out questionnaires, e.g., find the blanks and fill them out, so that the logic of how to operate the computer had temporarily been excluded from their thinking. The error was simple, but not surprising. However, the nonresponse consequences were profound in a situation where only a simple click of the mouse is necessary for deleting the questionnaire and moving on to the next mail or web page.

When an individual has been instructed to fill out a questionnaire, that person is stimulated to recall past experiences associated with completing questionnaires, the essential components of the process (e.g., questions, instructions and answer choices), and the response task (read questions and choose one of the answer categories). As a consequence, the person may momentarily forget that he or she is on a computer. Despite knowing that it is necessary to click the reply button in order to respond to an e-mail message, one simply forgets because of questionnaire logic being foremost in the person's mind.

People who use computers continually, but have relatively little questionnaire experience, may exhibit the opposite problem. They think first about computer operations and fail to think about the basic nature of the questionnaire response task. Questionnaires that are respondent-friendly will help respondents operate simultaneously within the separate logic systems of how questionnaires and computers operate.

Considerable progress has been made in identifying important principles for the visual layout and design of paper questionnaires. Based upon knowledge of how individuals see and interpret visual objects, numerous principles of respondent-friendly design for paper questionnaires have been articulated (Jenkins and Dillman, 1995, 1997; Dillman, Forthcoming). A separate body of literature on principles for the design of computer screens is developing (e.g., Couper, 1997). Because of the differences in logical systems for questionnaires and computers, and differences in the physical actions required for completing paper vs. computer questionnaires, it seems likely that some of the previously articulated principles apply, while others do not.

One reason for this potential difference is that while filling out a paper questionnaire, eyes and hands generally work in the same visual area of the page. However, when filling out a survey on computers, hands are in different locations (e.g., mouse, keyboard) than are the eyes. The respondent must, while viewing the computer screen, deal simultaneously with the location of questions on the screen, the cursor, and control features that are in the peripheral vision field. Thus, it seems unlikely that principles of visual layout and design that apply to either computers or paper questionnaires will apply totally to the other. While a theory of respondent-friendly web questionnaire design may draw from both, it will also have new features and require independent testing and evaluation. Most of the design principles outlined in this paper are concerned with assisting respondents in the linking of computer and questionnaire logic in what for many is a new response situation.

Responding to a web survey requires computer operating and software skills that are likely to vary widely among people who have access to the web. Some individuals are likely to use the web daily and have excellent computer skills; others are likely to visit the web rarely and be computer novices. This means that effective communication is necessary to assist the respondent in learning how to take all of the computer actions necessary for responding to a survey efficiently and accurately. These actions include tasks such as knowing when to click and double click with the mouse, when to use the return key, when and how to use a scroll bar, and how to change the size of windows. These are of course only a few of the many tasks essential to completing web surveys in an efficient and precise manner. Web surveys that ignore these needs seem destined to discourage responses from less computer-literate people, thus producing nonresponse error as well as poor measurement. Respondent-friendly design is aimed at reducing both of these important types of survey error.

Criterion 3: Web questionnaires should take into account the likelihood of their use in mixed-mode survey situations.

As noted earlier, most members of most survey populations do not have access to the Internet. In addition, some survey researchers are designing surveys to allow respondents their choice of modes of data collection. Abraham, et al. describe and assess the effectiveness of allowing education administrators and faculty in US colleges and universities the option of completing either a mail questionnaire or an electronic questionnaire. Therefore, we expect for the foreseeable future that most web surveys will be used in a mixed mode situation, whereby some data are collected via the web while other data are collected by paper self-administered questionnaires or by interviews. For this reason it is important that the construction of web surveys take into account how questions will be posed by other survey modes.

For example, “check all that apply” questions (e.g., “Please mark all of the sports events you have attended as a spectator during the past year,” followed by a list of 20 sports) are never asked in telephone interviews. Instead, each question is structured and presented in a way that requires people to respond separately to each stimulus. The problem with check-all-that- apply questions is that respondents tend to satisfice, i.e., continue reading until they have provided what seems to be a satisfactory answer (Krosnick et al., 1996). As a result, a bias may be produced against items that appear further down the list as shown by Israel and Taylor (1990).

Although the use of check-all-that-apply items on any survey is therefore undesirable, the likelihood of obtaining different responses becomes an added concern when the format question is changed across modes.

The limited screen space available for presenting questions produces a high likelihood that the question context experienced by web survey respondents may diverge significantly from that seem by either paper or interview respondents. We therefore pose as a third criterion for respondent-friendly design, making efforts to create a common stimulus across survey modes.

Principles for Designing Web Questionnaires

The process of designing web questionnaires can be broken down into many aspects, ranging from decisions on what information should appear on each screen to what programming tools are used to present it. Individual decisions must be made about each component of the screen, ranging from line length to where the response boxes are placed. The principles presented here are permeated by the desire to limit the computer memory required by the finished questionnaire. They also build upon knowledge from past research on other types of self-administered surveys of how to encourage response and, in particular, how to get answers that are accurate and complete.

The principles listed here may also be viewed as hypotheses. In addition to being derived from past research on paper questionnaires, they are based on review of dozens of web surveys and observation of respondent reactions in pretest situations. As of yet, most of the principles remain untested in experimental situations.

Principle 1. Introduce the web questionnaire with a welcome screen that is motivational, emphasizes the ease of responding, and instructs respondents on the action needed for proceeding to the next page.

Potential respondents may be directed to a web site that must either be entered manually or be achieved on certain browsers by clicking on an address contained in an e-mail message. In either case it is important that the respondent knows that he/she has arrived at the right place and how to proceed in order to answer the questionnaire.

Recipients of mail questionnaires are normally sent a letter that explains the reason for the survey, which encourages them to respond (Dillman, Forthcoming). A similar introductory message needs to be provided on the first screen, but the available screen space is quite limited. Thus, it seems desirable to make the message short. Because many people will have limited experience with how to answer a web questionnaire and perhaps how to operate a computer for this purpose, it's important that they be informed of what action will allow them to move to the first questions. For example, making the choice between touching the return key and clicking the mouse may not be obvious. The first questionnaire screen(s) is not the place to give a long series of instructions. It is easier to dispose of a web questionnaire than it is a paper one; therefore the first screen is designed to help people get to the content of the questionnaire as quickly as possible and with as little effort as is practical.

Web surveys conducted for the purpose of generalizing results to a known population must control who completes them. Therefore, a PIN or identification number will usually be provided that allows sampled individuals to gain access to the web questionnaire. This information needs also to be presented on the welcome page. An example of a welcome page, which contains a motivational message, an explanation of how to enter a PIN number, and how to then get to the first page of the actual questionnaire, is shown in Figure 1.

Principle 2. Begin the web questionnaire with a question that is fully visible on the first screen of the questionnaire, and will be easily comprehended and answered by all respondents.

The first question to appear on a screen tends to define the questionnaire as being easy or difficult to complete. If the content of the first question is hard to understand or some people don't know how to take the actions necessary for completing it, response rates are likely to suffer. The first screen is not the place to use a drop-down box or to require scrolling in order to see the entire first question. Therefore, it is desirable to avoid first questions like that shown in Figure 2. Besides including some items that probably don't apply to some respondents, it contains unexplained drop-down boxes and requires scrolling to see the remainder of the questionnaire items.

In contrast, Figure 3 shows a better first question which seems likely to apply to all respondents, explains how to respond, and requires only one answer before being able to move on.

The initial question should be interest-getting, and confirm to the respondent that it is worthwhile to continue. As is the case for paper questionnaires, this is <u>not</u> the place to list a series of background characteristics or demographic questions, e.g., education, age, income, and martial status (Dillman, Forthcoming).

Principle 3. Present each question in a conventional format similar to that normally used on paper questionnaires.

We have observed many web questionnaires which list questions without numbers in contrast to what is typically done in paper questionnaires. We have also observed web survey questions that were centered on the screen, much like a report title, as shown in Figure 4. Concern with lack of screen space has also influenced designers to provide no separation between questions and answer categories, thus losing the "grouping" qualities that help define questions and answers (Dillman, Forthcoming). The lack of spacing was created in one instance by devoting nearly half the screen to a common sponsor title that was shown on every screen. In addition, long dotted leaders have sometimes been used to connect far left-justified answers to answer spaces that were far right-justified in order to be as close to the scroll bar as possible. The intent was to make responding more efficient by facilitating movement back and forth between the scroll bar and answer choices. Still another observed questionnaire had a "yes" answer box located at the far left of the screen, and the alternative "no" answer was placed far away on the right part of the screen. Finally, we have observed an ordinal scale consisting of six answer choices ranging from highly favorable to highly unfavorable. The choices were displayed horizontally on the bottom two lines of the computer screen in a way that made it very difficult to identify the range of scale

alternatives and which box applied to which answer choice. In sum, there are many ways that questions may be constructed so that they seem unconventional to the respondent who brings expectations of what a questionnaire should look like from his/her past experiences. These are only a few of the ways that web questionnaires have deviated from conventional paper questionnaire construction.

Inasmuch as many respondents will be guided more by questionnaire logic than computer logic, much like the e-mail survey respondents who failed to hit the reply button and could not figure out why the questionnaire would not accept their answers, it seems useful to emulate normal paper questionnaire layouts. For example, each question should begin with a number. The question stem should be separated from the answer spaces. And, the answer spaces should be listed vertically and to the left of each category description. Figure 5 illustrates such a format.

In addition, research has shown that brightness, larger fonts, and spacing can be used to clearly identify the beginning of individual questions and therefore where the respondent should start reading each screen. Similarly, research on how people see objects has shown that people tend to start reading in the upper left-hand quadrant so this prime space is devoted to beginning each question. The lower right quadrant, which is the least likely to be seen first, is devoted to special logos or screen identifiers; for example, those that a sponsor may wish to use to identify sponsorship on each page of the survey (Jenkins and Dillman, 1997).

Principle 4. Limit line length to decrease the likelihood of a long line of prose being allowed to extend across the screen of the respondent's browser.

People are likely to read prose unevenly, with the result that critical words get skipped. Respondents seem less likely to skip words when lines are kept short. Shorter line-length therefore assures that each respondent is receiving the same word stimulus.

There are two means by which a web survey designer can limit the length of a line. One method is to insert a hard return after the last character of the word that fits within the prescribed line length. Doing this can be tedious and requires additional development time to ensure consistent line breaks. A more efficient method of truncating the line is to use a table-editing feature. Here cell contents are question numbers, question stems, and response categories. To restrict the line length the designer needs only to define the size of the column into which all response categories are placed. A method for allowing this to happen is to define columns of the table in a way that limits them to a set percent of the browser screen. The use of tables does not by itself increase significantly the memory required for constructing a web questionnaire, but provides enormous capability for making format improvements.

Principle 5. Provide specific instructions on how to take each necessary computer action for responding to the questionnaire.

Responding to web surveys requires knowledge of which computer functions to apply. For example:

- Radio buttons require clicking an alternative button in order to erase a previous answer, while check boxes require a single-click in order to erase them.

- Respondents may not know how to operate a scroll bar in order to see the entire question or the next questions.

- It may not be clear how use of the clicker (or mouse) differs from use of the return key.

- It may not be clear to some respondents what a drop-down menu is, and how to access the hidden categories.

- It may not be clear how open-ended answers are to be entered, or that in some cases there is far more space than shows on the screen.

Each of these techniques may be obvious to experienced computer users, but need to be explained to less experienced respondents.

Three methods might be used to accomplish this objective. One method is to provide instructions on how to perform each needed skill immediately following the stem of the question. This instruction would appear the first time each type of computer function skill is needed, and might be repeated once or twice. A second method is to ask on an initial screen for respondents to indicate whether they are or are not an experienced computer user. Those who judge themselves to be experienced could be directed to a version of the questionnaire that does not include instructions. Those who see themselves as novices could be directed to one that helps people at each step of the way with operating instructions that are needed for answering each type of question. A third method is to use a "floating window" that provides specific operation instructions. A floating window is simply a smaller window that "floats" atop the existing window of the browser and can be read for quick instructions and recalled when necessary. While feasible, this method requires additional processing time in addition to a compatible browser application to achieve compliancy.

Principle 6. Provide computer operation instructions as part of each question where the action is to be taken, not in a separate section prior to the beginning of the questionnaire.

A common but unfortunate procedure followed in the construction of many mail questionnaires is to provide long, detailed instructions at the beginning of a questionnaire. We once were shown a questionnaire that used a series of six initial screens to describe how to operate the scroll bar, radio buttons, check boxes, drop-down menus, two types of open-ended questions, and returning to a previous question. From a cognitive or learning perspective this is not a desirable practice. Providing many instructions about what to do in different situations, all of which are unfamiliar to a respondent, means there is considerable likelihood that the instructional details will be forgotten by the time each action is to be taken.

The appropriate place for providing computer-operating instructions is at the precise point a respondent may need to use the instructional information (as was shown in Figure 1). Therefore, as has been argued for paper questionnaires, instructions on computer actions, as well as specific response instructions (e.g., choose one answer), need to be provided as part of individual question structures. After an operational instruction, as appeared on one or two screens, it probably does not need to be repeated for later questions, or can appear in abbreviated form.

Principle 7. Do not require respondents to provide an answer to each question before being allowed to answer any subsequent ones.

One of the much-talked about attributes of some web questionnaires is the ability to force respondents to answer every question. Some software systems for constructing web questionnaires provide this option to the questionnaire designer. The penalty for not providing an answer is that the respondent cannot continue to the next question. Frequently this quality is promulgated as a distinct advantage of web surveys. In our view respondents should not be forced to provide an answer before moving on. Sometimes respondents have legitimate reasons for objecting to providing an answer and may, in fact, be unable to provide an answer to some questions. The frustration associated with this requirement seems likely to lead to premature terminations. In addition, it poses a problem for surveyors when human subject protection committees legitimately insist that people be told that their response to each question is voluntary. This quality makes the web survey different from self-administered mail surveys and may lead to mode differences.

In order to solve the human subject protection concern, it has been suggested that people be required to answer, but that a "prefer not to answer" and/or "don't know" category be provided for every item. People will still be required to provide an answer to each item. This procedure may or may not provide an adequate solution. No other type of questionnaire provides such a "forcing" mechanism. Respondent reactions to being required to answer each question, even if it is to indicate they don't want to answer, is a relatively unexplored issue.

Principle 8. Construct web questionnaires so that they scroll from question to question unless order effects are a major concern, large numbers of questions must be skipped, and/or a mixed-mode survey is being done for which telephone interview and web results will be combined.

One of the clear advantages of web questionnaires is that similar to interview surveys respondents can be directed to skip large numbers of questions without being aware that it is happening. Asking respondents to scroll past questions they are not being asked to complete seems likely to increase frustration as well as errors. Using a screen-by-screen construction technique also emulates the skip process so that in mixed-mode surveys the overall experience of responding will be similar.

However, if web survey results are to be mixed with paper questionnaire results, a quite different situation exists. Using individual screen construction techniques provides less context than people normally have for answering questions and is especially problematic when people are asked a series of related questions, e.g., details about a particular job. It becomes difficult to

review answers provided to previous questions. Paper questionnaire respondents may look both forward and backwards to get a sense of questionnaire length, to recheck a previous answer, or to simply keep a sense of where they are in the questionnaire. Observations of respondents answering questions that appeared one at a time on screens suggested that some respondents lost a sense of context. If their concentration was disrupted they could not go back and easily pick up on where they were in the mental process of responding.

To remedy this problem and retain the "screen-by-screen approach," it seemed necessary to add prose reminding people of how they had answered a previous question. As a result, the stimulus of each question became different than the way it would typically appear in either interview or paper questionnaires. A question-by-question back-up feature was also cumbersome. A quick glance backwards would have helped the respondent provide more accurate results.

At the same time, when concern over order effects exists, e.g., asking an unaided recall question about what grocery store people most like to shop at followed by the same question with prelisted choices, preventing people from scrolling ahead seems useful. However, it is not clear whether scrolling ahead will influence answers inasmuch as most people are likely to answer questions in the order they are presented. Comparison of mail and telephone questionnaires on the existence of order effects has produced equivocal results (Dillman, Forthcoming).

Principle 9. When the number of answer choices exceeds the number that can be displayed on one screen, consider double-banking with appropriate navigational instructions being added.

Double- or even triple-banking is frequently used to squeeze questions into a limited space. In general, we consider it an undesirable practice. The reason is that people's range of vision when attentive to a task like responding to a questionnaire is limited to about 8-10 characters. Consequently, the second or third bank of questions remains unseen.

However, in the case of web surveys there is frequently a tradeoff between undesirables. If questions are not double-banked then it may be necessary to spread a question's response categories over two screens. We choose double (or occasionally triple-banking) for web surveys because we do not think the negative consequences are as serious as they are for paper questionnaires. Also, the smaller size of screens, compared to paper pages, encourages limiting screens to a single question so that the second column of answers can be made more visible. To compensate for double–banking, a box is placed around the categories in order to "group" them as all being relevant to the question, as shown in Figure 6. This grouping method would not be used in paper questionnaires because it tends to invite people to skip over the boxed information. The limited visual scope of the screen makes the boxing method more effective here (Figure 6).

Principle 10. Use graphical symbols or words that convey a sense of where the respondent is in the completion progress, but avoid ones that require advanced programming.

When completing a paper questionnaire it is easy for respondents to estimate where they are in the completion process and to see how far they are from the end. Observation of web pretest

respondents suggests that some people begin to tire of a questionnaire and decide to quit even though there are only a few questions left. Fear that the last few questions will be missed leads some developers of web questionnaires to put potentially objectionable questions judged to be especially important to the survey objectives (e.g., income) early in the questionnaire. This practice seems likely to result in unnecessary cut-offs quite early in the questionnaire.

There are many ways that respondents may be kept informed of their progress. Questionnaires that scroll instead of using a screen-by-screen approach automatically reveal one's progress either by looking at the computer screen scroll bar, or one can simply scroll to the end of the questionnaire to estimate how much is left. An advanced construction method is to place a "progress bar" on the screen that shows how close people are to completing a questionnaire. Attempts of this nature may be quite creative, e.g., on an aircraft survey showing a plane taking off on a runway so that it lifted off just as the respondent reached the last question. However, such graphical techniques may also require considerable additional memory.

To limit the use of computer memory, simple transition sentences may also be used, e.g., "Finally, we want to ask a few questions about yourself." Figure 7 shows still another possible method, periodically reporting what proportion of the questionnaire is complete. A text-based method is most desirable inasmuch as it can be used for all computer and software situations, whereas visual animation requires more advanced programming and respondent browsers.

Principle 11. Be cautious about using question structures that have known measurement problems on paper questionnaires, e.g., check-all-that-apply and open-ended questions.

The web survey is a visual experience that is under the control of the respondent, as is the case for paper self-administered questionnaires. A type of question with a known defect in self-administered questionnaires is the "check-all-that-apply" question. People are asked to check items from a sometimes very long list. The drawback to their use is that people often satisfice, i.e., check answer choices until they think they have satisfactorily answered the questions. Considerable evidence exists that people often do not read all of the answer choices before going on to the next question. In addition, the order of reading answer choices tends to bias people's responses towards the first categories (Israel and Taylor, 1990; Krosnick, Narayan, and Smith, 1996; Dillman, Forthcoming).

The check-all-that-apply question is not used in telephone surveys. Instead people are asked to respond positively or negatively to each choice before continuing. In addition to creating a satisficing bias, the use of check all that apply questions on web questionnaires requires the use of check boxes rather than radio buttons which require the learning of a different correction procedure. If the list is quite long, and the respondent is required to scroll or click to the next screen, the likelihood of satisficing may increase. Thus, from the standpoint of survey error, check-all-that-apply questions should not be used in a web or any other type of survey.

The advent of web surveys has encouraged the use of check-all-that-apply questions, even providing a special type of answer box (as opposed to radio buttons) for which any number may be checked for each question. The use of such boxes invites measurement error, which can be

avoided. Many people have suggested that check-all-that-apply boxes constitute a strength of web surveys, and that to change to a "yes-no" format for each and every item would lengthen the time required for answering surveys, and therefore produce higher nonresponse rates. It is conceivable that limiting one's visual field to a computer screen and having to scroll or space through the entire screen may limit the satisficing effects that have been consistently observed on paper questionnaires. It seems particularly important that research be done on this issue.

Another type of question that produces typically poor answers on paper self-administered surveys is open-ended questions. Respondents give less complete answers than is the case with interview surveys where follow-up probes can be used. A paper survey solution is to convert individual questions (e.g., "What is your occupation?" to multiple questions such as, "What is your occupation? What kind of work do you do? Please describe your employer?") (Dillman, Forthcoming). However, at least one e-mail survey experiment has demonstrated that respondents provide more detailed answers to open-ended questions on computers than they do on paper questionnaires (Schaeffer and Dillman, 1998). Web surveys may also elicit larger answers but research on this possibility is needed.

Summary and Conclusions

Use of the World Wide Web to conduct surveys provides enormous opportunities as well as challenges. The cost advantages of collecting large amounts of data at very little cost means that its use will escalate rapidly. At the same time, maintaining quality, whereby the results of surveys can be generalized to a large population is far from automatic.

Respondent-friendly questionnaire design, found important to improving response to self-administered mail questionnaires, is also important for the development of web questionnaires. However, in a web context the term takes on a broader meaning. A respondent-friendly web questionnaire is one that interfaces effectively with the wide variety of computers and browsers possessed by respondents. It also makes other aspects of the response task easy and interesting for the respondent to complete. Respondent-friendly designed is aimed explicitly at reducing three of the four types of error that typically prevent accurate surveys from being done, i.e., nonresponse, measurement, and coverage of the survey population.

Three important criteria for achieving respondent-friendly design have been stated. They include, first, compliancy with technology available to the respondent. If a browser cannot recognize the programmed information being sent to it, the respondent cannot receive it. Questionnaires that use advanced programming that takes longer transmission times and requires more advanced browsers may result in unintended coverage and nonresponse error. A second criterion is the necessity of bridging between the logic by which respondents expect a questionnaire to operate and the logic associated with operating a computer. It's this connection that provides a questionnaire design challenge not previously faced by survey methodologists. In addition to these criteria, web designers must also consider the high likelihood that coverage problems will require that most quality web surveys, for the foreseeable future, will require the mixing of survey modes, whereby some respondents are surveyed by mail or telephone while others are surveyed via the web.

Based on these design criteria, 11 principles have been stated for the development of respondent-friendly web questionnaires, ranging from the content of specific screens to how the questions are graphically presented. The principles presented here are by no means complete. Others might also have been stated. However, the ones presented here suggest that an enormous challenge facing web questionnaire designers is how to keep questionnaire content simple, while the cutting edge of what's possible to include in web questionnaires continues to advance.

The principles presented here are based, to a considerable degree, on principles found important in the design of self-administered mail surveys. However, it must be recognized that the visual experience of completing a web questionnaire is somewhat different than that of completing a paper questionnaire. The cursor, the mouse, and the more limited scope of individual screen displays add dimensions of visual complexity and display that are different than those presented by the hand-eye coordination aspects involved in completing paper questionnaires. It's important that experiments be designed to test their importance.

It is no longer questionable whether the World Wide Web will be used to conduct important surveys. In fact, 1998 may well be remembered as the year web surveying "took off!" The yet to be answered question is how effective future web surveys will be conducted and whether they will gain scientific acceptance. Observation of the first use of these technologies suggests that many of these surveys are not being well designed. The defects range from dependence on "volunteer-only" respondents to the creation of design formats that emphasize creativity and flashy presentation over the reduction of survey error. Further development of scientifically-based principles of design, that go well beyond the initial ones proposed here, are critical to determining how important web surveys become as a valid method of conducting high quality surveys.

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