Conducting Web-based Survey Research: A Lesson in Internet Designs

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***Objectives*: To examine the tacit knowledge resulting from designing a complex Web site to facilitate administration of an Internet-based survey. *Methods*: Formative methods guided studying the feasibility of conducting an online survey using versions of the Keirsey Temperament Sorter II and the National College Health Risk Behavior Survey. *Results*: Web-site design software and pilot testing were critical to success. Incorporating the target audience as consumers in both Web site development and formative evaluation simplified data collection and analysis. *Conclusions*: Online instrumentation used in survey research is both practical and desirable. Future refinements are necessary, but improved designs can emanate from this particular effort.**

***Key words*: Internet survey, Web site design, online research**

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American college students exhibit morbidity and mortality rates related in part to health risk-taking behaviors. The Centers for Disease Control and Prevention (CDC) surveyed college students in 1995 using the National College Health Risk Behavior Survey (NCHRBS), which for the first time, provided health officials with data concerning behaviors in this age-group that most likely lead to causes of premature death and disease.[1]

Public health professionals have attempted to address health risk-taking behaviors among young adults through a variety of health-promotion mechanisms. Personality measures have been used often to assess situations associated with health or risk outcomes, such as coping, stress, and anger. Attempts to link personality traits and health behaviors such as tobacco use have been reported in the literature by Glover, et al.[2] Temperament type, a theory associated with Jung,[3] Myers and Myers,[4] and Keirsey[5] is a personality construct related to risk taking that has *not* been studied extensively in the health behavior literature. The purpose of this study was to identify whether a relationship between temperament type and health risk-taking behaviors existed among college students.

This study used the Internet to collect relevant data. This format was selected for 2 reasons. First, this method of collecting data is part of an emerging field of survey research that has not been used extensively to study health behavior. Second, the subpopulation being studied (college students) is generally thought to be more computer literate than many

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other population segments. It was postulated that conducting the study using this survey technique might further knowledge about whether this method is a viable option for collecting survey results from college students.

Rather than reporting the quantitative results of the study, this paper reports on the background work required to conduct the study of interest using the capabilities of the Internet. That is, it focuses on the *decisions,* the *obstacles,* and the *logistics* underlying a successfully conducted Internet survey. These factors are deemed critical in conveying information related to methods and procedures to future Internet survey researchers that allow them to obtain optimal results with minimal limitations and impediments. As Gold and Atkinson[6] point out, "tacit knowledge" is an extraordinarily underutilized resource because it rarely gets communicated in the literature. Consequently, what one researcher takes for granted after completing a study is information that may have to be learned from square one by the next person undertaking a similar task. This paper describes the formative process of conducting Internet survey research and, thus, attempts to minimize the extent to which future researchers repeat errors or fail to benefit from lessons already learned by their predecessors.

Internet Survey Research

This study, employing 2 established survey instruments, ordinarily might have been conducted using the paper-and-pencil technique of data collection, either through mailing the instruments or administering them face-to-face in a classroom setting. The advent of the Internet and widespread acceptance of online communications expands the potential modes of data collection, as well as the possibility of persons' completing surveys at a time of their choosing and under conditions that may be more conducive to thoughtful responses.

In *Culture of the Internet,* Kiesler[7] explores the social impact of the incredible spread of computer networks in society. In the late 1960s and early 1970s, computer systems that were linked together and carried human writing formed what is now referred to as the Internet. Moreover, when communication became hypertexted, the World Wide Web was created. This development allowed for a new means of communication technology to emerge — one that overcomes temporal and geographic barriers and connects all users to the same computer network.[7,8] The success of the World Wide Web is probably responsible for creating the misconception that virtually everyone in the United States, if not the world, has a personal computer and is computer literate and computer active. However, Kiesler[7] (p.xi) points out that "Networks are difficult technically *and* expensive"...and that "most people wouldn't be on them if work or school didn't provide computers and technical support." The texts by Kiesler[7] and Sproull and Kiesler[8] both note that computer-based communication technology exists predominantly in university settings, technical organizations, and within the business community, and that universities specifically are one of the well-established domains of electronic communities. Many major universities provide an e-mail account to their students as part of the large computer-based communication system within that school. Twenty-first-century undergraduate students now enter the university system with the ability and experience to use e-mail accounts for communication, even if other computer-related skills are more limited. Logistically, then, the ability to carry out electronic surveys at a large university is *not* a research barrier.

Thach[9] discusses 4 characteristics related to the advantages of e-mail survey research over mailed surveys. Speed, asynchronous communication (ie, responding at the convenience of the user), absence of intermediaries, and emphemerality are characteristics that are unique in this mode, as opposed to the more traditional methods of survey research. The last characteristic, relating to a sense of social distance, is an issue that has been mentioned by several authors. Respondents may be more likely to be self-disclosing or less likely to respond in a socially desirable way because of the sense of distance associated with responding on the Internet.[10-12]

Other advantages of conducting electronic survey research include lower costs, faster transmission time, and ease of editing.[9,13] One major disadvantage of the method, thus far, has been the lack of anonymity, since e-mail responses typi-

cally come back to the researcher with the sender's address. According to McDermott and Sarvela,[14] (p. 259) "Without question, one of the present limiting factors with e-mail surveys is the 'anonymity factor'." However, new software, including the program employed in this study, *Microsoft's FrontPage 2000*,[15] can facilitate a study design that allows for anonymity of the sender. Even were that not the case, Pealer, et al[16] conducted a study in which college students returned the completed NCHRBS via e-mail and, even in the absence of anonymity, found that virtually all items were completed. Moreover, the response rate was comparable to those reached by traditional methods of survey research. Thus, carrying out this survey design using the Internet was based upon advantages such as its speed, ease of editing, asynchronicity, and lack of expense, as well as the appropriate choice of instrument for a college population.

Limitations of Internet Survey Research

On balance, computer-based research is still in an early stage and has many problems associated with it. In the early 1980s, when computer-based survey research was in its infancy, one of the major problems was lack of access to computer communication networks. In fact, the major disadvantage to research was selection bias of subjects — those with computer access were typically white collar, better educated, technologically sophisticated, and urban — making generalizability impossible.[11,17] Other methodological disadvantages at that time included incompatible networks or software, technologically cumbersome programs that made research design a lengthier process than paper-and-pencil surveys, lack of computer skills, and concerns about response rates for this method versus more traditional methods.[11,18] Although greater numbers of undergraduate students are computer literate, there are still some whose computer skills are limited. Thus, creating a simple and user-friendly Web-based survey instrument is imperative.[19] Despite the preference of assessing the level of subjects' skills prior to data collection, doing so is impractical. Therefore, a simple e-mail link or providing an uncomplicated Universal Resource Locator (URL) to the study instrument is especially important.[12,20]

The issue of how using the Internet for carrying out survey research impacts response rates is still unresolved. Sproull[21] predicted that response rates from electronic surveys would be superior to those of postal surveys. However, studies have been inconsistent on this issue. Walsh et al[12] reviewed a self-selected survey where one of the most salient features was its favorable response rate. Kittleson[22] reports poorer response rates among respondents completing e-mail surveys than those completing postal surveys, whereas Mehta and Sivadas[23] and Pealer et al[16] report comparable response rates. DeBarnardo et al[24] found that an e-mail survey of undergraduates at Yale University regarding smoking attitudes resulted in a 56% return rate with no reminder e-mail messages being sent — a significantly higher rate of response than the 30% response from the traditional mailed surveys at that school. A University of Florida study compared response rates between students completing the NCHRBS through an e-mail survey versus a mailed survey and found them to be approximately equivalent.[16] It may be that as new undergraduate students arrive with greater computer competency and technological comfort, the issue of response rates simply may be one more factor in the study design, as it is in other research designs.

In addition to these limitations, still others exist. With Internet-based surveys, the actual data-collection environment can be neither controlled nor monitored. As such, the impact of random factors and events that may influence the respondent are unknown. Furthermore, as with the more familiar and traditional mailed surveys, whether it is the addressee who actually completes the survey, or an unintended respondent instead, is likely to be unknown to the investigator.

Designing a Web site for this study required research into various software systems as well as decisions regarding the design characteristics. Although Web-page design is generally regarded as a creative and exciting aspect of the research process, it is useful to keep in mind that it, too, may be fraught with difficulties. As Dillman[25] (p. 354) notes: "the enormous numbers of imaginative possibilities for constructing Web question-

naires also present major risks of increased survey error," in that the more complex and innovative a design, the more likely it is to be too complex for some participants to access that site. If a Web site has a level of technical sophistication that makes it difficult to gain entry to the survey, download it, complete it, or send back results, the likelihood increases that participants will not become involved in the study. Knowing that this lack of "user friendliness" was a possibility, creation of a relatively simple and technically uncomplicated design that was compatible with various operating systems was essential. A discussion of the pilot testing of the Web site for different computer systems is presented later in this paper (see Identifying Impediments and Providing Solutions to this Study).

The NCHRBS asks several highly sensitive questions, such as ones about illegal drug use, frequency of sexual activities, and others, making the issue of anonymity an important consideration in the survey design. Because the surveys were being returned in 2 forms (one downloaded to the academic department's server and one relayed via an e-mail message forwarded to the primary investigator), the possibility of revealing the participant's identity was a potential impediment to achieving an acceptable response rate that needed to be addressed. However, as mentioned above, the choice of software guarded against all but the most rare and unlikely loss of anonymity through external computer hacking, thus assuring "virtual" anonymity of respondents.

Temperament Type and Health Risk-Taking Behaviors Among College Students

The study for which the aforementioned Web site was developed attempted to address the relationship between temperament type and health risk-taking behaviors, an association that could have important implications in health education and other prevention efforts among college students, and in turn, other population segments. Little has been written about the temperament types of risk-taking college students.

Temperament theory is based upon the work of Swiss-born psychiatrist and anthropologist Carl Jung and states that behaviors seemingly random in human beings, are in fact, based upon natural preferences or instinctive inclinations. Jung[3] defined these preferences as 2 natural, dichotomous attitudes towards focusing energy (extraversion and introversion), and 4 fundamental psychological functions, also dichotomous and complementary: thinking/ feeling, and sensory/ intuitive. Jung's work was further refined by Briggs and Briggs Myers, who not only added another dichotomous preference, judging/perceiving, but also conceptualized Jung's theory by developing a psychometric instrument that allowed for individual testing of temperament type.[4] The Myers-Briggs Temperament Indicator (MBTI)[26] and the Keirsey Temperament Sorter II (KTS-II),[27] a temperament measurement developed by psychologist David Keirsey, are among the most widely used personality instruments in the world.[26-27] This study employed the Keirsey Temperament Sorter II, which is available online, and measures the independent variable of temperament type.[27]

Risk-taking behaviors among college students were determined through the use of the National College Health Risk Behavior Survey,[1] which was replicated at a survey site that was located at the Web site for this study. The NCHRBS has 6 subscales of behaviors including unintentional and intentional injury, alcohol and other drug use, tobacco use, sexual behaviors, physical activity, and nutrition-related behaviors.

Identifying Impediments and Providing Solutions in this Study

The choice of instruments for this study created the first issue relevant to the design of the survey website. The Myers-Briggs Type Indicator (MBTI) is available in a Web-based format, but the cost per test is prohibitive, given the minimum number of subjects that were needed for the study to provide adequate statistical power (n=420). The KTS II is available on the Internet at no cost, and because the 2 tests are psychometrically equivalent, the KTS II was chosen to measure temperament type. A problem with using the KTS II developed almost immediately in the early phases of the survey specifications, after receiving an e-mail reply from the Webmaster of the KTS II site, Dr David Keirsey (the son of David W. Keirsey, author of the KTS II). Permission could

not be obtained from the Keirsey organization to include the KTS II within the study's survey site itself, although Dr Keirsey did suggest building a link to the temperament survey from the research study website.

Since the NCHRBS is not available as a Web-based document, it needs to be replicated in a *Microsoft FrontPage 2000*[15] format on the Web, with the responses for each item formatted in such a way that they can be analyzed in an SPSS program.[28] In addition, the NCHRBS is an instrument that was designed to report the frequency of health risk-taking behaviors of college students as nominal-level data only. Therefore, prior to its inclusion in this study in a Web-based format, each item had to be reviewed by a panel of experts to assess response options for each item, one-by-one, assigning each response option a risk score from 1 to 5, thereby allowing for a higher level of statistical analysis.

Two activities became necessary to construct a survey site that could function to answer the research questions for this study: (1) publish and format the NCHRBS in its entirety and (2) connect the KTS II to the survey site in a way that would allow study participants to navigate back and forth between instruments. This procedure required more extensive and sophisticated knowledge of the design software.

Prior to publishing a site on the Internet for this specific study, a Web site was created that included several different pages. These pages included the primary investigator's curriculum vitae, as well as a page that would be devoted to this research study. During the several weeks in which these various pages were created and linked together, nothing was published on the Internet. Rather, this exercise served to increase the Web site developer's knowledge of the *Microsoft FrontPage 2000*[15] software, a step that later would prove invaluable when modifications were made following review of pilot-test data. After a large body of materials such as information "cut and pasted" from text documents was completed for posting on the Web site, a home page and a research page containing a skeletal outline of the NCHRBS were created. Thus, the first iteration of the research site was published on the Internet.

As posting to the Internet began, determinations were made regarding cosmetic structure of the surveys and the appearance of the research site. First, because the 2 surveys together would take 20-25 minutes to complete, a decision to create a research page as a form of introduction to the study was made. The research page explained the purpose of the study, the voluntary nature of participation, and the sponsorship by the academic department and university. Second, the research page had a link created on it ("Click here to participate in the study") that directed potential participants to a second page that served as an instruction page where participants would be directed to the separate surveys, one at a time. The NCHRBS was reproduced as closely as possible so as to resemble its original form. Only 2 changes were made to the instrument itself. The first change was adding 4 "either-or" items representing the 4-letter temperament types (ie, E or I, S or N, T or F, and J or P). The other change had to do with the inclusion criteria for the study, ie, delimited to undergraduates between the ages of 18 and 24 who were enrolled at the university where the study took place.

At the time of the initial posting of the survey and the instruction pages, a good example of the early learning curve of using new software was inadvertently created. This lesson involved the problem of navigating participants from the research page to the KTS II, where they would complete the survey, copy the 4-letter temperament type they obtained at the end of the survey, and return to the NCHRBS. Unfortunately, it seemed that the only way to accomplish the task of getting someone linked to the KTS II site was by creating a hyperlink to that Web site, at which time the participant would lose contact with the main study site. The first versions of the research page (the introduction page linked to the instruction page) and the survey instrument (the NCHRBS with the additional 4-letter temperament item from the KTS II) were basic. Three college students known to the investigators served as subjects for the pre-pilot[14] testing of the site, giving feedback about the readability of the screen, their ability to navigate back and forth between the research page and the KTS II, and any additional comments regarding the face validity of the Web pages. In addition, several Internet users, also

known to the investigators, were asked to prepilot the sites by going to the address sent to them by e-mail, because doing so would be one of the ways in which volunteers would be contacted. These people used several different types of personal computer systems, including PC and Macintosh models. This step was considered an essential part of the pilot-testing phase, because those students who agreed to participate in the study would be using a variety of software and hardware.

The initial responses in the pre-pilot phase were generally positive, if not exuberant. All subjects participating in this phase of Web site creation were able to log onto the site and move back and forth among the various links. The actual Web pages themselves were rated as highly unattractive (at this point, both the research page and the survey instrument had white backgrounds with uninterrupted black text in Times New Roman font). It was strongly recommended by the college students engaged in the prepilot phase that some visual changes be made. Background images were added to all of the study forms on the Internet that were under the control of the investigators (ie, with the exception of the KTS II). This addition created continuity among the different Web pages and increased the attractiveness of the overall site. Other simple changes included font style and color as well as the addition of clip art to the survey, reflecting the behaviors of the different subscales being measured, such as tobacco use, alcohol use, and so on. One final alteration made to both the home page and the research page was the addition of a digital photograph of the primary investigator serving as the contact person for this project. This suggestion came from 2 of the college students, who felt that it would add a more personal touch to the survey, especially because recruitment of students would take place in large (and fairly impersonal) undergraduate classes.

Pilot tests were conducted in volunteer undergraduate classes of 20 to 40 persons to determine completion times, readability, and response rates. The first pilot test took place in a university computer lab, and participants were directed to the Web site by typing in the URL provided to them at that time. With no instructions given other than the Web address, the instrument was found to perform as expected in terms of receiving responses to completed surveys. However, written responses to the pilot test revealed that the respondents were generally confused by the difficulty of navigating from the research instruction page to a different Web site (where the KTS II was located) and back again to complete the remainder of the survey (the NCHRBS). Results of the first pilot test revealed that the time of completion was 22 minutes, and the rate of completion was 75% (21 out of 28 students).

A few changes were made to the instructions, and the survey was pilot tested a second time. For this second round of pilot testing, conditions were made similar to those planned for the study itself. That is, potential participants were sent an e-mail message directing them to the Web site, and in turn, the participants were expected to read through the instructions and complete the surveys. Again, changes were made based upon suggestions made by the pilot-test participants. In particular, one undergraduate who designed Web pages as a part-time job suggested employing a split-frame design for the instruction page, a modification that would keep the instructions on the side of the page at all times. Therefore, all subjects could respond to each of the 2 surveys without having to leave the study site.

The new design was informally pilot tested with 2 undergraduate classes (N of subjects = 36) not previously asked to complete the 2 surveys. Once again, these students were directed to the URL address, but given no additional instructions. The written responses to the survey showed that completion time still averaged 22 minutes. However, the completion rate by the 36 students was much higher. In all, 35 out of 36 students completed the NCHRBS fully, including the 4-letter temperament type (an increase in completion rate from 75% to 97%). This split-frame design was the solution to the problem of administering 2 independent survey instruments. Data collection occurred in March-April 2000. Of 1553 undergraduate students who were solicited through direct recruitment in large undergraduate classes and who subsequently provided their e-mail addresses, 987 completed the survey.

Shortly after the study was concluded, the Web site that contains the KTS II

Table 1
Overview of Steps in Design and Development of Web-based Survey

- **Preparation: Decisions regarding Web sites and software**
  - URL address development
  - Assessment of software capabilities
- **Assessment of Instrument(s)**
  - Web-based versus traditional (transforming instrument to Web-based design)
  - Linking multiple instruments
- **Decisions Regarding Survey Construction**
  - Designing instructions
  - Data coding
  - Data collection
  - Time to complete
- **Publishing and Pilot Testing**
  - Pre-pilot testing with members of target audience
  - Multiple rounds of pilot testing
  - Full field test
- **Subject Recruitment**

became unavailable for several days while it was being re-designed by its Webmaster. This fact was discovered serendipitously when students in a nonsurveyed undergraduate course reported an inability to access the Web site for an out-of-class assignment. Had the timing of this redesign been during data collection, the impact on the study would have been cataclysmic. The loss of access to that Web site for the same amount of time might have resulted in missing at least 360 (36.5%) completed surveys. This event points out an important aspect of using and relying on external Internet links. They may be unaccountably unavailable, making the researcher vulnerable to the eccentricities of the Internet. Individuals contemplating linking to external sites for research or other purposes may need to contact such Web sites in advance to determine if scheduled maintenance is planned that may interrupt services and, therefore, corrupt the research process.

Learning the specific idiosyncrasies of software programs and local servers was time-consuming in the initial phases of the study, but turned out to be critical for carrying out subsequent phases of the research process. This point was especially true when rapid editing of the survey instrument took place between pilot tests. Understanding the capabilities of Web servers also is extremely important, because servers may differ even within the same institution. Being unaware of the specifics of an operating system may result in wasted time or effort. An overview of the steps in the design of the Web-based survey described herein is provided in Table 1.

CONCLUSION

Overall, the extensive amount of work on the Web site and survey formats in the months preceding the data collection proved to be fruitful. Once the surveys were submitted, data entry was accomplished in a matter of minutes, with several clicks of the mouse. Although the initial construction of the form was painstakingly tedious, it was gratifying to witness how efficiently the survey could be completed, submitted, and downloaded into a usable database.

There were some important lessons learned in this research process. First, involving knowledgeable members of the target population (in this case, college students) was essential in finding solutions to logistical problems, in identifying attractive images to enhance face valid-

ity of the survey, and in general, for promoting interest in the project. At the time, the dilemma of accessing two completely independent Internet surveys seemed almost insurmountable, and threatened to undermine the study. However, a simple solution offered by one particularly knowledgeable and resourceful student overcame this potential barrier and contributed to the success of the project. Many, if not most, college students are comfortable with computers and have extensive experience in navigating the Internet. For persons interested in duplicating this study or creating new databases using the Internet, working closely with members of the target population is recommended. Secondly, the importance of pilot testing the instruments cannot be underestimated. Given the technological complexities of designing and conducting Internet-based survey research, the return yielded as a result of pilot testing far outweighed the effort in conducting it.

Instructional technology (IT) personnel are employed in most universities and many other organizations, and such technicians could have been used to design and operationalize the current Web site instead of health educators or health behavior researchers. This fact notwithstanding, the role of the researchers in creation of the vehicle of data collection may be of sufficient importance to justify recommending further skill development in the area of Web-page design. The blending and refinement of survey design and Web-page design skills, along with knowledge of health content, could foster improvements in health behavior research in the future. The wedding of technology and health education research is not a new concept,[29,30] but its relevance may be greater than ever before.

Investigating different ways of recruiting subjects via the Internet is an additional issue for online surveys that should be explored. Anecdotally, it seems that one of the reasons so many students were willing to participate in this study was that the survey was available on the Internet and was easy to complete. This topic has been raised several times in discussions of the strengths as weaknesses of this study and deserves further thought. As the uniqueness of online surveys begins to erode, interest and rates of participation may decline. Thus, new incentives may need to be developed to encourage participation. In this study, a decision was made to oversample the undergraduate student population, because it was unknown how many students would be willing to participate in a Web-based survey that did not offer any form of compensation. Until more is known about the various techniques to recruit participants for Internet research, oversampling may be necessary.

Finally, regarding the question of the feasibility, desirability, and utility of collecting and analyzing data from an online survey directed at a college population, the answer seems to be resoundingly affirmative. Although this format must undergo further refinement, it will be an exciting future strategy for health education and health behavior research. ■

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