

BALCH INTERNET RESEARCH AND ANALYSIS TOOL DEVELOPMENT CASE STUDY

A Dissertation

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by

Charles V. Balch

B.S., University of California at Davis, 1984

M.Ed., University of the Virgin Islands, 1991

MBA, University of the Virgin Islands, 1996

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DEDICATION

This dissertation is dedicated first and foremost to my wife, Alexandra Lee Balch. Many years ago we agreed to follow each others dreams as well as our own. I could not have could not have accomplished this dissertation or my many distracting studies of things "not required for the degree" without your understanding, support, tolerance, patience, and, most of all, love. This dissertation is also dedicated to both our families. Without our families' love and support, this dissertation would never have happened. Thank you for making my dreams happen. While this dissertation is the final act of one of my biggest dreams, the degree it represents opens doors for even bigger dreams and goals., I do not think of this as a terminal degree. This degree is a very important step in that it empowers me to address new challenges and obligations. The future looks fun, rewarding, and interesting.

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ABSTRACT

The Internet has become increasingly popular as a vehicle to deliver surveys. An essential objective of research is to collect accurate data and there has been little work to insure that Internet survey systems are employing best practices as defined by academic and professional research to collect data. This paper reviews the current literature relating to best practices in Internet survey design and best practices in software design and development. The paper then documents the development and a deployment of an Open Source and publicly licensed Internet survey system computer aided software engineering survey development system that allows researchers to easily create, deploy, and analyze the results of Internet surveys. The resultant Internet survey design product, the Balch Internet Research and Analysis Tool (<http://birat.net>) is a full-featured Internet survey system which addresses best Internet research practices as defined by academic and professional research. The system was designed and coded by the author and is considered by him to be both innovative and unique to the field. This paper then reviews the system features, describes how the system was deployed, and discusses the strategies used to increase use and adoption of the system.

CHAPTER ONE: INTRODUCTION TO INTERNET SURVEYS

To be professionally useful, research should be based on proven techniques and practices. In planning a research project, key considerations include (1) the need for a significant issue to research, (2) appropriate means or method for collection of data, (3) proper analysis of the data collected, and (4) an accurate description of the results in the light of previous research. While accurate data collection is fundamental to the success of a research project, proper data collection methodology is often given least attention.

There are a number of considerations unique to Internet survey research which must be addressed to insure that the data collected are valid and reliable.

Except by chance, inaccurate data will provide results that have little or no validity or reliability. "Garbage In Garbage Out" (GIGO) is a term commonly used in the computer industry to remind us that, if the data being analyzed are incorrect, the result will likewise be incorrect. While no survey design system can correct for improper sampling or poor item construction, it is essential to have a survey platform that allows for and supports best practices in presentation, sampling, data collection, and analysis -- all as supported by research.

HISTORY

The Internet came into existence in the 1970s as an outgrowth of the Advanced Research Process Agency Network (ARPANET), a Department of Defense (DOD) project (Fitzgerald, 2002; Yoder, 2003). There was little growth in use of the Internet for the first fifteen years. Then, around the mid 1990s Internet usage began to increase dramatically.

According to the Internet World Stats website (2006), Internet users grew from 16 million in 1995 to over a billion users in 2005 and continues to increase as part of this growth. As another example, Figure 1 shows a growth of Internet usage from 0.4% of the world population in 1995 to almost 16% of the world population in 2005. This growth also means increased access to the world population – a further benefit for survey designers.

According to Horrigan (2005), while the percent of Internet users in industrial countries, such as the United States, is growing the rate of increase in usage has declined. This decline may indicate that the market is approaching saturation and therefore has less room to grow. As suggested by Figure 1, however, the rate of world-wide growth is expected to continue in a somewhat linear trend.

Widespread use of surveys in research in the United States began shortly after World War II. Since the 1940s, surveys have become an increasingly popular technique for data collection in many different disciplines including advertising, marketing, social science, and education.

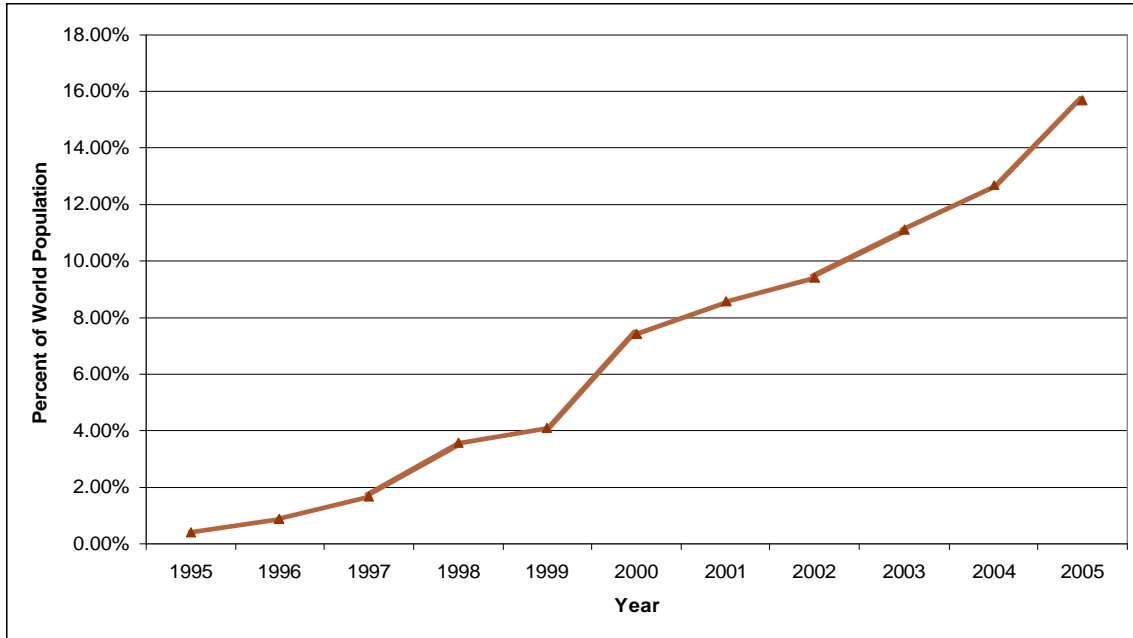


Figure 1: Growth in the percent of the world population using the Internet
 Note: Adapted from Internet World Stats (2006)

According to a number of researchers (Creswell, 2002; Gall, Borg, & Gall, 1996; Hinkle, Wiersma, & Jurs, 2003; Isaac & Michael, 1997) surveys have become one of the most commonly accepted methods for learning the characteristics of a population. The Council of American Survey Research Organizations (2001) reports the first United States Census was conducted in 1790 (14 years after the Revolutionary War) in order to discover the new nation's population characteristics. The U.S. Census has been used to gather various kinds of information about our population ever since.

While the objective of discovering characteristics of selected portions of the population has not changed, survey delivery methods used in census taking, as well as in other kinds of research, have evolved as new technology has become available, the Internet being a prime example (Hudson, Seah, Hite, & Haab, 2004; Strauss, 1996). Telephone surveys became popular after the great majority of households among target populations were equipped with telephones. Part of the attraction of the telephone for

survey work was, and is, the low cost of reaching a random sample of the population as compared to other survey methods, such as face-to-face surveys which require researchers and participants to be in the same physical vicinity and the researcher to personally administer surveys to the selected participants.

In the 1990s, the rising popularity of survey research and the growing number of persons using the Internet led quite naturally to increased use of the Internet to deliver surveys to collect responses (Best & Kreuger, 2004; Fowler, 2002; Schonlau, Fricker Jr., & Elliott, 2002). A number of researchers (Andrews, Nonnecke, & Preece, 2003; Bowers, 1999; Stanton & Gogelberg, 2001; Stewart, 2003; Truell, 2003) concluded that the Internet was an attractive medium for delivering and collecting survey information for reasons that included ease of data collection, ability to reach ever larger samples, and low cost of survey delivery. An indication of the popularity of the Internet for survey research is the 712,000 "hits" produced by a search for the terms "Internet" and "survey," using the Google scholar search engine in April, 2006.

Researchers are, however, past the point of uncritical enthusiasm that characterized much of the early use of the Internet for survey research. While the Internet provides many new advantages for survey research, there are also many unique concerns in Internet survey research that must be addressed to produce quality research results.

UNIQUE CONSIDERATIONS IN INTERNET SURVEYS

The Internet is particularly well suited for some types of survey work and therefore very attractive to many researchers. Watt (1997) concluded "...if you haven't

done Internet survey research -- you will." Given that the Internet is an increasingly valuable option in survey delivery, researchers still need to carefully consider a number of issues for Internet survey design and delivery. Changes in data collection modalities require new and adapted methodologies to insure that new modalities are reliable and have been validated. Just as phone surveys required changes in sampling methods and in validation of results as compared to traditional methods, Internet survey methods must also be developed and then evaluated.

Methodology scholars have identified a number of issues that must be considered if Internet survey research is to be of high quality. These issues include considerations in Internet survey delivery and integrity (Gurney, Chambers, Grant, Shah, & Sullivan, 2004; Schaeffer & Presser, 2003; Simsek & Veiga, 2001; Solomon, 2001; Yeaworth, 2001). Considerations also include issues such as identifying a selection of nonbiased participants, insuring that participants perceive and respond to surveys as expected, assuring non-biased selection of participants, ensuring that participants complete surveys, and reaching a large sample (Couper, Traugott, & Lamias, 2001; Heerwegh, Vanhove, Matthijs, & Loosveldt, 2005; Horrigan, 2005).

Various researchers (Carbonaro, Bainbridge, & Wolodko, 2002; Couper et al., 2001; Eaton, 1997; Gales, 2006; Nielson, 2005a) have noted that many current Internet surveys do not generally follow best survey design principles as established by research. Failure to follow best practices in Internet survey design can result in faulty data collection and therefore lead to erroneous conclusions. A related issue in Internet survey design is the fact that researchers occasionally desire to explore survey design

possibilities unique to Internet delivered surveys. These design possibilities create both new opportunities and new issues.

INTERNET SURVEY COST

The relatively low cost of delivery and data collection through use of Internet surveys is attractive to many researchers (Eaton, 1997; Stanton & Gogelberg, 2001; Strauss, 1996; Yeaworth, 2001), while as shown in Figure 2, Watt (1997) concluded that Internet surveys provide considerable cost savings when compared to other survey methods. The lower overall cost of Internet surveys results from lower cost of delivery, lower cost in personnel time, and lower cost to convert data into a format that statistical programs can analyze. The development costs for all survey types are about the same. Other components of survey research may favor the Internet.

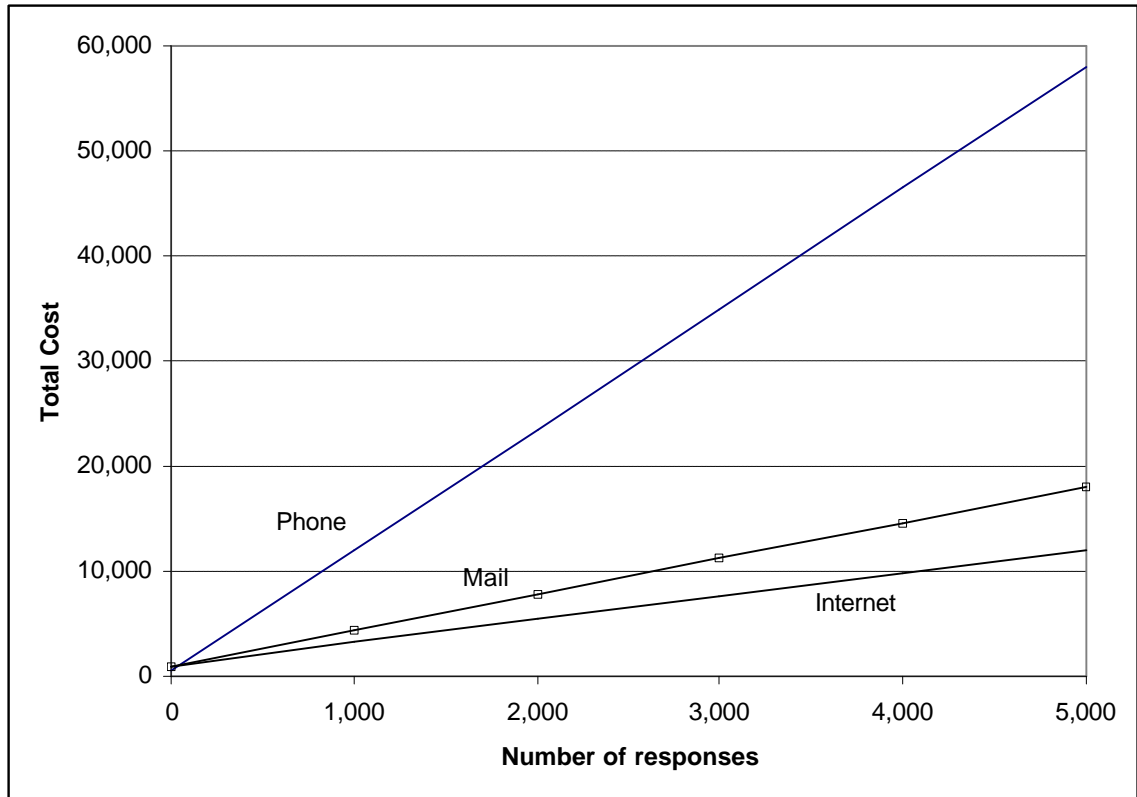


Figure 2: Relative cost of survey methodologies
 Note: Adapted from Watt (1997)

Davis (1997) and Watt (1997) concluded, that, while the expense of Internet survey development is roughly equivalent to that of other survey formats, such as phone and traditional mail, the delivery expense of Internet surveys is far lower. With Internet surveys, personnel and incremental materials costs are drastically reduced or removed altogether. In addition, costs of data entry and validation are avoided with the capability of direct data transfers into databases and/or spreadsheets for further analysis. However, as noted earlier, use of the Internet does not reduce the cost of survey design and may actually increase costs as compared to other survey methods that do not require expensive initial programming or software development in addition to survey content development.

Internet survey development costs can be reduced through use of dedicated survey systems. While versatile and expensive Internet survey design systems do exist (Creative Research Systems, 2006; Survey Said, 2005), there are very few inexpensive or free Internet survey design systems that follow research-based Internet survey design practices and provide the researcher with the possibility of adding survey features that explore what survey systems may accomplish. Ironically, high cost is not an indication of quality in that a survey system follows best practices in survey design and delivery as defined by academic research.

INTERNET SURVEY TYPES

In addition to cost, there are other issues associated with the selection of Internet survey systems. Internet survey systems, academic understanding of Internet survey methodology, and the options available for Internet surveys are constantly changing.

According to a number of researchers, the three primary ways to deliver surveys and collect results from participants via the Internet are Email, customized applications, and web pages (Andrews, Nonnecke, & Preece, 2003; Davis, 1997; Eaton, 1997; Hudson et al., 2004; Solomon, 2001). These methods should be considered in the context of the information they can provide and how the survey is delivered.

Some of the relevant literature (Couper et al., 2001; Stanton & Gogelberg, 2001; Truell, 2003) suggests that the major considerations in comparing Internet survey methods are:

- Adherence to known best practices in survey design,

- Ease of creation,
- Data collection options,
- Ease of delivery,
- Acceptability to participants,
- Ease of data collection.

As discussed below, the optimal method for Internet survey delivery is typically a web page, but Email and customized applications are worthy of discussion as they are also occasionally used and can be effective. These delivery methods are occasionally combined. In particular, Email is often used to distribute an invitation which provides a link to a web based survey.

EMAIL

Email offers the simplest method for conducting Internet surveys (Simsek & Veiga, 2001; Venier, 1999). With Email, the survey designer needs only to type the questions/items and send a message. Unfortunately the ease of creating Email for surveys is offset by a variety of usability issues including formatting, delivery success, and interpreting responses. A further concern in Email survey selection is that it can be difficult for the researcher to discover an appropriate population of potential Email recipients.

Email Background

To appreciate the limits of Email's usefulness as an Internet survey option it is helpful to understand how Email is processed. Both an Email server and client software are essential to the creation, distribution, and reception of Email. *Email server software* receives, stores, and distributes Email messages. In addition to the fundamental functions of Email reception and distribution, Email server software often examines Email for spam, viruses, and malignant software attachments.

Unfortunately, both Email senders and recipients often have little or no influence on the Email server administrator's definition of spam and malignant software attachments. It is often the case that the sender and the recipient are not aware of their respective Email servers' policies. Automatic changes to and removal of messages often occurs in the background without the awareness of either the sender or recipient. Thus, Email filtering creates the possibility that Email will not be received, with a resultant decrease in response percentages for reasons that have nothing to do with the survey respondents' decisions to participate.

Survey respondents use *Email client software* to view, edit, and respond to Email. Email clients may be installed locally on the users' systems with applications such as Microsoft Outlook (Microsoft, 2006c) and Eudora (Qualcomm Inc., 2006) or accessed through popular Internet browsers such as Internet Explorer (Microsoft, 2006a) and Firefox (Mozilla Foundation, 2006), which in turn connect to remote or Internet/Web based Email client/server systems such as Yahoo (Yahoo, 2006) and Gmail (Google, 2006b) that allow users to view their Email though a web browser interface. Local Email

clients such as Microsoft Outlook and Eudora typically connect to a remote Email server, download new messages, and then store the messages on the user's hard drive for local reading and response.

Email Survey Concerns

The greatest concern in delivery of Email surveys is consistent presentation. Despite sharing the Internet as a common transportation medium, the variety of Email clients and servers in use today create conditions in which there are no reliable ways to anticipate how Email is edited, processed, received, or viewed. Since all participants may not have the same survey experience, this lack of consistency creates unique challenges for researchers who wish to collect data via Email responses.

Email looks different when using different Email software clients and there is no way for the Email sender (researcher) to know what type of Email client participants will use to read the Email (Koyanl, Balkey, & Nall, 2003; McGraw, Tew, & Williams, 2000). This is important because different Email clients display text in radically different ways (Eaton, 1997; Gurney et al., 2004; Leung & Kember, 2005). Some Email clients will not present images in Email messages at all, while others automatically convert images into attachments that require additional effort to view. Also, the attachments then will not be associated with the intended location in the text. In addition, many potential participants lack the knowledge and/or motivation to view images available only as attachments.

Some Email servers such as those provided by the popular Lotus systems routinely remove images and/or remove formatting by converting Email into plain text that has no formatting, such as **bold** or *italic*. As noted in Figure 3, these changes created

by Email servers and/or clients result in delivery of a message that is perceived somewhat differently by various participants. Another consideration with all Email clients is that users and/or their technical support staff can and often do modify Email viewing settings.

Formatted Email Questions in bold must be answered. Q1) What is your favorite color? Q2) How many years have you attended school?
Unformatted Email Questions in bold must be answered. Q1) What is your favorite color? Q2) How many years have you attended school?

Figure 3: Changes in formatting affect the way participants perceive and respond to Email

As compared to local Email clients, Internet based Email clients such as Yahoo (Yahoo, 2006) and Google Email (Google, 2006b) tend to offer more consistent user experiences (Nielsen, 2004, U.S. Department of Health and Human Services, 2005). However, as discussed later in the context of web based surveys, even web pages do not offer consistent participant experience because Internet pages look different in different browsers (Koyanl et al., 2003).

Another concern when using Email is the possibility that messages will not be received at all. Regardless of the receivers' method of Email reception, there is no way to be sure that a message is received by the potential respondent to a survey. The two primary reasons for that are (1) recipients not reading all their Email and (2) spam filters. Many persons find Email, especially considerable numbers of Email messages, overwhelming, and they respond by ignoring most or all their messages. Other Email users scan their incoming messages and respond only to trusted senders. In such

situations, response rates will be increased if the sender is one that the recipient recognizes and considers trusted because they have provided useful information or are important to the sender (Eaton, 1997; Tse, 1998). Thus, researchers may wish to recruit the assistance of trusted senders to send their messages and thus increase response rates. "Trusted senders" are often authority figures or associations.

Spam filters are another threat to reliable Email delivery. A message identified as spam is unlikely to be read. The rules for identification of an Email message as spam are complicated and constantly changing. Further, messages identified as spam are automatically deleted in a number of places in the Email sending and receiving process. Potential participants are not likely to have complete control over which messages they actually receive. Some messages may be deleted before they can read. In fact, potential participants are often unaware that many messages addressed to them are deleted both before and after they reach their inbox.

Mass emailing, such as often used by Internet survey research systems, may unintentionally cause spam filters to delete many of the messages sent to potential participants. Email survey delivery often requires that large numbers of Email messages be delivered over a short period of time. Some spam filter algorithms look specifically for large numbers of similar Email messages delivered over a short period of time and delete them. Thus, many Email messages will not be received by the intended recipients (McConkey, Stevens, & Loudon, 2003; Royal, 2005).

There are some ways to reduce automatic spam filtering for focused bulk Email. These methods include introducing a delay between sending of each message so that

messages will not arrive in bulk, slight changes to each message, and sending from a trusted sender. In this context, trusted senders would be from an Email address that the Email spam filter considers an always accepted source of incoming Email.

Another concern with the use of Email for collecting survey data is that Email replies do not have consistent response formats. As an example, responses to the question "How many years have you attended school?" shown in Figure 4, survey participants may respond to Email surveys in very different ways (Hart, 2004). Some of these response patterns are difficult to code or interpret. For a variety of reasons, including unexpected responses, and time needed to hunt for participant responses. For example, open text responses to the question of number of years of school attendance might legitimately include "All the way through my Masters," "Until I was thirty," or "All my life." The researcher interested in knowing the actual number of years would find it difficult or impossible to determine years of school attendance, when the participant started schooling, or if the participant attended school full-time. Open text responses can also create coding problems. For example, when using an open response format, if asked for their favorite color, participants might respond with shades of colors instead of primary colors desired by the researcher. Lime, Jade, and Avocado are all shades of green that might fall outside a researcher's coding scheme.

<p>Original Message Q1) What is your favorite color? Q2) How many years have you attended school?</p>
<p>Participant response at top <i>Lime</i> Seventeen Q1) What is your favorite color? Q2) How many years have you attended school?</p>
<p>Participant response in-text Q1) What is your favorite color? <i>Jade</i> Q2) How many years have you attended school? All the way through my Masters.</p>
<p>Participant response at bottom Q1) What is your favorite color? Q2) How many years have you attended school? Green <i>Until I was thirty</i></p>
<p>Participant response without sent content Avocado, all my life</p>

Figure 4: Different participant response patterns when responding to Email
Note: Emphasis added to show participant response areas

Some of these response issues may be addressed with better instructions to the participant; but longer instructions, even if used for the sake of clarity, have been found to reduce response rates (Baron, Manners, Sinickas, Jones, & Hogben, 2005). Furthermore, the instructions may not be followed (Bowers, 1999; Dillman, Tortora, Conradt, & Bowker, 1998; Eaton, 1997). Thus, the inability to automate Email data collection counters one of the greatest strengths of the Internet: the ability to collect data easily.

USER RUN SURVEY PROGRAMS

Some survey methods require respondents to download and run a specialized program in order to answer the survey. User run survey programs are programs that must be installed and run on the computer the participant is using. User run survey programs provide the greatest control over the participant experience as compared to other computer based, self-administered survey delivery systems (Bowers, 1999). In particular, they can provide precise recording of the timing of user responses, strong control of item presentation, and very strong security.

User run survey programs are included in this review because they often include the capability of delivering participant responses over the Internet. While survey applications have unique strengths and offer the advantages noted above, there are a number of reasons why survey applications are not the preferred method for Internet surveys.

Particularly for self-administrated surveys, the greater control provided by applications is offset by unique issues including that of participation. Unless survey participants are highly motivated to participate in a survey and are able to install an appropriate application, dedicated survey applications are not an effective way to collect information on the Internet (Bowers, 1999; Dillman, Tortora, & Bowker, 1999; Gurney et al., 2004; Leung & Kember, 2005; Solomon, 2001). Eaton (1997) noted that there are a variety of reasons why few users are willing to download, install, or run an application from a relatively unknown source. LaPrairie (2006) suggested that reasons users hesitate

to download applications include fear of malignant applications, lack of ability to install applications, lack of disk space, and/or restricted access to installed applications.

The nature of survey application distribution and development creates added levels of complexity for researchers and participants. Unfortunately, because local applications cannot run properly, or at all, on all possible computer configurations, different versions of the survey must be developed for all anticipated survey environments. Development of survey applications for all possible environments is beyond the resources of most researchers. For instance, a program developed to run on a Macintosh computer will not run on a Windows system without recompiling. In some cases the code used to create the application cannot be compiled for other environments. Thus programs often require a specific version or later of an operating system to run properly. Many researchers would not wish to limit their access to participants by the type of operating systems that participants use. Examples of downloadable survey applications include *The Survey Application* (Sybase, 2003) and *Zoomerang* (Zoomerang, 2006).

Brooks (1982) defines computer applications as a set of rules that make a computer run and shows that difficulty and cost of development increase as complexity increases. Thus, a substantial portion of the added application development cost results from the expense of testing exponentially increasing numbers of interactions and designing for different operating systems.

The addition of multimedia also adds to the complexity of application development. For example, a survey that asked respondents to answer questions about a

short video clip or a piece of music would be experienced differently on computer systems with no speaker system, or those with two, or five speaker systems. Quality of the speakers would also affect the experience as would the resolution and size of video display system.

It is worth noting that dedicated survey and testing applications are often used in restricted environments such as testing centers (Educational Testing Service, 2006; Kaplan, 2006). In these controlled environments, dedicated testing applications are superior and desirable because the researcher can be sure that applications are installed on a platform and in an environment where they will work as expected. The use of dedicated applications also provides greater control of proprietary material.

WEB PAGE SURVEY SYSTEMS

Creating a web page survey is not simply a matter of transcribing a paper survey into a web-based format. As discussed below, there are many special considerations in web page design.

According to Nielson (2004b) and Eaton (1997) web technologies address many of the problems inherent in presentation and data retrieval across a variety of participant computing operating environments. Participants navigate to the survey web site using a Universal Resource Link (URL) and interact with the centrally hosted content using browser software such as Internet Explorer (Microsoft, 2006b) or FireFox (Mozilla, 2006). Unfortunately, web browsers present Internet content in slightly different ways.

As there are a variety of web browsers for all major operating systems, web content is both universally accessible and experienced with slight differences by most participants.

HyperText Markup Language Background

Hypertext Markup Language (HTML) was created partially in response to the wide variety of incompatible protocols for document storage and presentation that existed when the Internet was first developed (Fitzgerald, 2002; Johnson, 2003; Yoder, 2003). Web page surveys are typically developed in HTML and associated technologies that are designed to be universally accessible through Internet browsers.

The HTML protocol was designed to provide universally similar presentation of content with platform and program independence through a set of standards and specifications maintained by an independent body (World Wide Web Consortium, 2006). These standards are intended to allow the creation of documents that can be displayed in a predictable manner on a wide variety of computer systems. Such universal presentation of content was and is needed. In the early 1990s, when the Internet was becoming popular, there was a serious access problem in that not all content was universally readable. For example, word processed documents created in a given application, such as WordStar and DisplayWrite, were not viewable or editable in other word processing applications (Wikipedia, 2006). Often, document files created by a given application were not even viewable in different versions of the same application. Even greater compatibility problems existed with the exchange of data between different operating systems.

While it lacks the ability to contain formatted content, plain text is a universal standard for data exchange. That can contain information about intended formatting. Figure 5 illustrates how the HyperText Markup Language (HTML) uses rigidly specified tags to define formatting. This formatting method creates content intended to be universally readable regardless of browser type, operating system, or computer hardware. HTML is readily interpreted by web browsers or clients such as Microsoft Internet Explorer (Microsoft, 2006a) and Mozilla FireFox (Mozilla Foundation, 2006). Such web browsers are available for all popular computer operating systems. For example, with HTML, a bold word would be placed between the tags `bold` or `bold`.

Thus the text file format that HTML uses is accepted by browsers on all operating systems. Unlike the proprietary methods used by commercial word processing applications, HTML tagging is very portable because it follows a universal and published standard. Because they are text based, HTML documents can be created and/or modified with numerous applications that are available in all popular operating systems.

The universal access provided by HTML occurs at the cost of some capability and speed. One of the reasons that operating systems and applications use protocols other than text for storing information is that other protocols are more efficient and/or provide additional capabilities not defined in the HTML specifications. Given the capacity and speed of modern computers, a moderate reduction in efficiency is not a concern, however. Unfortunately, control over appearance remains an issue, inasmuch as, despite its design goals, HTML does not provide universally similar presentation on all computers.

HTML Code	Result
<pre>Bold
 <I>Italic</I>
 <I>Bold Italic</I>
</pre>	<p>Bold Italic Bold Italic</p>
<pre>Font size 1
 Font size 2
 Font size 3 (default)
 Font size 4
 Font size 5
 Font size 6
</pre>	<p>Font size 1 Font size 2 Font size 3 (default) Font size 4 Font size 5 Font size 6</p>
<pre><P>Paragraph Space</P> New Line
 Text <HR> Text</pre>	<p>Paragraph Space New Line Text <hr/>Text</p>

Figure 5: HTML Code Examples

Note: HTML examples adapted from <http://yacs.org/yacs/demo/htmlquickref.html> (Balch, 1998)

Even though the HTML document specification is rigidly defined by an internationally accepted agency (World Wide Web Consortium, 2006), the specifications are only partially adopted by popular web browsers like Internet Explorer (Microsoft, 2006b) and Firefox (Mozilla, 2006). For example, different browsers interpret some formatting tags in slightly different ways; they may not provide support for some tags, and they may include the provision for proprietary tags of their own. The result is that Internet survey designers cannot be sure how their surveys will appear on participants' computers. Different presentations (appearance) of a survey page may result in different responses and thus introduce a source for possible error through a lack of a commonality of experience.

There are also other considerations in web page perception. While HTML documents are basically generic text content with formatting tags, as shown in Figure 5, HTML documents exist in a complicated environment that includes much more than text and HTML codes. Considerations special to the Internet and browser environment include association with other file types such as Cascading Style Sheets (CSS), Javascript, and associations with graphics or multimedia files in popular formats such as MPEG, JPG, and GIF to display multimedia content.

Each of these presentation technologies brings more capability to programs using web pages for survey work. CSS gives far greater control of formatting than the HTML specification. Javascript allows for automation and interaction with HTML objects beyond the HTML specification. Multimedia allows the inclusion of images and even movies. Like HTML, CSS and Javascript are interpreted differently by popular browsers, so great care must be taken to insure that pages will appear the same to all participants and thus that interaction will be the same across various Internet browsers. Some multimedia content, such as Flash files (Macromedia Inc., 2006), require participants to install additional software before the content can be viewed. It is not reasonable for researchers to assume that participants will take the extra effort required to install the additional software needed to perceive surveys as intended by the researcher (Barry, 2001; Deal, 2003; Hart, 2004; Reips, 2002b). That use includes material in proprietary formats such as Flash or RealAudio.

Internet Survey Coding/Creation/Management

Internet survey creation requires a synthesis of many professional skills. These skills include the knowledge needed for appropriate item development, as well as technical skills in a number of areas. Fortunately, the researcher does not need to have knowledge of web page programming and fundamental Internet functions anymore than they need to know how paper is made or how a photocopier works to develop paper based surveys or how to create their own word processing software.

Researchers using the Internet should, nevertheless, have some knowledge of the unique characteristics of this medium. At a minimum, researchers should have a basic understanding of such things as bandwidth, format, and accessible population as appropriate to their survey scope. With this basic knowledge researchers will be able to assist Internet survey designers in the creation of surveys with optimal distribution and participant experience.

Web Page Creation

There are a number of different ways to create a web page. While experienced HTML programmers are comfortable creating documents using often cryptic and cumbersome HTML tags and programming, many designers create very readable static HTML documents with the "SaveAs HTML" or "Publish to the Web" options available in most modern computer applications including popular word processors. The SaveAs option is not advocated here because this option often creates pages that are not compatible with all browsers and SaveAs pages are excessively large as compared to pages created with other methods. In addition, SaveAs options are often not capable of

creating even primitive surveys in that they do not provide for the ability to create forms which might in turn be used to collect the data. In addition, SaveAs type web creation does not create the backend logic required to process submitted forms or surveys.

General purpose web page development tools are also not suitable for creating and distributing information and questions, or for collecting data when using online surveys. Web page creation programs such as FrontPage (Microsoft, 2003) and Dreamweaver (Macromedia Inc., 2006) are dedicated to web page design and web site creation through *What You See Is What You Get* (WYSIWYG) web page design interfaces. While these applications are capable of creating basic surveys, such surveys are not suited to widespread distribution and the resultant data are usually not easily accessible or collected.

The ideal methodology for most researchers will be the use of a system dedicated to the creation of Internet surveys. Such Internet survey design systems will be extensively discussed in later in this document.

The problems for survey designers get worse when dynamic content is used. There is a growing trend to create Internet content on demand dynamically. Historically, Internet documents were statically created, stored, and delivered without any changes to the content. Many Internet survey design systems create dynamic documents where the content is created as needed in response to current environmental conditions. Dynamic documents often have file extensions such ASP (Active Server Page), CFM (Cold Fusion), PHP (Hypertext Preprocessor), and CGI (Common Gateway Interface) that indicate the program used to create them. Dynamic content is of importance to the

researcher because it allows for documents to change from participant to participant, and this in turn creates the possibility of a loss of commonality of experience among the survey participants (Christian & Dillman, 2004; Eaton, 1997; Josephson & Holmes, 2002; Redline, Dillman, Carley-Baxtor, & Creecy, 2005). As noted earlier, differences in participant perception of an instrument may create discrepancies in the participants' responses since they are not all experiencing the instrument in the same way. It should be noted that dynamic content does not have to change from participant to participant and many survey design systems create content that does not change from participant to participant.

Internet Survey Costs

Internet surveys have some inherently different costs associated with their creation and distribution as compared to other media (Davis, 1997; Healey, Macpherson, & Kuijten, 2005; Leung & Kember, 2005). Development cost is of particular concern. While many researchers are familiar with the design requirements for paper survey items and instruments, few researchers have the expertise to create the code required to deliver, present, and receive data from web surveys. Even fewer researchers are familiar with the special considerations that should be taken into account with Internet survey design (Andrews, Nonnecke & Preece, 2003; Dillman et al., 1998; Hart, 2004; Redline et al., 2005; Reips, 2002b).

The potentially higher cost of Internet survey design is balanced by lower cost of delivery and data collection. The cost of transcribing the data collected using surveys based on other media can be substantial, making cost of delivery for additional traditional

surveys linear and significant. On the other hand, there is little or no incremental cost to send additional Internet surveys to an enlarged list. A properly designed Internet survey system will collect any number of responses in machine readable format with essentially no added cost. The cost of Internet survey programming may be reduced through use of purchased survey design systems or through the use of resource centers, available at some universities that provide free services.

HTML Survey Distribution

There are a number of ways to distribute information and questions in an Internet based survey and then collect results. These methods include sending links by Email, print and web advertisements, and web pages. These methods of survey distribution are often combined.

Problems with Online Survey Systems

A researcher's criteria in evaluating survey authoring system features should include (a) number of available item types, (b) ability to export data, (b) ability to scale to research needs, and (d) compliance with best practices in web survey presentation. Particular emphasis should be placed on the system's ability to present survey content in a format consistent with best Internet survey practices. For example, many "free" Web page survey systems place advertisements and/or other distracting graphics in the instrument they create and host. Free web systems also tend to have severe limitations in terms of the size of the survey they can accommodate and in the number of respondents allowed.

Consistency of experience is of concern to the researcher as advertising content is not the same for all participants. For example, one participant might see an advertisement for clothing while another might see one for books. The direct or subliminal association with this advertising content can change participant answers to questions (Dillman et al., 1998; Redline et al., 2005; Smyth, Dillman, Christian, & Stern, 2004).

The presence of ads is only one source of inconstant presentation of surveys. Nielsen (2004b) noted that the different appearance of web pages results from a number of causes but, changes in appearance are primarily a result of browsers accepting proprietary tags while ignoring or not properly interpreting some official HTML tags. These perceptual changes occur despite rigorous official HTML specifications (World Wide Web Consortium, 2006).

Other changes result from areas that may be under participant control. For instance participants can change the size of displayed type and browser window size. As text and other objects such as images literally flow to fit the size of the window, the resulting experience cannot be fully predicted by the web designer. Best practice is to design for the most restrictive environment on the web page. For example, the designer should not assume that the participant's computer screen will exceed commonly used resolutions or that the participant will enjoy a high speed Internet connection.

Insuring that Internet survey design follows best presentation practices is discussed in detail in later chapters. It is mentioned here as another concern for the Internet researcher in the selection of an Internet survey system. For example, online survey systems are often designed with "glitzy" features, such as animated graphics and

complex text formatting. These features can distract survey participants from the essential content of the survey (Koyanl et al., 2003; Nielsen, 2003a) and such distractions can change user responses, thus bringing the validity and reliability of the collected information into question.

Internet survey designers should be careful when considering use of the many "free" Internet survey development systems that are now available. These systems are often intentionally scaled down versions of more robust commercial Internet survey systems (Simsek & Veiga, 2001; Solomon, 2001; Truell, 2003; Yeaworth, 2001; Zoomerang, 2006). Internet survey system developers use these scaled down versions as teasers or loss leaders to encourage researchers to purchase a more full-featured product. Scaled down versions of Internet surveys typically limit researchers as to the number of allowed items and/or the number of allowed participants. According to Andrews and Whittaker (2006), such limitations may cripple research at inopportune moments such as when a posted survey gets a surge in responses. Such a surge could result in a loss of important data because of the system's limits.

INTERNET SURVEY TYPE SUMMARY

As shown in Table 1, there are a number of considerations that will affect a researcher's choice among the three primary options available for delivery of self-administered Internet surveys. Each system has strengths and weaknesses and no system is perfect. Internet survey delivery is clearly the superior method when ease of creation,

data collection options, ease of delivery, participant acceptability, ease of data collection, and required participant knowledge are considered.

Table 1: Review of considerations in the comparison of Internet Survey Delivery Methods by Delivery Type

Consideration \ Type	Ease of Creation	Data Collection Options	Ease of Delivery	Participant Acceptability	Ease of Data Collection	Required Participant Knowledge
Email	Easy	Minimal	Very Easy	Very acceptable	Difficult	Little
User downloaded applications	Difficult	Open	Can be difficult to install	Low	Low	High
Internet survey delivery	Moderate	Large	Very	High	Can be high	Low

CHAPTER TWO: INTERNET SURVEY LITERATURE

REVIEW

According to a number of researchers, the Internet provides for constantly expanding, fluid, interactive, and effective survey design possibilities that expand and improve upon traditional survey methods such as telephone and paper surveys (Couper, Tourangeau, Conrad, & Crawford, 2004; Davis, 1997; Dillman et al., 1998; Eaton, 1997). Internet survey design considerations that deserve special attention include (a) the selection of technology, (b) coverage of the target population, (c) participation, (d) distribution speed, (e) cost, (f) informed consent, (g) failure to connect, and (h) total cost of survey. In order to obtain accurate response and minimize participant confusion and frustration, it is important for the researcher to follow best practices in Internet survey design as defined by research. Table 2 provides a synopsis of important considerations in Internet survey design.

Internet survey design research suggests that a simple clean design with clear grouping and sub grouping of content is the most effective way to deliver an Internet based instrument (Andrews, Nonnecke, & Preece, 2003; Couper et al., 2004). Various researchers also suggest that any content that does not focus on the intent of the survey distracts the participant from the intent and purpose of the survey and thus diminishes the quality of the results (Koyanl et al., 2003; Nielsen, 2001; VanDuyne, Landay, & Hong, 2002).

Table 2: Various Factors in Internet Survey Design

Consideration	Internet Based Surveys
Coverage	Varies from low to high depending on availability of audience contact information and audience access to the Internet.
Participation percentage	Low, usually around 50%.
Distribution Speed	Very high.
Return Cost to user	Minimal or no cost/effort (some users pay by units of connection time/data used).
Informed consent	Cannot be collected in traditional ways.
Incentive availability	Difficult to use with anonymous surveys but otherwise similar to other modalities.
Failure to connect with intended participant	More frequent than with other modalities.
Labor needed to distribute	Low.
Labor needed to create from a defined list of times	High, but labor can be reduced through use of various survey creation tools.
Expertise to construct items	High. Internet based surveys require tradition design skills and understanding of unique Internet survey issues.
Incremental distribution cost.	Extremely minimal unless incentives are used or there is a cost to discover participants.

CONSIDERATIONS IN WEB SURVEY DESIGN TECHNOLOGY

The Internet provides ever increasing and exciting design options and technology for survey research. Some web page designers are quick to adopt new capabilities in the hope of improving the overall survey experience. While the constantly evolving improvements made possible by new web design technology are seductive, the use of the most recent and/or less than mainstream technology is not appropriate for survey research.

Unfortunately, early adopter designers (Rogers, 2003) often do not take into consideration that, unless the target population can be defined to include only those persons who use a computer with the latest updates and a specific web browser, it is likely that many participants receiving a survey that contains cutting edge web design

technology will not be able to interact properly with it (Koyanl et al., 2003; U.S. Department of Health and Human Services, 2005; VanDuyne et al., 2002). Results are compromised when all participants cannot interact with a survey as expected and when there is not a commonality of experience. There are a number of other factors that change the way participants interact with web based surveys.

Differences in the way that web browsers respond to common commands and code make it impossible to create a universal web experience. There are constant changes and expansions to fundamental web browser technologies including HyperText Markup Language (HTML), Cascading Style Sheets (CSS), and Javascript specifications. Developers of various browsers often decline to use some of these new specifications and then add their own proprietary programming technology.

Third party software additions that provide some added function are another problem. A number of researchers agree that web page content that requires third party software additions to browsers does not represent the best practice for Internet survey design because participants may not have the software necessary to view the third party content (Koyanl et al., 2003; Nielsen, 2000; Nielsen, 2003c; Nielsen, 2004b). For instance, many design options such as those provided by Flash (Adobe, 2006), Acrobat (Adobe, 2006), and Real Player (Real, 2006) require additional software and/or browser plug-ins before web content associated with them can be viewed. Participants who do not have the appropriate additions required to view special content may not make the required changes and uploads to view the content. Potential responses from such participants will be lost.

Another issue is the ability of participants to use HTML objects in ways not anticipated by the researcher. It is best practice to use standard and expected web interfaces in order to avoid participant confusion. Participants enter web sites with certain expectations and with a certain level of understanding of how the Internet works and how they expect to interact with the web site (Brook, 1996; Nielsen, 2003a; Nielsen, 2003b; Nielsen, 2004b; Nielsen, 2004c; U.S. Department of Health and Human Services, 2005; VanDuyne et al., 2002). While participant expectations for web page interactions may be conscious or unconscious, they are learned and are based on experience. For instance, as shown in Figure 6, a button object should look like a button and the designer should not use an image that might not be identified by participants as a button.

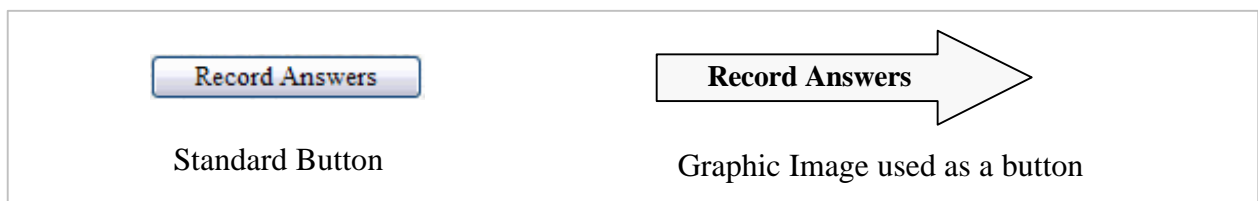


Figure 6: Standard buttons are better than graphic images for navigation because buttons are the expected interactive object for the common graphic user interface
Note: Standard button image from the BIRAT (Balch, 2006b) online statistical system.

Standard web design is particularly important if the participant population includes people with computer accessibility limitations (Barry, 2001; Center for Information Technology Accommodation, 2002) as the technology these participants use to perceive web pages is not likely to include the ability to decipher non-standard interfaces and/or complex coding.

Not all "new" Internet web design options should be discarded, however. Researchers should be familiar with innovations as they become commonly accepted and should adopt those that improve the research process. For example, with Javascript, it is

possible to include interactive logic to insure that responses are complete and within expected ranges, as when participants are forced to select only one option as compared to a paper based survey that might allow inappropriate selection of multiple items or no item at all.

A brief discussion of Computer Aided Software Engineering (CASE) tools is appropriate in the context of Internet survey design. Yager (2004) suggests that modern CASE tools such as Visual Studio allow the rapid development of prototype applications that are often acceptable for deployment.

In my opinion, the biggest problem with general purpose CASE tools is the fact that developers of CASE software cannot anticipate all the needs of researchers. On the other hand, CASE tools with a focus on survey development are capable of creating surveys that meet all researcher needs. More robust languages and databases require much more work to achieve a given result, but they provide almost infinite possibilities in the results they achieve. The investment in extra effort is more than returned by the opportunity to achieve exactly the desired results. In an ideal world, researchers would employ a sophisticated and open source CASE tool that also allows for the modification and expansion of the development tool.

The tendency for CASE tools to create slightly bulkier and somewhat less efficient products as compared to products that are created entirely from scratch may not be a concern. Yager (2004) notes that the power of modern computers makes it more reasonable to deploy less efficient applications such as created by CASE tools because the greater capacity of modern computer systems makes it possible to run less efficient

applications with acceptable results. Further, the products created by CASE tools are less likely to have design errors.

In summary, all web based survey design concerns have the added factor of a relative lack of understanding on the part of survey designers of how participants interact with Internet surveys. Improvements in web page design may provide the possibility for improved data collection. However, these new options need to be tested in a wide variety of environments before they are accepted as appropriate research methodology. Thus, unless the researcher's goal is to explore the worth of a new item type, layout, or other web page innovation, conservative web page design using methods supported by current research is suggested.

NAVIGATION CONSIDERATIONS

The participant's navigation and perception experience has a considerable effect on how participants respond to a survey. For example, what is noticed and not noticed on the instrument can make a huge difference in the quality of the information collected with a survey. It is unreasonable for researchers to expect participants to spend significant effort on understanding and exploring survey instruments and instructions for their use. The burden is on the researcher to make navigation easy and item intent clear.

Navigation is not a simple matter of expecting the participant to review and respond to a series of items. Navigation considerations should include participants' initial perceptions, flow of content, item grouping, instructions, instruction placement, and

selection of appropriate item types. The researcher's first concerns should be consistent, ergonomic design of their instrument based on research as discussed below.

WEB PAGE PERCEPTION

A participant's initial perception or preattentive processing of the web instrument is important because it influences much of the user's later interaction with the web survey content. Somewhat like the old adage that first impressions are the most important, what participants first see of a web page strongly influences the rest of their experience with the survey.

Initial perception of web based surveys is different from the participants perception of paper based surveys where the entire page content is exposed at once. In an Internet survey it is difficult to predict what content the participants' will first experience as Internet page organization tends to be fluid and contain unique features like animation which may be distracting from other content or take longer to load than other content. Initial perception theories tend to cluster around either perception of object types such as images and scanning paths that reflect the path and duration that participants' eyes follow on pages. In addition, unlike paper, computers tend to be owned by the participant and computers provide a vertical screen orientation. Both ownership and orientation may have profound effects on participant perception.

According to Koshman (2005), participants perceive some parts of a website before others through a process called preattentive processing. Preattentive processing occurs quickly -- often in less than a quarter second. For example, for a given location on

the page, animation tends to draw the participants' attention before static images, which are in turn viewed before text. Josephson and Holmes (2002) noted that what is observed first on web pages depends on a variety of factors, including page content loading order and type of content. When there is a delay of more than a quarter second between the loading of different content areas such as text and images, content that is loaded first is observed first despite how the content might otherwise be observed with a completely loaded page.

Researchers have noted that preattentive processing patterns are evolving as sophisticated users alter their scanning patterns to avoid advertisements that are now typically placed in areas that research once found were getting first viewing. Even animated images in locations once thought to be ideal are now often ignored by persons who have been trained to avoid content that is not of interest or content that does not generally contribute to the content they wish to explore (Barry, 2001; Gales, 2006; Josephson & Holmes, 2002). The top and right portions of the screen are now the most ignored web page areas. This should be of particular interest to researchers who use web based surveys as they should avoid placing graphics and instructions in those areas.

Gorn, Chattopadhyay, Sengupta, and Tripathi (2004) add that shapes and colors have a significant effect on preattentive processing with color having the most significant effect. As shown in Figure 7, in a grid of shapes an object in a different color will draw attention first while a different shape is perceived second. Researchers should take this perceptual tendency into account when designing instruments. Items noticed first may be responded to first while other items may be ignored.

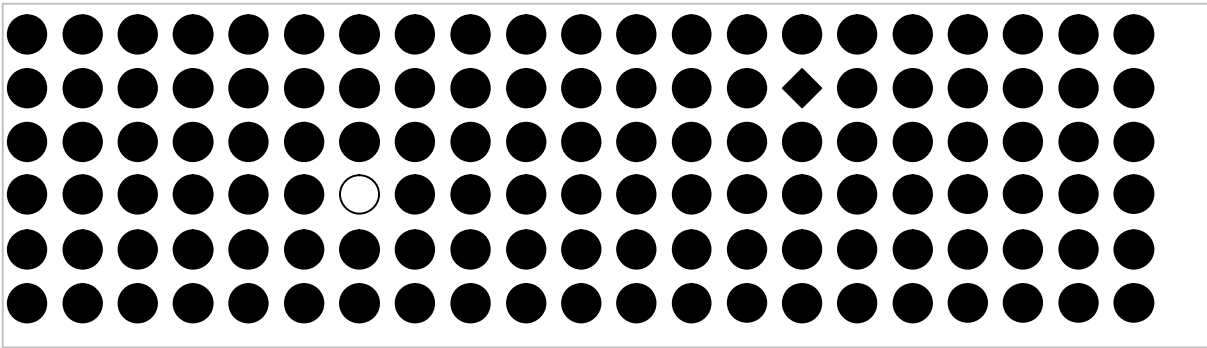


Figure 7: Different colors are noticed before different shapes in a group of objects
Note: There are both a different color and a different shape in the grid above.

Research has found that web pages tend to be viewed in a variety of different patterns or Scanpaths. Healey, Macpherson, and Kuijten (2005) found that participants tend to start reading at the upper left quadrant of printed pages while they tend to ignore instructions and response options on the right side or margin of printed pages. Web page participants tend to pay increased attention to content at the top or the bottom of pages. I find the bias towards the bottom of web pages paradoxical because the fluid nature of web page content makes it difficult for the researcher and/or web designer to control what content will appear at the bottom of web pages. (See Problems with online survey systems on page 26 for further discussion.)

There are a number of factors that can affect and therefore change how participants scan pages. In a review of Scanpath theory, Josephson and Holmes (2002) found that, while there are some preferred web paths patterns, the importance of these paths may be superseded by features such as images and memory effects related to expected page layout.

Josephson and Holmes (2002) also found that there is not a consistent perception path for web pages across different users or for individual users over time. Their findings suggest that changes in initial processing and therefore perception of web pages are due

to a number of factors. For example, web page viewers may read instructions or navigational information the first few times they visit a page but ignore such information on subsequent visits. This finding is particularly important to researchers designing web surveys as it suggests that participants may ignore instructions that appear similar for numerous groupings of items or instructions associated with repetitive display of similar pages. Thus, when instructions are repeated, researchers should use strong visual cues to indicate when and where instructions change.

Nielsen's (2006) reports a different Scanpath where users tend to read web pages in an F-shaped pattern, with two horizontal stripes followed by a vertical stripe. This is fairly consistent with examining the title of the page then looking for subtitles and reading content associated with the titles and menu(s). The findings also suggest that users often do not read text thoroughly. This research suggests that the first line of paragraphs should contain the most important information, and that subheadings are not only helpful but sometimes critical to thorough user navigation. Nielsen also noted that scanning patterns change with content. For example, users tend to have a different scan pattern when they are looking at a list of prices as opposed to a page of text.

GROUPING CONSIDERATIONS

The concept of grouping suggests that a variety of influences and cues cause participants to perceive Internet web pages as both a whole and interconnected groups and subgroups (Eaton, 1997; Geoffrey, Shaun, & Steven, 2003; Smyth et al., 2004). Proper use of perceptual grouping cues helps researchers to get participants to focus on

items and their associated instructions with the result of a clearer understanding and thus improved responses. Unintentional grouping effects can cause participant error and care should be taken to avoid them.

Internet surveys present unique challenges in survey design for grouping of items. For example it is possible to use objects such as drop down menus, which because they are animated and require user interaction to be perceived, are not possible with traditional paper survey instruments. Web based surveys also lend themselves to the effective use of color. In addition, dynamic changes in web page content may occur both through programming and through participant changes to their computer environment such as when the participant changes the font size or the size of web pages.

Gorn, Chattopadhyay, Sengupta, and Tripathi (2004) found that, after initial perceptions, there are a variety of cues that people use to perceive and group web page content. These cues include spacing, color, size, orientation, figure-ground, and/or common context. Of these cues, they found common color to have the strongest influence.

As shown in Table 3, the fluid nature of screen level grouping is of particular concern to a web designer as participants' computers employ a variety of different screen sizes and resolutions (TheCounter.com, 2006). As only one screen of information can be shown at a time, all surveys are automatically grouped at the screen level. Unfortunately this screen level grouping can change from participant to participant.

An associated concern with screen resolution is that the percentage of various screen resolutions change by country, economic status, and technological proficiency of

viewers (OneStat.com, 2006). For instance, higher screen resolutions are associated with the higher economic status and technological proficiency of viewers. Figure 8 illustrates how the grouping experience of participants changes depending on screen density.

Table 3: Most popular screen resolutions of users Worldwide

Screen Resolution	Percentage
1024 x 768	56.15%
1280 x 1024	15.79%
800 x 600	12.04%
1280 x 800	4.09%
1152 x 864	3.90%

Note: Data from OneStat.com (2006)

Loss of grouping due to low screen density might show just the following	Grouping interaction due to high screen density
<p>Q2) What are your favorite months?</p> <ul style="list-style-type: none"> <input type="checkbox"/> January <input type="checkbox"/> February <input type="checkbox"/> March <input type="checkbox"/> April <input type="checkbox"/> May <input type="checkbox"/> June 	<p>Q1) In what month does spring semester start?</p> <ul style="list-style-type: none"> <input type="radio"/> January <input type="radio"/> February <p>Q2) What are your favorite months?</p> <ul style="list-style-type: none"> <input type="checkbox"/> January <input type="checkbox"/> February <input type="checkbox"/> March <input type="checkbox"/> April <input type="checkbox"/> May <input type="checkbox"/> June <input type="checkbox"/> July <input type="checkbox"/> August

Figure 8: Comparison of screen shots showing more or less grouping than desired

Note: The response options are not perceived as their entirety as the rest of the months do not fit on the low resolution screen.

Note: There is interaction between the two questions on the screen.

Another grouping consideration with Internet administered surveys is the possibility of presenting web questions one screen at a time, which would not be practical with a paper instrument. Presentations made one screen at a time can help to reduce the cross influence of items and give more control over grouping effects. Unfortunately, presentation of questions one screen at a time increases the time required to complete the instrument and, according to a number of researchers, increased time has been found to

reduce survey completion rates (Andrews, Nonnecke, & Preece, 2003; Couper et al., 2001; Nielsen, 2004a; Schaeffer & Presser, 2003; Solomon, 2001). The relative value of single screen presentation of questions versus presentation of surveys all at once is discussed in more detail later in this paper.

SELECTIVE FOCUS

Christian & Dillman (2004) provide another perspective on web page viewing. They found that web page readers sequentially focus on an area within about two degrees of their visual field or an area about eight to ten characters in width. They define this area as the *foveal view* and this factor may have a strong effect on how content is perceived and how items are grouped. From the perspective of foveal view, while the entire screen is visible, only a relatively small area of focus is actively perceived and mentally processed at a particular moment in time. Examples of this viewing pattern are shown in Figure 9 and Figure 10.

What is your level of education?

Working toward or have obtained a Bachelors degree.

Working toward or have obtained a Masters degree.

Working toward or have obtained a Doctoral degree.

Which student study groups would you join?

Art

Science

Math

English

Research methods

How much free time do you have?

None Lots

Do you think that joining clubs in school is a good idea?

Not at all Very much so

Figure 9: Original web page
 Note: Web page view from the BIRAT survey system (Balch, 2006b)

What is your level of education?

Working toward or have obtained a Bachelors degree.

Working toward or have obtained a Masters degree.

Working toward or have obtained a Doctoral degree.

Which student study groups would you join?

Art

Science

Math

English

Research methods

How much free time do you have?

None Lots

Do you think that joining clubs in school is a good idea?

Not at all Very much so

Figure 10: Initial web page perception as suggested by Christian and Dillman (2004). In this example the first three words are perceived
 Note: Web page view modified from the BIRAT survey system (Balch, 2006b).

Gestalt psychology provides some additional understanding about how perception occurs. As shown in Figure 11, Gestalt psychology identifies four fundamental principles of grouping (AllPsych.com, 2006; Wertheimer, 1938). These principles are:

1. **Closure** describes the tendency to perceive objects in patterns with which we are familiar. The circle and square in Figure 11 are not complete but most observers still perceive them as complete circles and squares.
2. **Continuity.** According to this principle, most people have a tendency to perceive patterns as though they had been continued or completed. In Figure 11 most observers perceive an "X."
3. **Similarity:** The third principle of grouping concerns our tendency to group objects together based on how similar they are to each other. In Figure 11, the dots are grouped in black and white groups even though there are other patterns that might make more sense logically such as rows or columns.
4. **Proximity:** Under this principle, we tend to group similar items based on how close they are to each other. In Figure 11 many observers perceive three lines instead of six.

Physical grouping of items also has a significant impact on how people respond. Smyth, Dillman, Christian, and Stern (2004) found that breaking up a group of possible answers with white spaces and/or subheads created a tendency to provide answer in all the visual subgroups even if responses in all areas were not appropriate. The tendency for participants to provide responses across multiple items that have extra white space or some other form of visual break between response options may be a result of a perception

on the part of the respondent that each area was a separate item requiring a separate response. Figure 12 and Figure 13 provide examples of how the same question can produce different results depending on how the items are visually grouped.

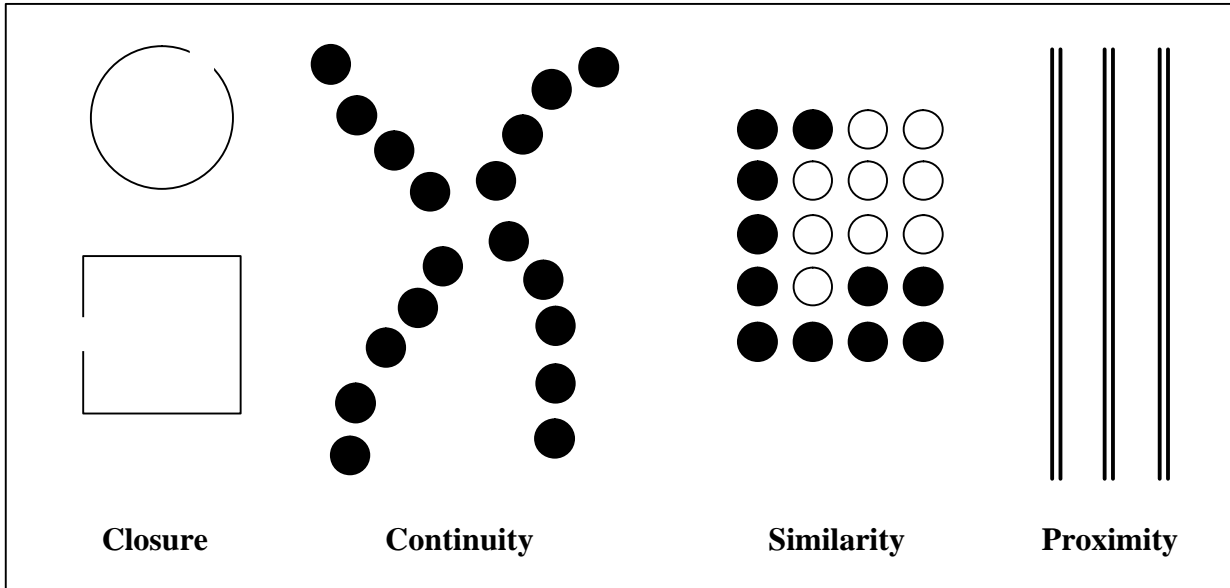


Figure 11: Gestalt Principles of Grouping: Closure, Continuity, Similarity, and Proximity
 Note: figure adapted from AllPsych.com (AllPsych.com, 2006)

- Q 18. What are the most important benefits of the student recreation center?**
- The variety of physical fitness offerings.
 - The health and wellness offerings
 - Helps reduce stress

 - Improve academic productivity
 - Enhances learning experience
 - Provides information for students to learn about their health.

 - Don't know

Figure 12: Checklist Items with space breaks across a group of similar items tend to get responses in each group

Q 18. What are the most important benefits of the student recreation center?

- The variety of physical fitness offerings.
- The health and wellness offerings
- Helps reduce stress
- Improve academic productivity
- Enhances learning experience
- Provides information for students to learn about their health.
- Don't know

Figure 13: Items without the sub-grouping got fewer multiple responses

Grouping effects are not limited to the response area. Altmann (2002) found that, while instructions can and should be grouped, there is a trade-off between decay of understanding and time lost in repetition of instructions. Items that were clearly grouped with instructions pertaining to them were more likely to receive proper responses.

INSTRUCTIONS

It is the obligation of the researcher to provide instructions that reduce the cognitive effort of participants so as to provide a clear and unambiguous experience with the survey instrument. Participant confusion results in bad data and bad data results in wrong conclusions. Since the layout of internet survey pages can change depending on the participants' computer environment and since some participants may not be willing to invest significant effort in the survey, special care must be taken to provide concise and clear instructions. There are a number of concerns and potential conflicts in maintaining participant focus and understanding as participants interact with surveys.

Instructional clarity is essential to proper participant interaction. Unfortunately, greater instructional clarity can result in lengthier instructions. Surveys which take longer for the participant to complete are in conflict with a survey design objective of

minimizing the amount of time a participant must spend in taking a survey (Nielsen, 2004a), Clear instructions and proper survey design will minimize misunderstanding on the part of participants, as well as minimize the time needed to complete a survey.

As shown in Figure 14, appropriate use of graphics may reduce participant confusion. Christian and Dillman (2004) found the use of arrows to identify subordinate or follow-up questions had mixed results. On the other hand, arrows significantly increased the percentage of participants who correctly found the appropriate area to respond to a subordinate question. Unfortunately, however, arrows also significantly increased the number of participants who answered a question when they should not have. In other words, some participants responded to areas with arrows whether or not it was appropriate.

Given this experience, it is clear that attention focusing objects, such as arrows, should be used cautiously, with their purpose and intended use made quite clear. Otherwise they may be used or followed in ways not intended, thus causing the participant to respond incorrectly.

1) What is your favorite color?
<input type="radio"/> Red
<input type="radio"/> Green
<input type="radio"/> Blue
<input type="radio"/> Other What → <input type="text"/>

Figure 14: Use of an arrow to identify a subordinate question leads to the question being answered more often including times when it should not be answered

Note: Figure adapted from Christian & Dillman (2004)

ACCESS AND DISPLAY ISSUES

Despite the desire of survey creators to use the Internet to create a universally applicable display environment, experience has shown that the Internet does not provide the same experience to every participant. Differences in browser type, in scripting, in font size, in window size, in monitor type, in system settings, and differences in capabilities of participants are among the causes for small and large differences in perception of the content of Internet surveys. According to Carbonaro, Bainbridge, and Wolodko (2002) browser compatibility and resultant perceptual differences for Internet survey participants represent a troublesome issue for Internet survey designers.

Although the HTML specification is rigidly defined (World Wide Web Consortium, 2006), most popular browser applications display the same HTML content differently. Even the same browser type may render information differently in different browser versions. Such changes are exaggerated by use of different computer platforms such as Macintosh and Windows based personal computers. Table 5 on page 54 summarizes Internet access and display issues.

Handicap Issues

Access for visually challenged users is a serious concern for web design. The Section 508 requirements (Center for Information Technology Accommodation, 2002) of the US government developed for handicapped users are often cited as a foundation for generic or standard web page design. For example, Section 508 requirements depreciate and discourage the use of frame objects which break the page into sections with different

sources. Framed sections are difficult for assisted reading devices to explore and frames additionally may require the viewer to enable programming languages, such as Javascript, for navigation.

Universal readability for the handicapped is most easily accomplished when the structure and function of the page is kept simple. A number of researchers (Koyanl et al., 2003; Nielsen, 2004b; Nielsen, 2005b; U.S. Department of Health and Human Services, 2005; VanDuyne et al., 2002) suggest that not only the code for pages be kept to the least common denominator but that pages be presented in such a way that the rendering of page content is not significantly altered across a variety of browser environments.

Section 508 (Center for Information Technology Accommodation, 2002) also encourages the use of well described images when images are used at all. In particular, graphical interfaces, such as mapped images, are very difficult for visually challenged users to navigate as they cannot perceive the image areas that correspond to the map links.

Javascript

Scripting languages, such as Javascript, provide the possibility to incorporate a number of additional functions to web pages. This is another area where different browsers behave differently. Arguably, the most useful aspect of scripting for Internet survey designers is in the ability to check data completeness and the validity of responses before data are submitted by the survey participant. Traditionally participants are directed to correct omissions and improper answers with an error message. Unfortunately, while error messages may improve the integrity of received answers, according to Dillman,

Tortora, and Bowker (1999) error messages also cause participant frustration which may result in a change in the participants' response style and may also significantly increase abandonment of the instrument. In addition, since scripted messages are in response to certain participant actions which are expected to be different from one participant to another, not all participants will receive the same error messages or instructions. This certainly has the potential to affect survey results.

Perhaps a more fundamental problem with scripting is the fact that many users (and system administrators) turn off the scripting capability of their browsers for security reasons. Scripting also allows for the possibility of malicious and/or distracting events such as pop-up windows. Researchers should take into account the possibility that scripting may not be active on all participants' computers and therefore they should not depend on scripting for the delivery of their instrument or critical content.

As with HTML and CSS, scripting protocols are not universal in their applicability. Different browsers treat Javascript code differently and some Javascript capabilities are not supported by all browsers. This fact is of particular importance when working with a complicated script that involves graphics. Different scripts are often required for each of the popular browsers. Developing numerous scripts is expensive. In addition, the scripting code must be maintained for each of various browser programs as they change and evolve adding further to the cost.

In view of the information presented above, it is clear that scripting should be used with great care. Anything that causes participants to have different instrument

experiences should give the researcher concern as to the validity of pooling participant responses.

Monitors

Monitor differences are perhaps the greatest threat to commonality of experience in Internet surveys. These differences make it very difficult to predict the participants' viewing experience. Screens and monitors vary widely in size. In addition to differences in monitor sizes, a further concern for the researcher is the fact that monitor resolution can be adjusted by users. As a rule of thumb for minimum sizing, the resolution of computer monitors rarely goes below 640x480 while 800x600 is currently the default standard for web page design (Nielsen, 2004b).

Resolution makes a significant difference in participant experience. An 800x600 resolution displays about 36% more information than a 640x480 resolution. Thus, a survey where an image is shown along with a question, the image might render well on the higher resolution screen but may require user scrolling on the lower resolution screen.

It should be noted that there is a difference between the terms *monitor* and *window*. Monitors are physical devices that provide the screen which the survey participant views. Windows are a variably sized area on the screen used to view a given image or application. In our case, the application of interest is a browser displaying an Internet survey. Computer users can adjust the resolution of their monitors and the size of their windows on the monitor. Examples of these issues are shown in Figure 8 on page 41 and Table 3 on page 41.

Color

The most significant concerns related to use of color in web surveys are the color depth of the monitor, manner of use of color in the presentation, and the problem of color blindness. A significant percentage of the population is color blind with the inability to distinguish between red and green being the most common challenge. Survey designers should take the possibility of color blindness into account and not use cues that may not be sensed or perceived as intended.

Color depth refers to the number of colors that can be displayed on a screen. This used to be an important issue particularly for the display of pictures. Images look significantly different when they are rendered within a range 256 colors instead of the millions of colors that most modern computers can now display. Computer systems built in the last five years are very likely able to provide color resolutions in the higher ranges so the color depth issue is no longer as important as it once was.

An issue related to color in its importance for Internet survey designers is the requirement that content be easily read and perceived. Koyanl, Balkey, and Nall (2003) point out that there should be a clear and significant contrast between text and its background. For example, text in a pale color displayed on a pale color background will often be hard or impossible to read. This will certainly be annoying to the participant and will distract from the content. Participants cannot respond correctly to what they cannot read.



Figure 15: Dark text on a dark background is hard to read.

Factors Controlled by the Participant

Participants can adjust their browsers in ways over which Internet survey designers have little or no control. For example, participants often adjust the size of their browser windows to an area within the size and resolution of their screens. Participants can also adjust font sizes and types within their browsers to specifications that the survey designer will not have expected. Web page designers cannot expect special fonts or letter shapes used to create a survey to be viewable as designed to participants, so unusual fonts should not be used in a survey.

Table 4: Access and display issues resulting from different user environments

Criteria	Description
Monitors and resolution	Monitors may be of different sizes and resolutions. The monitor/resolution combination defines the size of objects and the number of objects that will appear in a window.
Color	Different monitors have different levels of color displayed.
Window Size	Participants can set a number of different windows sizes within their monitor.
User fonts and color	Participants can define their preferred fonts and color schemes within web pages. These definitions supersede whatever definitions the web page designer assigned.

INSTRUMENTS AS A CONVERSATION

Internet instruments may be viewed as a conversation between the participant and the researcher (Schwarz, Grayson, & Knäuper, 1998). In this paradigm, participants interact with the survey instrument much as they would in a conversation between the researcher and themselves. From the perspective of web surveys viewed as a conversation, it is important to design an atmosphere or context that guides participants in consistent and desired directions. The need for clarity in this conversation (layout) becomes increasingly important to the extent that participants are unsure what is expected

of them and to the extent that the researcher desires to guide the experience (Leung & Kember, 2005).

Context influences responses in ways that we have not discussed previously. There is an intricate relationship between how an item appears on a questionnaire, the cognitive processing of information by participants, and the quality of the resultant data (Burgoon et al., 2000; Crawford, Couper, & Lamias, 2001; Smyth et al., 2004). While models vary in the number of stages used to describe the participant's process of responding to a survey item, most process or communication models include the following elements: understanding a question, retrieving or constructing an answer, and reporting the answer in the specified format (Simsek & Veiga, 2001). Table 5 shows the three critical areas which must be addressed for effective surveys.

Table 5: Three critical areas in participant item response process

Area
Participant understands the question the item represents
Participant retrieves/constructs a response
Participant reports the answer in an understandable format

Schaeffer and Presser (2003) noted that, as in a conversation, survey questions are often intended to build on each other and thus develop context. For example, when participants are asked to rate their marriage and then their entire life, participants will tend to respond to the life question with their feelings on their marriage, while this may not be at all what researcher wants. Proper item construction is necessary to get desired information. In this context, Figure 16 shows an example of wording to define a term within an item.

Good Wording	Bad Wording
Now I'd like to know about motorized vehicles including scooters, motorcycles, automobiles, and trucks. How many motorized vehicles do you own?	How many motorized vehicles do you own?

Figure 16: Include the definition of the term in your question

Note: Example adapted from Schaeffer and Presser (2003) page 69.

GENERAL SURVEY LAYOUT CONSIDERATIONS

ITEM SIZING

VanDuyne, Landy, and Hong (2002) found that increasing the size of an item significantly improved participant response. While increased item size may be desirable, it needs to be balanced against the limitations of available window space. As shown in Figure 17, fewer and larger items, such as larger buttons or increased text size, make it easier for participants to respond to questions at the expense of a reduction of the total visible items and changes in grouping.

Loss of grouping due to low screen density might show just the following	Grouping interaction due to high screen density
Q2) What are your favorite months? <input type="checkbox"/> January <input type="checkbox"/> February <input type="checkbox"/> March <input type="checkbox"/> April <input type="checkbox"/> May <input type="checkbox"/> June	Q1) In what month does spring semester start? <input type="radio"/> January <input type="radio"/> February Q2) What are your favorite months? <input type="checkbox"/> January <input type="checkbox"/> February <input type="checkbox"/> March <input type="checkbox"/> April <input type="checkbox"/> May <input type="checkbox"/> June <input type="checkbox"/> July <input type="checkbox"/> August
The rest of the months are not shown because the text does not fit on the low resolution screen.	There is interaction between the two questions as the screen allows for more text.

Figure 17: Comparison of screen shots showing more or less grouping than desired
Note: This is a duplication of Figure 8.

INSTRUCTIONS

Instructions are critical to the success of any survey. Unfortunately instructions may be a blind spot for many academics that create surveys inasmuch as they routinely process complex and often lengthy sentences and text. Academics are often passionately interested and willing to spend considerable effort in understanding their chosen areas of research. It is not reasonable to assume that participants will have the same skills, focus, or intensity of interest in the content of a survey as does the academic who creates the survey. Thus, instructions, like the surveys themselves, should be unambiguous, clear, and focused.

Altman (2002) found that correct performance by participants taking surveys was dependent on their remembering instructions and following them. He found that, when instructions change often within the same survey, memory must first decay or lose activation to prevent one set of instructions from interfering with or introducing

confusion with the next set of instructions. His conclusion was that complicated and frequently changing instructions confuse participants and should be avoided. There is also the risk that frequently changing instructions will be ignored.

Unfortunately, there is a trade-off between reducing the length or complexity of instructions and increasing the quality of data collected. While grouping items and thus instructions can simplify the survey experience, Couper, Traugott, and Lamias (2001) found that grouping items may cause the respondent to perceive the grouped items as related and thus respond in similar ways to the grouped items resulting in a false high correlation between the items. In addition, users may not even read items completely before responding when they perceive items as related. Similar findings were found with branching systems where correct compliance with the instructions were greatly increased by making sure the instructions were proximate, clear, and properly grouped (Smyth et al., 2004).

User computer experience and other digital divide issues may also influence results. For example, Smyth, Dillman, and Christian (2005) found that some participants may not know that radio buttons are reserved for single answer questions while checkboxes allow multiple responses. To overcome problems due to such possible confusion, instructions should clearly indicate whether the participant is allowed one or multiple answers.

PATTERN RESPONSES

The term "pattern response" refers to the manner of response of some survey participants to questions based not on instructions but on their personal habit or preference as they first look at (view) then respond to a survey page. When the reasons for pattern responses are known, survey designers can attempt to reduce them and consider them in the data analysis phase.

There are a variety of pattern response effects that researchers should be aware of. Participants who feel compelled to complete a survey will often respond to certain locations regardless of the content (Reips, 2002b). Pattern response also extends to grouping of options within survey items.

The layout and grouping of response options can have significant impact on participant responses. Christian and Dillman (2004) found that participant responses to items arranged in a linear format have a significant bias towards selection of the top options or choices. On the other hand, there is a bias towards responses to item options on the left of non-linear layouts. Examples of linear and non-linear layouts are shown in Figure 18 and Figure 19. Christian and Dillman (2004) speculate that this response pattern occurs because of the likelihood that participants will take the path of least resistance when completing an instrument, simply answering the options they perceive first.

The response area of least resistance or the response pattern of respondents may change from participant to participant with some participants finding it most convenient to answer at the top, middle, or bottom of the survey page without care for the content of

their responses (Reips, 2002b). While inappropriate response patterns can be detected and the resultant data discarded, instruments should be designed to avoid these issues. For instance, a student responding to a course evaluation might have a genuinely positive or negative opinion of the course. If all of the items are weighted in the same direction, the student's response could create a false positive for a pattern response. Alternatively changing the direction of the weighting would be more likely to reveal the students true feelings about the course.

<p>Q 12. What activities would you be interested in participating in?</p> <ul style="list-style-type: none"><input type="checkbox"/> Sports<input type="checkbox"/> Social<input type="checkbox"/> Debate<input type="checkbox"/> Study Groups
--

Figure 18: Linear Formatted Questions tend to have more item responses

<p>Q 12. What activities would you be interested in participating in?</p> <table><tr><td><input type="checkbox"/> Sports</td><td><input type="checkbox"/> Social</td></tr><tr><td><input type="checkbox"/> Debate</td><td><input type="checkbox"/> Study Groups</td></tr></table>	<input type="checkbox"/> Sports	<input type="checkbox"/> Social	<input type="checkbox"/> Debate	<input type="checkbox"/> Study Groups
<input type="checkbox"/> Sports	<input type="checkbox"/> Social			
<input type="checkbox"/> Debate	<input type="checkbox"/> Study Groups			

Figure 19: Non-linear Format items to the right garner fewer responses

SURVEY ABANDONMENT

Researchers should also balance their interest in collecting a wide sample of participants with the distraction and invasion of privacy that their survey, and even the offer to take the survey, represents. While there is a natural tendency for researchers to believe that their survey is of critical importance, not all surveys contribute equally to the increase or improvement of our common knowledge. Potential survey participants may have a low tolerance for the number of surveys in which they are willing to participate. For such participants, each survey a participant takes results in a survey that they will not participate in elsewhere. Thus, in some cases, taking a survey focused on a relatively

trivial topic might prevent the participant from taking a survey focused on an important topic.

Another common reason for survey abandonment is that the survey requires technology that is incompatible with the participant's browser (Reips, 2002a). This may result from code that is not compatible with the browser, absent browser add-ins, or even technology the participant has not activated. Participants may not be willing or able to make the changes required to take the survey when special technology is needed and they may just abandon the survey.

Bowers (1999) found participants abandon longer surveys more often than shorter ones. Thus, while there is a natural tendency for researchers to want to gather all possible information, it is better to collect some information than none at all. Bowers (1999) suggested that surveys should not take longer than about twenty minutes to complete. Reips (2002b) suggested that the time to take surveys should be measured in a few minutes.

Researchers should consider that persons who complete a longer survey that many others abandon may not be representative of the target population. Jeavons (1999) examined web logs of survey behavior and discovered three main exit points in survey abandonment:

1. The first question;
2. Encountering a complex question grid;
3. When the participant is asked to supply personal information such an Email address.

Reips (2002a), who described dropout rates as noncompliance or abandonment, had an interesting perspective on dropouts. He suggests that dropouts can be used as a dependent variable and notes that surveys may be compromised when dropouts are systemic as when participants drop out in response to the experimental manipulation. In particular, participants may drop out because they find the web survey topic distasteful, unimportant, or boring. With a single page survey, the researcher has no way to discover why or at what point in the survey the participant abandoned the instrument. Useful information may be collected when the location of participant abandonment may be collected.

I suggest that noncompliance or abandonment of surveys has a negative connotation that may not be justified. Perhaps a better term would be "failure to adopt." This term implies that the participant was not sufficiently engaged to complete the survey. Thus, the failure to complete the instrument may be interpreted in two ways: either the participant simply declined to complete the experience or the researcher failed to engage the participant sufficiently.

A number of researchers (Andrews, Nonnecke, & Preece, 2003; Couper et al., 2001; Nielsen, 2004a; Schaeffer & Presser, 2003; Solomon, 2001) found that user participation is significantly and inversely related to web page load times. Participants tend to abandon instruments with greater frequency when there is a longer page load time. According to Nielsen (1994) a tenth of a second page load time is perceived as instantaneous. Load times around one second keep the flow of thought uninterrupted while page loads that are longer than ten seconds can cause the user to lose focus on the web survey experience.

There are a number of factors that affect page load times. Page load factors of significance include the following: capability of the server delivering the instrument, the load on the server, the bandwidth available to both the server and the participant, and the size of the web survey content. In addition, design factors can affect page load times. For instance, some content such as tables must be completely received before they are displayed. This is not a problem when the content is small but tables that enclose large amounts of data will have increased delays in being displayed. Large images or the use of multimedia will also tend to cause delays in downloading.

There are mixed findings on the use of progress meters that show participants their degree of survey completion. Couper, Traugot, and Lamias (2001) found that progress meters which indicate the participants' percentage of completion increase motivation to complete surveys and also increase survey completion time. They also found a modest decrease in abandonment when progress meters are used. Due to the fact that different question types and different content can take longer to complete, there is some question as to how to measure progress or percent of survey completion. On the other hand, Couper, Traugott, & Lamias (2001) found that progress meters had no significant effect on Internet survey participation.

COMPLEXITY

The consensus is that a less complex survey design will contribute much to the goal of obtaining accurate results. Various researchers (Nielsen, Dillman et al., 1998; Heerwegh & Loosveldt, 2002; Koyanl et al., 2003; 2001) have found mixed results with

increasing complexity, for example, using features such as mixed type styles, images, animation, and extensive use of color. In general, it was found that an increase in complexity improves user motivation. Yet, such features often distract from participant focus on item and instruction content, and this could affect the validity of the results.

As shown in Table 6, Simsek and Veiga (2001) found that complexity or "media richness" can be measured using four characteristics. Where appropriate, they suggest researchers design survey instruments to take full advantage of the Internet's ability to provide immediate feedback, multiple cues, normal language, and personalized response in order to reduce the participants' cognitive load. Such adjustments can create a special challenge to investigators in that they must design instruments that interact with the participant. At the same time such interaction may reduce the commonality of participant experience and thus reduce the value of the data.

Table 6: Simsek and Veiga (2001) characteristics of media richness

Characteristic
Capacity for immediate feedback,
Capacity to transmit multiple cues,
Use of normal language (words rather than numbers or formulas),
Capacity to have a personal focus.

SCALES

There has been considerable discussion in this field concerning appropriate size for item scales (Cook, Heath, Thompson, & Thompson, 2001; Miller, 1994; Schaeffer & Presser, 2003; Schwarz et al., 1998; Schwarz, Hippler, Deutsche, & Strack, 1985; Schwarz, Knäuper, Hippler, Noelle-Neumann, & Clark, 1991). The general agreement is

that scales should have five or seven response points and that odd numbers allow for a needed middle response option.

There is some question about the type of data provided by five or seven point scales (Creswell, 2002; Gall et al., 1996; Hinkle et al., 2003). It can be argued that five or seven point scales collect ordinal information and thus fail to meet parametric statistic assumptions which require data at the interval level. Failure to meet parametric statistic's assumptions would invalidate the use of many statistics such as t-tests and ANOVA. Even so, five and seven point scales are commonly used in all forms of surveys and parametric statistics are routinely used to analyze and review the collected data.

There is some research to support the use of five and seven point scales with parametric data. In a review of literature supported by personal research, Miller (1994) concluded that there is a basic limit to our ability to discriminate various stimuli and that limit is about seven items. In other words, even though scale items may be nearly continuous, most persons tend to group large numbers of items into groups between five and seven items (see Figure 20). Thus, larger scales may be condensed by participants into smaller scales at the perceptual level. As all participants could not be expected to group item options in the same way there would be a lack of commonality in the survey experience. Miller's (1994) research is important when considering the appropriate size of Likert style questions as it suggests that larger scales are no more effective than scales with five or seven options and may actually be less effective.

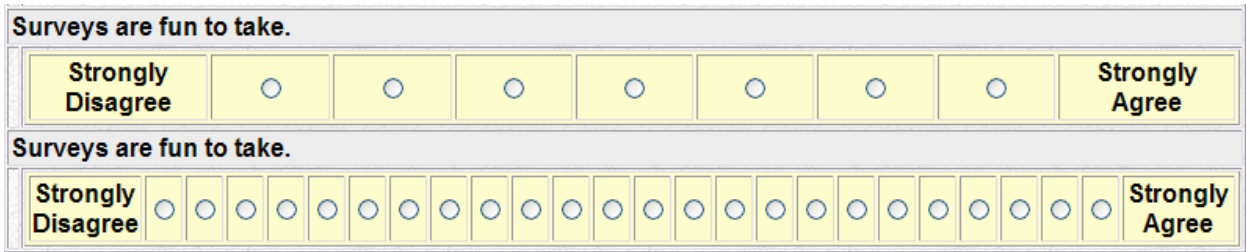


Figure 20: Increasing the scale of an item may not lead to greater discrimination as the participant may perceptually group the results into a smaller set of scales

Note: Web page view from the BIRAT survey system (Balch, 2006b)

It appears that with more complex responses involving two factors, participant grouping discrimination increases while the discrimination of the individual constructs components (axis) are decreased. As shown in Figure 21, Miller (1994) noted that the number of perceived groups increased for two dimensional items such as reporting the X and Y coordinates of a dot on a graph to a value much larger than seven. However, in two dimensional situations the number of perceived groups on the single dimensions of X and Y coordinates are reduced.

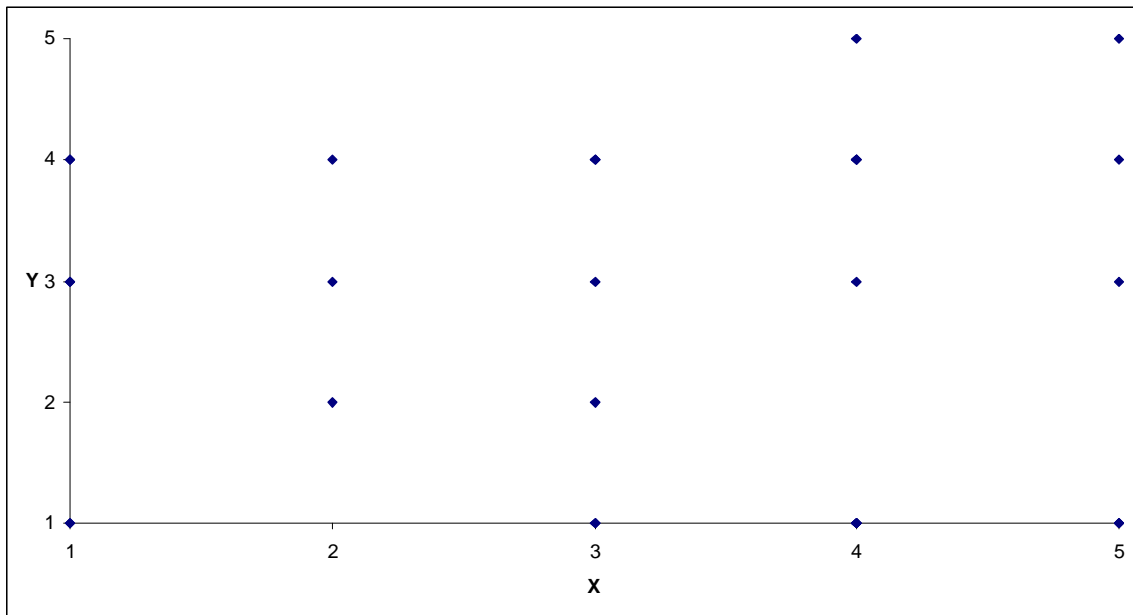


Figure 21: Number of perceived groups is increased with two dimensions

BRANCHING SURVEYS

Branching is a process in which the items presented to participants change depending on their response to previous items. Branching can be static, where the participants are directed in each step or they may be automated where the survey content changes in response to the participants' previous responses. The ability to collect information conditionally depending on previous responses is often considered desirable as it avoids participants' experiencing and perhaps responding inappropriately to parts of surveys where no participant response was desired. Additionally, conditional content based on previous responses reduces survey participation time but it does so at the expense of loss of commonality in the survey experience.

There are some special considerations in the design of static branching questions used in Internet surveys. Christian and Dillman (2004) found that placement of instructions immediately before a static branching question increases response speed and therefore contributes to the accuracy of the measurements. Figure 22 shows an example of improper placement of instructions while Figure 23 suggests proper placement of instructions.

<p>Q3) Are you a member of the team?</p> <p><input type="checkbox"/> Yes</p> <p><input type="checkbox"/> No</p> <p>If you answered yes, answer the next question.</p> <p>Q4) Do you enjoy being on the team?</p> <p><input type="checkbox"/> Yes</p> <p><input type="checkbox"/> No</p>

Figure 22: Placement of instructions after a branching question reduces its efficiency

If you answer no to the next question, skip the next question.

Q3) Are you a member of the team?

- Yes
- No

Q4) Do you enjoy being on the team?

- Yes
- No

Figure 23: Placement of instructions before a branching question increases its efficiency

By their nature, static branching surveys where all questions are visible and participants answer questions in response to an instructional roadmap require more complex instructions and therefore lend themselves to more participant error. Redline et al. (2005) report that increased complexity of instructions leads to increased response errors. Some participants will respond to items even when the instructions indicate they should not, while other participants, who should respond to a conditional item, may ignore the item. It is possible that inappropriate responses are caused not so much by participant error as by participant pattern responses where the participant is not even reading all of the questions or instructions.

There is a solution to participant branching system confusion. As stated earlier it is possible to program Internet surveys to create branching survey content that changes item content depending on responses to previous items. Thus, Internet surveys reduce the need for complex navigational instructions with their accompanying distractions. Such programming also helps to keep participants from entering spurious data but does not prevent pattern responses. Figure 24 shows an example of how such a branching survey might appear to the participant in various contexts. Note that changing surveys in response to item answers means that, in effect, participants experience different surveys.

This difference in experience may raise some question as to the pooling of the collected data, since participants arguably did not respond to the same instrument.

Original Item Have you ever been found guilty of a felony crime? Yes <input type="radio"/> No <input type="radio"/>
Item with a positive response displays a secondary item Have you ever been found guilty of a felony crime? Yes <input checked="" type="radio"/> No <input type="radio"/> What felony did you commit? <input type="text"/>
Item with a negative response does not show secondary item Have you ever been found guilty of a felony crime? Yes <input type="radio"/> No <input checked="" type="radio"/>

Figure 24: Example of a branching system showing how a following item will appear depending on the response to a previous item

CHUNKING VERSUS SINGLE PAGES

Chunked survey content is information presented in a series of pages, where the same information might otherwise be presented as a single page. The smallest reasonable chunk would be to deliver one item, along with its associated response options, at a time. Responses to chunked pages are recorded as the participant moves from page to page. There are solid arguments both for and against the use of chunked pages versus single page content.

There are a number of considerations associated with all-at-once presentation of surveys versus chunking. Perhaps the greatest disadvantage of single page surveys as compared to chunked surveys is the longer load time required for all content to be displayed at once. Single page load times can be reduced by keeping the downloaded content size small and coding in ways that allow the page to be displayed partially before

it is completely downloaded. In addition, with single page presentations, there is no reliable way to record participant responses as they answer each item in a single page survey. Thus, if the participant abandons the survey at any time before submitting their responses, all response data is lost. In addition, the all-at-once presentation of a large survey may be intimidating to participants and cause them to abandon the survey whereas they might accept a survey of equal length if it were delivered with a number of chunked pages. Single pages also allow participants to review and change their responses as new survey content becomes available and in response to that new content. Some researchers may find this possibility for participants to review their responses and then to change them before submitting them and change answers before submitting them if they so choose, to be a beneficial aspect of the survey process.

All-at-once presentation of surveys has some advantages. Development is simpler and participants are exposed to the complete survey at the very beginning. Single pages present all the survey instrument items on a single page, and that allows the respondents to review the entire survey before responding to any question instead of changing responses as they experience survey content. Single pages also give the user a clear idea of their progress as the viewer can see the progress indicated on the right scroll bar.

There are some advantages to chunking content into screens. When information is recorded with each page or form submittal, chunking provides the ability to record data up to the point where a survey was abandoned. Multiple pages also allow greater control for branching surveys where items change based on responses to previous items. For example, instead of providing instructions to ignore an item depending on responses to previous items, the instrument can be programmed to not display the item at all.

Chunking also decreases individual survey page load times. As noted above, user participation is significantly and directly improved with shorter load times.

The final advantage to chunking is that it provides a better possibility for the researcher to totally control the content that the user sees. With scrollable pages, it is possible for separation of content that the researcher would like grouped and grouped content the researcher may want to keep separate. For example, instructions associated with an item might not be visible on a large single page survey, where they would be visible in the smaller subset of the survey that chunking provides.

Conversely, chunking requires a far more complex programming environment and researchers may have a false sense of control as chunks are rendered differently in different participant environments.

On balance, under most circumstances, while the list of complaints against one page surveys is longer, the listed problems are minor. There does not appear to be a definitive argument for or against chunked or single page survey content. Researchers should take the strengths and weaknesses of single page versus chunked content into consideration when choosing between these survey delivery options as the researcher may have special needs related to participants and/or content that will influence the choice.

SECURITY

Security issues fall into two primary categories: need for confidentiality of participant responses and insuring that collected data is not lost. Need for confidentiality

varies depending on the items and the participants. For example, a simple blind poll of club members to learn their preference among a number of possible club activities would not require as much security as a survey collecting sensitive health care information, including such things as child abuse.

To insure security, when appropriate, researchers should use HyperText Transport Protocol with Security (HTTPS) and safe data storage practices to insure participant privacy. HTTPS adds security to HTTP content by encrypting all responses making it difficult for third parties monitoring web traffic to discover the content of participant responses. Many computer savvy Internet users routinely look for the padlock icon at the bottom of their web browsers indicating HTTPS security is operating before they submit sensitive information. A closed lock indicates that the page is secure and that information sent will be encrypted and thus safe from third parties. Participants may decline to submit data if they feel that their information can be compromised (Jeavons, 1999).

Safe data storage practices require that collected data be stored in such a way that it would be difficult to compromise it externally and that the data will not be lost due to system failure. Sensitive data and data products should not be visible on Internet networks and should require authentication on local (intranet) networks. Password protection is generally considered acceptable for mildly sensitive data. Other data, such as health information, social security numbers, and personal financial data require much more stringent data protection (Strauss, 1996).

In this context, researchers should consider what data they really need when designing their survey instruments. For instance, if there is no need for sensitive data

such as exact birth dates or social security numbers, this type of information should not be requested by the survey. Requests for sensitive data can also increase survey abandonment (Reips, 2002a; Stark, 2004; Track Marketing Group, 2002; Truell, Bartlett, & Alexander, 2002).

Researchers lose considerable credibility and may expose themselves to legal action when supposedly confidential information collected on the Internet is exposed. It is thus important to insure that collected data cannot be accessed by hackers or casual web surfers (Reips, 2002b). Data saved on computers connected to the Internet are particularly vulnerable to theft and unwanted exposure. Researchers should be aware that search engines such as Google (Google, 2006b) will completely explore all the linked contents of web sites and thus provide the possibility of exposure of information that the research thought would not be casually found. Wherever it resides, all confidential data should at least be password protected.

Finally, all persons who work with the collected data need to be aware of the data's sensitivity and should follow proper procedures for keeping data secure. The most common reason for loss of data privacy is not sophisticated hacking by unknown assailants, as some believe. The most common reason for loss of data is *social engineering* where people are convinced to share data with a person who offers a convincing reason that they should also have access to the data, even when such sharing is against established policy. After basic security procedures have been implemented, the best way to insure that inappropriate data sharing does not occur is to educate persons with access to the data as to privacy policies, as well as the importance of the measures

they must take to insure that privacy, and, finally, to provide penalties for the inappropriate sharing of data.

WEB SURVEY ITEM TYPES

Internet surveys can provide the entire range of traditional paper survey item types and in addition offer the possibility for interactive item types that would not be possible with a static medium such as paper. Examples of unique Internet item options include the ability to require and/or measure timing and logic to test the validity of user responses before the responses are submitted. Computer presented surveys also encourage the use of special or unusual item types, such as feeling thermometers, which are tedious to score when used on paper surveys.

Internet survey item types may be displayed in a variety of ways unique to the interactive HTML environment (World Wide Web Consortium, 2006). However, the display of items in unique ways is not always appropriate. Researchers have found that in presenting survey items it is most important that presentation be consistent with standard Internet protocols and displays (Gales, 2006; Head, 1997; VanDuyne et al., 2002).

The need for use of common interface objects in their traditionally defined role is further emphasized as participants with visual challenges find it difficult to interpret page objects that are not used in traditional ways (Center for Information Technology Accommodation, 2002). For instance, as shown in Figure 25 on page 75 and according to a number of researchers, participants navigate more effectively when navigation objects

are presented as a traditional button object instead of as an image (Bowker & Dillman, 2000; Head, 1997; Nielsen, 2004b; VanDuyne et al., 2002).

SUBMIT AND BUTTON OBJECTS

The HTML specification allows for two button-like objects that have identical appearance. Button and Submit objects are "pressed" in order to initiate some action or process. A common participant use for Submit and Button objects is to indicate completion of their responses to a survey and deliver the content of the survey to the researchers server. The Submit object is used to submit forms and does not require any associated code other than the action specified by the Form object (Forms are a collection of input objects). The Button object is associated with Javascript code and is used to automate various actions within a web page.

Actions associated with buttons may include submittal of a web Form and/or validation of user entries before submittal of an Internet survey. Submit button objects may be associated with Javascript, making the two object types somewhat interchangeable so long as Javascript is enabled on the participant's browser. While Javascript is not required for the Button object to submit form data, any Javascript associated with the Button object will not run if Javascript is turned off at the client's browser.

While it is possible to make almost any HTML object clickable, buttons are defined in the common Graphic User Interface (GUI) as the object users should expect to

click on for a response (World Wide Web Consortium, 2006). As shown in Figure 25, use of objects other than buttons may confuse participants.

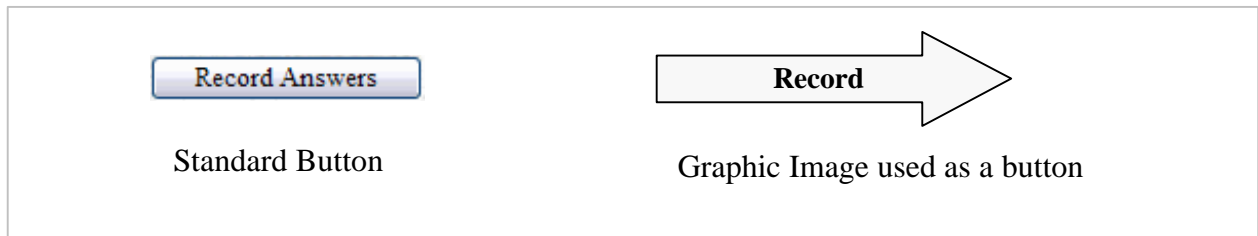


Figure 25: Standard buttons are better than graphic images for navigation because buttons are the expected interactive object for the common graphic user interface

Ironically, it is possible to alter the appearance of buttons and it may be that bigger buttons are easier to use (Center for Information Technology Accommodation, 2002). However, according to Nielsen (2004b), increased size of objects such as buttons takes up more valuable screen space and extra-large buttons may not be in accordance with the best principles of the common graphic user interface and this may confuse participants and thus reduce the quality of their responses.

RADIO BUTTONS

Radio buttons are the HTML object of choice when the number of responses is defined, relatively limited, and exclusive. In operation, radio buttons provide a grouped series of small circles (?) where participants select a single choice by clicking on the circle associated with a text response. Figure 26 shows an example of a radio button group.

There are special Internet survey design considerations associated with the use of radio buttons in Internet survey design. Radio buttons are faster and easier for the

participant to use as opposed to entering a value into a textbox. However it is important to note that the web page designer must define all of the mutually exclusive responses or, as shown in Figure 26, provide for an alternative or "other" response. As shown in Figure 27, radio buttons are particularly effective for Likert or semantic differential style questions where only one response is expected.

My favorite subject area is.	
<input type="radio"/>	English
<input type="radio"/>	History
<input type="radio"/>	Math
<input checked="" type="radio"/>	Biology
<input type="radio"/>	Sports
<input type="radio"/>	Other
If you answered other above, what is your favorite subject area?	
<input type="text"/>	

Figure 26: Radio button allow only one option. This example provides an option to respond with "other" using a secondary textbox or short answer item.

Note: Radio button image from the BIRAT (Balch, 2006b) online statistical system. Other is a short answer textbox item type.

Surveys are fun to take.							
Strongly Disagree	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Strongly Agree	N/A <input type="radio"/>

Figure 27: Likert style Radio Button Example with N/A ("Not Applicable") option

Note: Radio button image item from the BIRAT (Balch, 2006b) online statistical system. N/A is part of the mutually exclusive group.

According to a number of researchers, fixed response categories such as provided by radio buttons require special consideration in survey design (Couper et al., 2004; Schwarz et al., 1998; Simsek & Veiga, 2001). On the positive side, radio buttons can prevent out-of-bounds responses by insuring that participants respond in ways that the survey designer expects and wants. On the other hand, participants may not agree with the bounded categories and thus the participant may experience frustration when they

perceive that they cannot answer the question with a response they consider adequate. This frustration may be expressed in a variety of ways including abandonment of the instrument, abandonment of the item, and randomized or pattern responses. Thus, it is important for the researcher to consider the possibility that the response options are complete for all anticipated participants.

Inclusion of the possibility of a response of "other" with an associated textbox is often a best practice. It is also a good idea, where appropriate, to include "Not Applicable" as a response possibility. For example, a survey that asks for the education level of participants might need to take into account differences in international educational systems and the possibility that some participants are self-educated.

FEELING THERMOMETERS

Web page survey design provides for inclusion of seldom used survey item types such as feeling thermometers which attempt to address issues related to scale size while avoiding problems with scale grouping (Alwin, 1997; Wilcox, Sigelman, & Cook, 1989). Feeling thermometer style items are reported to provide data more appropriate to parametric statistics. Figure 28 shows an example of a feeling thermometer. The participant response is shown as a yellow dot which the participants can place at any point on the scale. The response item in the example has an interval level discrimination of 500 points and does not encourage discrete individual response areas that could be caused when numbers individual response items choices greater than seven are visible.



Figure 28: Feeling thermometer

Note: Text area image from the BIRAT (Balch, 2006b) online statistical system.

CHECK BOXES

As shown in Figure 29, check boxes are similar to radio buttons except that, for a given grouping, it is possible for respondents to select more than one option in a given question. At the programming level, according to the HTML specification, checkboxes are considered unique entities and are not grouped as radio buttons are. The appearance of item grouping is controlled by the page designer and the uniqueness of each item can make the collection and interpretation of resultant data difficult. In essence, when using check boxes, each response option must be treated as a unique item. Otherwise, the same concerns and suggestions for radio buttons apply to check boxes.

Check boxes limit the number of possible responses to a given question, and this may result in loss of important participant categories. Thus, the same suggestions of providing "not applicable" and "other" response options apply as well to check boxes. For instance, in Figure 29, the participant might like Music classes (not listed) or may not have attended school at all.

I like classes in	
<input checked="" type="checkbox"/>	English
<input type="checkbox"/>	History
<input checked="" type="checkbox"/>	Math
<input type="checkbox"/>	Biology
<input checked="" type="checkbox"/>	Sports

Figure 29: Check Boxes allow more than one selection

Note: Check box image from the BIRAT (Balch, 2006b) online statistical system.

TEXT BOXES

Text box items are displayed on instruments as a box with a defined width allowing for one line of text. Text boxes are thus appropriate for short, open-response answers.

Text boxes can provide participants a wider selection and of responses and can also increase response speed when there are a substantial number of possible response categories. For instance, Smyth, Dillman, Christian, and Stern (2004) found that it is more time efficient for participants to type in an answer when there is a large number of options. Of course analyzing and categorizing diverse responses places an additional burden on the researcher. On the other hand, some researchers might argue that the discovery of all possible categories is an important part of research (Creswell, 2002; Gall et al., 1996; Hinkle et al., 2003). Figure 26 shows an example of a text box associated with radio buttons.

Size of text boxes is an import consideration. While text boxes can receive considerably more information than 100 characters, in practice, the expected content of

text boxes should be the length of just a few words. Too large a text box will not fit on many computer screens without horizontal scrolling.

Christian and Dillman (2004) found a direct correlation between the size of answering space and the length of participant answers. They found that participants respond to the context of the answering space size and thus smaller answering spaces tend to result in shorter answers. Conversely, large spaces tend to encourage longer answers. It may be that shorter answering spaces encourage shorter answers because the participant feels they must fit their answer into the provided space even though they would have preferred to write a longer and, in their opinion, a more accurate response. If the researcher expects a longer open response, the web survey designer should use the text area type object that is discussed below.

Contextual clues provided for text box responses can be an important aid in getting usable responses. As shown in Figure 30, Hart (2004) found that placing a clear example of the format that should be used in the text box area significantly increased the percentage of participants who responded with the correct response format. For instance, when a four digit year is desired, placing a YYYY above or below the text box significantly improves participants' correctness in response.

Better	Worse
What year were you born? <input data-bbox="345 1560 505 1604" type="text"/> YYYY	What year were you born? <input data-bbox="933 1560 1092 1604" type="text"/>

Figure 30: Explicit demonstration of data entry yields superior results

TEXT AREA

As shown in Figure 31, text area responses provide more space for responses than text boxes. Typically the area for a text area response will be the full screen width and will provide for at least two lines of response. The practical limit for a text area response is about thirty-two kilobytes or about twelve type-written pages. However, I suggest that, if very long responses are expected, the possibility for file uploads be provided. In particular, longer responses take considerable time to compose and this is one of the numbers of factors that can break the connection between an instrument and the server that delivered it. Participant responses would be lost if the connection were broken.

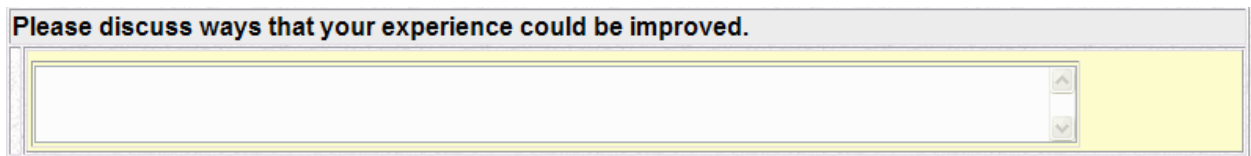


Figure 31: Text area response areas allow for longer answers

Note: Text area image from the BIRAT (Balch, 2006b) online statistical system.

FILE UPLOADS

The HTML language provides the possibility for participants to select and upload files from their computers and send them to a designated place on the Internet. Under ideal conditions, the practical limit of such files is about two hundred megabytes which is substantially larger than most text documents, but small compared to the size of many multi-media documents. The practical size of a document that can be uploaded varies by the participants' and the researcher's server bandwidth and storage capabilities. Ten megabytes is about the largest size document that can be practically sent using HTML file uploads.

There are a number of considerations one should be aware of in the use of file uploads. While HTML file transfers are not as efficient as FTP transfers, HTML file transfers are not usually blocked by firewalls and are easier for most users because they do not require the use of another program. Since the server receiving the files needs to have appropriate permissions and sufficient space to accept the files, file upload capability may open the server to a variety of hostile actions including the uploading of scripts that can damage the server, or numerous large files that would overload the servers disk capacity. Thus, it is good practice to limit file uploads by file type (such as images or documents) as well as by file size.

IMAGE ITEM TYPES

Image item types are another example where computers enable the use of item types that were previously tedious to score and evaluate. As shown in Figure 32, one use of the image item is to allow the participant to indicate the area of most importance in relation to the item question. While image item types are not unique to the computer environment, like feeling thermometers, web page delivery makes image item types much more practical than when delivered through traditional methods because the process of collecting and consolidating the information is somewhat simplified.

Image item type results can be analyzed in a variety of ways. There are two primary methods -- as shown in Table 7 image item results may be provided numerically as a series of X and Y coordinates or, as shown in Figure 33, image items may be displayed with an overlaid scatter plot showing all areas that were selected by

participants. Use of coordinates may provide indications of tendencies to select particular image areas while a composite of participant responses may give researchers an intuitive understanding that other survey item types could not easily provide. The simulated responses shown in Table 7 represent a sample of the coordinates of areas clicked by participants on an image item. Web surveys automate the collection of this type of information and thus increase both research possibilities and research modalities.

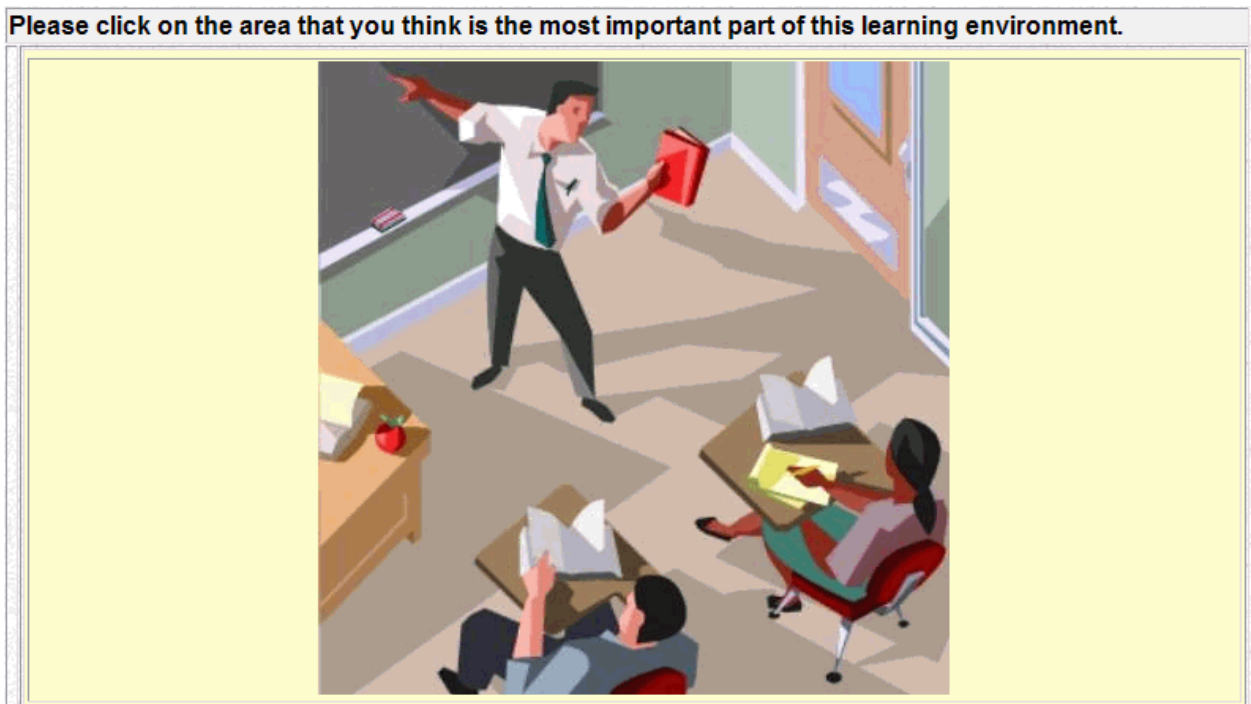


Figure 32: Image item type

Note: Text area image from the BIRAT (Balch, 2006b) online statistical system.

Figure 33 uses simulated data to show how a researcher could use an image item learn that what most participants found to be the most important part of the learning environment with an image centered on the instructor.

Table 7: Image response coordinates

X	Y
377	245
233	63
224	67
48	246
39	50
116	7
175	311
319	222
152	96

Note: Sample data output from the BIRAT (Balch, 2006b) online statistical system. Responses are simulated.



Figure 33: Simulated image item response to the question "Please click on the area that you think is the most important part of the learning environment."

Note: responses from the BIRAT (Balch, 2006b) online statistical system. Responses are simulated.

HIDDEN FORM OBJECTS

Hidden objects are form objects incorporated in a survey whose value is not easily visible to the participant. Hidden content can be collected and modified in a variety of ways including Javascript code that modifies the object. Other uses for hidden objects in Internet survey research include passing information associated with the survey environment such as the time of delivery, participant identification, and timing of responses from item to item.

Associated with the hidden type is the researcher's ability to collect a considerable amount of information about the participants' environments from the header information exchanged between the server and the participant web browser. This includes the unique address of the computer, the type of the browser being used, screen resolution, and the operating system being used by the participant.

It should be noted that the information contained in hidden responses is accessible to participants who are aware of widely understood Internet coding principles. For instance, such knowledgeable participants could simply view the web page code to see what hidden information is included. These same participants may also be aware of the considerable amount of information that may be provided by simply connecting to a server. In short, Internet researchers should consider hidden responses and collection of participant environment information as possibilities that participants may be aware of and have access to.

INTERNET SURVEY SAMPLING CONSIDERATIONS

Internet surveys may not provide a representative sample for all population demographics (Track Marketing Group, 2002; Venier, 1999; Walsh, Kiesler, Sproll, & Hesse, 1992). For example, an Internet based survey exploring why persons choose to not use the Internet does not make sense as the researcher would be unlikely to reach many persons in the target population using the Internet as a delivery mechanism. Fortunately for Internet researchers, the bias towards Internet users is rapidly being reduced as a result of rapidly expanding Internet usage across most population demographics (Gurney et al., 2004; Roster, Rogers, Albaum, & Klein, 2004).

Digital divide issues including computer literacy and access to computers and the Internet also create an environment where Internet surveys tend to under-represent persons who do not have, or choose not to have, access to the Internet (Gurney et al., 2004; Tse, 1998). As shown in Table 8, in a report of 2003 data, the US Census (2005) found that just over half the United States population (54.7%) had a presence on the Internet. This means that almost half the population does not have access to the Internet. Internet presence increased with income and education. Asians and whites had nearly twenty percent more presence than other races.

There are also differences in response rates within the university environment based on academic discipline. Leung and Kebler (2005) found that response rates vary across academic disciplines, with significantly higher response rates to Internet surveys in hard science such as engineering and slightly higher response rates to mailed surveys in

education and social science. They found no significant differences in the reliability of responses that might be related to modes of delivery.

Sample selection is important because, according to a number of researchers, statistics are not accurate unless the sample used is representative of the population identified for purposes of the survey (Andrews, Nonnecke, & Preece, 2003; Creswell, 2002; Hinkle et al., 2003; McGraw et al., 2000; Taylor, 1999; Yeong-Hyeon Hwang & Fesenmaier, 2004). Other researchers (Roster et al., 2004; Taylor, 1999) argue that Internet survey results are valid since quota sampling in sufficient numbers has been proven to provide results similar to random sampling. There is no argument that web based surveys can provide for large sample sizes and thus would allow researchers to meet the criteria of large numbers.

Roster et al. (2004) argue that the generally low response rate of Internet surveys is not significantly different than the low response rates of other survey methods. Regardless of the sampling method, they say, any sample with less than an eighty percent response rate should be considered a convenience sample. Since all survey modalities usually fail to achieve better than a sixty percent response rate, either Internet survey results should be considered just as equally acceptable as other methods, or survey results from all modalities that achieve less than an eighty percent response rate should be discarded.

Table 8: Presence of a computer and Internet in United States Households

Characteristics	Total households	Presence of a computer		Presence of the Internet	
		Yes Number	Percent	Yes Number	Percent
Total Households	113,126	69,936	61.8	61,852	54.7
Age of Householder					
15-24 years		7,115	4,034	56.7	3,350 47.1
25-34 years		19,718	13,543	68.7	11,901 60.4
35-44 years		23,856	17,482	73.3	15,572 65.3
45-54 years		22,905	16,464	71.9	14,922 65.1
55-64 years		16,488	10,405	63.1	9,335 56.6
65 years and over		23,044	8,007	34.7	6,773 29.4
Sex of Householder					
Male		60,058	39,475	65.7	35,264 58.7
Female		53,068	30,461	57.4	26,588 50.1
Race/Hispanic Origin of Householder					
White alone		93,014	59,482	63.9	53,038 57.0
White alone not Hispanic		81,857	54,541	66.6	49,017 59.9
Black alone		13,746	6,136	44.6	4,951 36.0
Asian alone		4,009	2,923	72.9	2,674 66.7
Hispanic		12,023	5,321	44.3	4,326 36.0
White alone or in combination		94,248	60,256	63.9	53,723 57.0
White not Hispanic alone or in combination		81,857	54,541	66.6	49,017 59.9
Black alone or in combination		14,054	6,308	44.9	5,100 36.3
Asian alone or in combination		4,186	3,061	73.1	2,794 66.8
Region of Household					
Northeast		21,570	13,474	62.5	12,155 56.4
Midwest		26,139	16,029	61.3	14,010 53.6
South		40,746	23,974	58.8	21,082 51.7
West		24,671	16,459	66.7	14,605 59.2
Education Of Householder					
Less than high school graduate		16,972	4,740	27.9	3,434 20.2
High school graduate or GED		34,377	17,567	51.1	14,813 43.1
Some college or associate degree		30,320	21,439	70.7	18,967 62.6
Bachelor's degree		20,464	16,753	81.9	15,720 76.8
Advanced degree		10,993	9,437	85.8	8,918 81.1
Family Income					
Total Families		76,617	53,292	69.6	47,536 62.0
Less than \$5,000		1,307	474	36.3	328 25.1
\$5,000-\$9,999		2,374	852	35.9	606 25.5
\$10,000-\$14,999		3,562	1,301	36.5	936 26.3

Table 8: Continued

Characteristics	Total households	Presence of a computer		Presence of the Internet		
		Yes		Yes		
		Number	Percent	Number	Percent	
\$15,000-\$19,999		2,830	1,185	41.9	916	32.4
\$20,000-\$29,999		8,035	4,234	52.7	3,403	42.4
\$30,000-\$39,999		8,126	5,329	65.6	4,493	55.3
\$40,000-\$49,999		5,952	4,564	76.7	4,061	68.2
\$50,000-\$59,999		6,053	4,872	80.5	4,467	73.8
\$60,000-\$74,999		6,927	5,986	86.4	5,650	81.6
\$75,000-\$99,999		7,918	7,112	89.8	6,796	85.8
\$100,000-\$149,999		5,666	5,331	94.1	5,187	91.5
\$150,000 or more		3,626	3,464	95.6	3,378	93.2
Not reported		14,242	8,589	60.3	7,315	51.4
Household Type						
Total families		76,617	53,292	69.6	47,536	62.0
Married couple family		58,433	43,152	73.8	39,176	67.0
Male householder		4,824	2,701	56.0	2,310	47.9
Female householder		13,360	7,438	55.7	6,049	45.3
Nonfamily households		36,509	16,644	45.6	14,316	39.2
Household Size						
1 person		29,926	12,318	41.2	10,434	34.9
2 people		38,034	23,963	63.0	21,430	56.3
3 people		18,198	13,002	71.4	11,557	63.5
4-5 people		23,089	17,889	77.5	16,127	69.8
More than 5 people		3,878	2,764	71.3	2,304	59.4
Children In Household						
With children 6-17 years		30,271	23,054	76.2	20,293	67.0
Without children 6-17 years		82,854	46,881	56.6	41,559	50.2

Note: Adapted from Table 1A, Computer and Internet use in the United States (U.S. Census Bureau, 2005)

OVERCOMING INTERNET SAMPLING BIAS

There are sampling biases inherent in all survey methodologies. Much of this bias results from what portions of the population are excluded from the survey or those portions of the population that are over-sampled. The challenge of achieving a representative sample with Internet surveys may, to a large extent, be overcome. Even though the population of Internet users is increasing, it is not reasonable for researchers

to assume that the population they wish to investigate can be adequately be represented with a sample that only includes Internet users. Indeed researchers must take special care to insure that potential participants in the target population have equal chance of being reached or discovered regardless of the vehicle being used (Couper et al., 2001; Davis, 1997; Eaton, 1997; McConkey et al., 2003).

One way to overcome the Internet survey bias is to use a process similar to stratified sampling where researchers are able to compensate for sampling concerns resulting from different presence rates of various demographics (Crawford et al., 2001; Creswell, 2002; Gall et al., 1996; Hinkle et al., 2003). Unfortunately, correcting for differences in the population requires a known distribution of Internet users in the subgroups of the population. This requirement may not be achievable as the purpose of doing a survey in the first place is often to find population characteristics (Andrews, Nonnecke, & Preece, 2003; Davis, 1997; Eaton, 1997).

Uniform mixed methodology which combines Internet surveys with other survey methods such as phone polling, mail and faxes is another way to reduce method bias (Baron et al., 2005; Cobanoglu & Cobanoglu, 2003; Solomon, 2001).

There are a number of factors that can affect Internet survey results. Many researchers (Leung & Kember, 2005; Roster et al., 2004; Yeong-Hyeon Hwang & Fesenmaier, 2004) worry that issues such as self-selection, attitude, intentions, and differences in methods of survey delivery cause differences in participant perception of surveys. This lack of commonality of experience may invalidate results or it may produce mixed results. Research shows that participants respond differently depending on the type

of media used such as Email, telephone, in-person, or Internet surveys and thus may create a *modality* bias (Dillman et al., 1999; Roster et al., 2004).

The direction and type of this modality bias varies but, in general, responses to instruments delivered in person have less variance than instruments delivered via the Internet. In other words, participants tend to provide more extreme answers on the Internet than when presented with the same items and options using other methods such as in-person, telephone, or mailed paper surveys.

The location and type of the computer used by participants are apparently not an issue that researchers need to be concerned about. McGraw, Tew, and Williams (2000) found that the location of the computer which participants used to take the survey such as in research laboratory, university student laboratory, libraries, college dormitory, or at their home did not make a difference in results. In contrast to much of the discussion above, they also found that results did not vary among factors such as user operating systems, screen resolutions, and web browsers being used.

Some researchers (McGraw et al., 2000; Reips, 2002a) suggest that, inasmuch as Internet surveys are more representational when the target population has a high percentage of Internet users, one way for researchers to avoid the issue of excess weighting towards Internet users is to simply define Internet use a necessary characteristic of the target population.

INTERNET SURVEY DELIVERY MODALITIES

There a variety of ways to reach potential web survey participants on the Internet. Solomon (2001) reports that the most common methods of Internet survey distribution are to either use a link on a web page or a link in an Email "Cover Letter." Links printed in journals, magazines, and newspapers are also occasionally used. The researcher should take great care with printed links to insure that they are not overly and that they are not hard to type.

At first glance Email appears a simple and attractive way to deliver Internet surveys. It is easy to compose Email messages and there are a variety of ways to collect large numbers of Email addresses (Gurney et al., 2004). Another advantage of Internet survey delivery via Email is extremely fast response rates from participants who do respond (Reips, 2002b). Unfortunately, there are problems associated with survey delivery via Email.

Disadvantages of Email delivery include the high number of "bounces" (messages that are undeliverable) for terminated Email accounts and increasing automatic deletion of Email by Spam filters. Whatever the reason, some researchers report lower response rates for Email compared to other methods, such as telephone surveys and traditional mail (Roster et al., 2004). Another problem with Email is reaching a representative sample. Unless a captive audience, such as university students with available institutional information is defined, it is difficult to collect a comprehensive list of Email addresses for most target populations (Eaton, 1997). While it is possible to obtain focused lists of

Email addresses, these lists are usually expensive and are often used for spam, and this can cause recipients to be wary of unsolicited messages.

The most effective way to reduce deletion of Email messages is to send them from a known or trusted address (Eaton, 1997; Heerwegh et al., 2005; Tse, 1998). In the university environment, such trusted addresses would include faculty chairs, Deans, and chancellors.

Opportunistic web delivery methods, such as a link to a survey on a popular website are often used to distribute surveys. These methods include posting links to discussion groups, news groups, chat rooms, use of banner advertisements, and providing links in the press (Cho & LaRose, 1999).

Opportunistic delivery methods are of questionable value because self-selected respondents may not be representative of the target population (Hudson et al., 2004; Simsek & Veiga, 2001; Walsh et al., 1992; Yeong-Hyeon Hwang & Fesenmaier, 2004). Only persons who are motivated to view the page used by the researcher to recruit participants will see the survey link and then only persons motivated to take the survey will follow the link and participate in the survey. Both motivations may reduce the degree to which the sample represents the target population. In other words, people who are indifferent to a survey topic will tend not to take the survey and only those with some strong opinions will provide survey data. On the plus side, it has been noted that motivated survey takers are more likely to complete a survey (Gurney et al., 2004).

EQUIVALENT VALIDITY

Online surveys have shown to have equivalent validity to other survey methods. For example, Einhart (2003) found Internet surveys to have equivalent predictive accuracy as compared with telephone and paper surveys in projects such as predicting the results of presidential elections.

Dilman et al (1999) suggest four main reasons for measurement differences between different modes of survey delivery: (1) social desirability, (2) acquiescence, (3) question order effects, and (4) primary/recency effects. They suggest that these effects can be diminished, if not completely eliminated, by applying a uni-mode design which focuses on writing and presenting questions in a way that ensures respondents receive a common mental stimulus. Thus, multi-mode surveys should be designed in such a way that all participants will perceive the survey in the same way regardless of the mode of delivery. Unfortunately, inherent differences among modalities are likely to make uni-mode design impossible.

PILOT STUDIES

Stanton and Gogelberg (2001) emphasize that survey instrument design and content should be tested before an Internet based survey is distributed. Such testing is particularly important for web based surveys where problems may occur with the content, the manner of presentation, and the delivery/data collection mechanisms.

Pilot studies are one way of testing survey design, delivery, and content. Pilot studies allow the researcher to discover areas where participants are not able to respond

to items in expected ways. For example, some questions should provide a "not applicable" (N/A) option which many survey designers fail to provide (Reips, 2002b). Participants may also find questions' wording and instructions confusing. Inherent in pilot testing is the confirmation that the Internet delivery methodology used in the pilot worked.

Schaeffer and Presser (2003) found that pilot studies, including cognitive interviews where participants were asked to think aloud during their survey experience, were very effective. Such interviews are difficult to do remotely but can be simulated with the use of email, or the participants can take the survey via the Internet in an area where the researcher can observe the participants as they experience the survey. Even if the cognitive interview methodology is used, Pilot surveys should also include an area where users can comment on the structure and content of the survey. Ideally the researcher would also do an exit interview with participants.

Pilot studies are also important in the context of unique web technology issues which include testing the technology to insure that the system works as expected, even in sometimes novel circumstances.

PRIVACY AND SURVEY INTEGRITY

There are a number of types of privacy that Internet surveys can violate intentionally or by accident. It is important not to violate participant privacy for both ethical and validity considerations. Cho and LaRose (1999) point out that there are threats to survey result integrity when privacy is breached. For example, individuals and groups

may boycott the survey or provide false information when they feel the survey attempts to violate their privacy.

According to Cho and Larose (1999) privacy violations include physical, informational, psychological, and invasion of private community space. Solitude or physical privacy is violated when an unwanted intrusion or observation occurs. Anonymity or informational space is violated when the participant loses control of his or her information, such as when information is inappropriately shared or is provided to third parties without the participants' consent. Table 9 reviews a number of privacy issues.

Burgoon et al (1989) found that computer users often identify with their computers as an extension of themselves. Thus, invasions of privacy using a web survey on a personal computer are particularly abhorrent as they violate both information concerns and personal space.

Another form of privacy violation concerns reserve or psychological privacy which occurs when a survey changes the participants' cognition or affects (Burgoon, Parrott, le Poire, & Kelley, 1989). For instance, violation of intimacy or invasion of private community space occurs when a person enters an online community devoted to a particular topic and then distracts from that topic. An off-topic survey distributed to a special interest group on the Internet could be an example of such a distraction. Push surveys, which mask themselves as neutral, while attempting to change the participants' opinion, are another example of privacy violation. Both of these examples would not generally be allowed in a university environment because of rules for academic honesty

and because of concern for the methodology used to select participants. In many cases, Institutional Review Boards (IRBs) will assist in making sure that surveys do not violate privacy.

Not all violations of privacy are perceived to have equal degrees of intrusion. Cho and LaRose (1999) state that the degree of perceived intrusion depends on the type of information requested and is situational. For example, many participants feel questions about gender are less invasive than those about race or income. Participants are also more willing to provide personal information when there is a clear need for the information, such as when a survey seeks to explore age group differences and this has been made clear to the participant at the onset.

Privacy concerns are further complicated by personal safety concerns which are well known problems on the Internet. "Phishing" occurs through misrepresentation of the sender where the recipient is encouraged to give information that allows their financial information to be compromised. For example, the ever increasing number of phishing identity theft attempts should make both survey creators and potential participants all the more careful about web survey design and content and what participants may be exposing themselves to when they agree to take a survey (Cho & LaRose, 1999). Another area of popular concern is the increased use of the Internet by child predators to identify their victims.

With these safety concerns in mind, it is important to insure that sensitive personal information is secure or not collected at all. Thus, an important part of survey design is to explicitly let end-users know how the information collected will be used and

not used. In this context, items should focus on survey issues and should not attempt to collect unnecessary demographics or other data that deviates from the survey's manifest purpose.

Table 9: Selected privacy issue responses from Truste 2004 (Stark, 2004)

Item	Percent
I like registering information on websites because it allows the site to remember me and to customize the content I receive when I visit.	14%
I do not like registering because I have to give personal information about me, but I will do so if it is necessary to obtain content/information that I really want.	71%
I never/almost never register even if I'd like to access content on the site because I have to give personal information.	15%
I trust companies to safeguard my personal information and share it without permission.	Agree 43% Disagree 33%
Percent of persons who trust various organizations to keep their information secure and not share by organization type	
Banks and Financial institutions	69%
Government departments and agencies	48%
Credit card companies	42%
Online shopping sites such as Amazon or eBay	42%
Large retail stores	34%
Internet sites where you register to get services (such as free Email or news)	17%
Importance consumers place on online privacy	
A really important issue that I think about often	64%
A somewhat important issue that I think about sometimes	33%
Not much of an issue / I hardly ever think about it	3%

Participant anxiety about privacy is reduced when surveys come from a trusted source such as a school website and the site clearly provides contact information (Stark, 2004). Participants perceive trusted survey sources to have and enforce strong policies to protect personal information.

INFORMED CONSENT

Most academic survey research requires informed consent by the participant. Printed surveys usually require proof of informed consent via a form the participant signs with a copy they get to keep. On the Internet, it is not reasonably possible to collect signatures and the consent process needs to be modified. Two generally accepted practices for participants demonstrating their consent in Internet surveys are to include the content of the consent message in an Email message or to include an introductory consent page before reaching the content of the survey. In either case, participants indicate their consent by continuing with the survey process and may keep a copy of the consent content in a variety of ways explained to them in the consent statement.

It is worth noting that the act of requesting consent can change the survey results. Informed consent pages appear to have a polarizing effect (Eaton, 1997; Reips, 2002a). In some cases informed consent page increase survey abandonment because of the verbose "legalese" or the added time required to complete the survey. On the other hand, informed consent pages also may provide a "warm-up" that encourages participants to proceed by providing neutral content while still getting some degree of commitment to the survey. Once a participant has invested some time in a survey, they are not as likely to abandon the survey.

INCREASING RESPONSE RATES

Many authors have suggested that the best way to achieve maximum response rates for a target group is through the use of mixed methods of survey distribution

(Bartlett & Alexander, 2002; Carbonaro et al., 2002; Eaton, 1997; Einhart, 2003; Schuldt & Totten, 1994; Solomon, 2001; Truell et al., 2002). Alternative survey methods include traditional mail, face-to-face polling, and telephone surveys. Some of these methods require additional knowledge about participants beyond the Email addresses such as a physical address or telephone numbers. These methods, however, do not provide for self-selection and self-administration on the part of participants with the ease that is possible with Internet surveys.

In a meta-analysis of Internet survey methods, Solomon (2001) concluded that contacting participants before sending out the survey, follow-ups to non-respondents, and personalized contact increased survey response rates. These methods can be used individually or combined. Reips (2002a) reached similar conclusions. It should be noted that use of any participant tracking methods means that the survey cannot be anonymous.

Incentives or rewards are a commonly used and effective method to encourage survey participation and completion (Kypri & Gallagher, 2003). There are some special issues associated with the use of Internet based incentives. Internet based incentives remove anonymity, increase survey cost, and may change the demographics of the sample as the response rates from participants who would not normally respond to the survey increase (Reips, 2002b).

Cobanoglu & Cobangolu (2003) report that the most effective of use of Internet based incentives is a combination of two incentives instead of one. They found that a chance at a larger prize is more effective than small physical incentives, which in turn are more effective than cash. They also suggest that incentives be selected in such a way as

to not bias survey results as might be done with a push survey. The example given was the reward for taking a survey on shampoo should not be a sample of one of the shampoos reviewed as participants may respond more positively to the particular shampoo they receive as a reward.

Incentives should not be so large that a person will take the survey simply to receive the reward. Cobanoglu and Cobangolu (2003) found that discordant feelings and therefore less than accurate responses occur when a person has been encouraged to do something that they would normally not do such as fill out a survey in exchange for a reward. Cobanoglu and Cobangolu (2003) also reported that increases in monetary rewards have little effect in increasing survey response. For example, response rates changed very little between two dollar and five dollar incentives.

Rewards with no measurable monetary value are also effective in increasing participant response rates. Various researchers (Dillman et al., 1998; Joinson, Woodley, & Reips, in press; Reips, 2002a) have found that intrinsic rewards such as personalizing surveys, promising immediate feedback, and promising participant access to the results increase survey response rates.

As discussed in more detail earlier in this paper, other significant factors in increasing response rates are reducing the speed with which pages load and the use of relatively uncomplicated survey design (Dillman et al., 1998; Koyanl et al., 2003; Nielsen, 2004a; VanDuyne et al., 2002).

AUTHENTIC RESPONSE ISSUES

Participants provide incorrect information for a number of reasons. One reason for giving incorrect information is a strong desire to "pass the test" where the participant attempts to provide information that they think the researcher wants and not necessarily information authentic to the user (Nielsen, 2005a). The tendency for participants to provide incorrect information also increases when outcomes of the survey may impact the participant personally, such as on a job application, and when strong incentives such as a reward are offered to encourage participation.

Another source of error in collecting Internet survey information is participant fear of giving personal information to strangers (Simsek & Veiga, 2001). Common and suggested best Internet practices dictate that Internet users not give personal information in response to any request even if it appears to be from a legitimate source. As discussed above, phishing attempts, where message authorship is faked to appear as originating from a legitimate authority in order to trick the recipient into providing personal information have made many potential Internet survey participants wary of providing authentic personal information in response to any source. Some participants may respond to request for personal information by providing incorrect information.

A third area of concern in regard to authentic participant response is software applications designed to automatically complete surveys and other forms. These applications may provide random response or responses designed to bias the survey results in a particular direction. Participants may use these automated survey filling

applications in the hope of increasing their chances of receiving a reward associated with the survey.

Another important factor affecting authentic response is the damage that a participant may anticipate as a result of sharing certain information (Reips, 2002a). For example, if participants believe their survey responses might become available to their employer; participants would be reluctant to respond to or perhaps would provide untrue or incorrect information on a survey exploring the number of days they called in sick when they were actually well.

PARTICIPANT TRACKING

Participant tracking provides some very useful benefits while it also introduces additional complexity to Internet survey design considerations. On the positive side, with participant tracking, researchers can identify users for follow-up, insure that responses are not duplicated, and increase survey response percentages by sending follow-up participation requests (Reips, 2002a; Track Marketing Group, 2002). On the other hand, with participant tracking, the researcher can no longer define responses as anonymous or give the assurance of anonymity to participants. Depending on the content of the survey, lack of anonymity may cause participants to respond differently if they respond at all (Joinson et al., in press).

There are a variety of ways to uniquely identify survey users. One common method to establish identity is to assign each participant a user name and password. Couper, Traugott, & Lamias (2001) point out that tracking with user names and

passwords adds another layer of complexity that might discourage potential participants and increases the need for researcher support as participants have difficulty with their UserID and password. Difficulties include losing the login information and mistyping information provided resulting in a failure to answer the survey. The authors suggest that, if user names and passwords are to be used, it is a best practice to avoid ambiguous characters like O/0 (Letter oh/number 0) and I/1 (letter "i"/number one) and to use relatively short and simple UserIDs and passwords. Unfortunately use of relatively simple identification increases the risk that unwanted third parties can fake their identity and participate in the survey.

Another way to track participants is to assign each of them a unique and large random number and include this number as part of a link to the survey (Reips, 2002a). This method does not avoid the problem of users having to type a complicated link. BIRAT (Balch, 2006b) is an example of a survey system that uses this unique identifier method. It should be noted that there is also the possibility of a hacker trying numerous numbers in an effort to discover "active" numbers. This type of invasion is easily detected by reviewing the unique Internet Protocol (IP) address of persons who met the survey identification system challenge. Numerous attempts to discover a working number from the same IP address could be ignored.

Online environments where unique user information is required in order to participate, such as content management systems, courseware systems, and bulletin boards, also provide possibilities for insuring unique participation. Of course the issues associated with lack of anonymity exist in these environments as well. In addition, the software programs associated with these systems often do not make it possible for

external programs to share their resources, including user lists. This limits the researcher to the survey tools associated with the system used mutually by the researcher and the participant. These survey tools, when they exist, may be inferior or may not otherwise address the researcher's needs.

DETECTING MULTIPLE ENTRIES

Multiple responses to self-selected and self-administered surveys are a problem because some participants may wish to "stuff the ballot box" and skew the results by taking surveys multiple times. Fortunately, there are ways to test for multiple entries while not using code that uniquely identifies users. Methods for testing for multiple entries include analyzing data for duplicate responses, testing for the originating IP address of the computer, and time sequence analysis.

These methods to detect multiple entries have weaknesses. For example, many modern network environments use the common networking addressing protocol (NAP) where the entire network appears to come from a single address. This creates the possibility for false positives on duplicate IP addresses in a scenario such as when a group of students in a lab participate simultaneously.

CONSIDERATIONS IN INTERNET SURVEY SYSTEM SELECTION

Table 10 provides a rubric for reviewing Internet survey design systems based on the discussion above.

Table 10: A Rubric for Reviewing Internet Survey Design Systems

Criteria	Discussion
Web Site	The Internet address of the survey development system.
Item Limitations	While in practice it not usually a good idea to create a survey that had a large number of items because lengthy surveys discourage participation, researchers and survey designers need a system that provides a reasonable number of items. I would say that fifty is a reasonable number. All of the reviewed survey systems either provided no limitations on item numbers or had limits so low (n=10) that that the survey system would not be useful to a researcher.
Participant Limits	Many free or low cost survey systems limit the number of participants. Limiting the number of participants can be a problem to researchers using surveys with self-subscribed participation.
Pricing	Many researchers are on minimal or no budgets. A review of Internet websites shows that price is very loosely related to quality.

Survey Item Issues

Number of Item Types	My review of the number of reported item types shows that there are wide differences in how Internet survey designers measure the number of item types in their offerings. In example, multiple choice with only one choice may be described as semantic differential style items or a horizontal variation of multiple choice with one choice.
MC- One Choice	Multiple choice with only one choice is the most common item type offered on Internet surveys. This item type includes the possibility of polling for the most popular response.
MC - MC	Multiple choice with multiple choices provides the participant with the possibility to include more than one response to a list of options. This item type should provide the survey designer with the possibility of selecting other and a text box for the participants to include alternative responses.
Customizable Scales	The number of options presented on a scale is very important to many researchers.
Short Answer	Short answer provides the opportunity for respondents to provide an open-ended response. This possibility is very important for survey research.
Adjust text box size	The response area for this item is measured in characters. As the size of the response area influences the participant response, it is important that the researcher be able to change the size of the response area.
Essay	Essay response areas provide the participant with an opportunity to give a lengthy open ended response.
Adjust Essay area size	The response area of this item type is measured in lines. As the size of the response influences the participant response, it is important that the researcher be able to change the size of the response area.

Table 10: Continued

Criteria	Discussion
Semantic Differential	Many of the reviewed survey systems did not consider semantic differentials a unique item type. Instead, they provide the possibility for horizontal and vertical multiple choice with one response option. The horizontal option provided the possibility for semantic differential type questions.
N/A option	Essay response areas provide the participant with an opportunity to give a lengthy open ended response.
Question Batteries	Question batteries or matrices provide the ability to provide a common set of questions with grouped instructions.
Unique Item types	Does the Internet survey design system provide unique item types?
Date and Time Item	Does the Internet survey design system provide for an item type that is specially suited to receiving date and time information?
Rank Order	Does the Internet survey design system provide for an item type that is specially suited to receiving ranking information? Some survey systems provide background logic to insure that the participant accurately responds to the ranking specified by the researcher.
Pages	The ability to present Internet surveys in multiple screens or pages is controversial. On the one hand multiple screens control presentation and thus the participant experience. On the other hand multiple screens can delay participant experience and thus reduce responses.

Survey Design Issues

Ease of editor use	While any editor is relatively easy to use once it has been learned, the amount of time it takes to learn to use the editor is a very important criterion in survey system selection.
Reorder questions	A good survey editor should allow the survey designer to change the order of the questions.
Use of JavaScript	While Javascript provides the opportunity to monitor participant responses, researchers should not depend on participants allowing Javascript on their browsers.
Use of color	Proper use of color can help to instruct and guide participants through a survey.
Embed Multimedia	The ability to include multimedia, such as images, is occasionally desirable to survey designers.
Require Answers	The ability to require that a question be answered is often desirable to researchers. This function is somewhat controversial in that requiring answers can antagonize participants and thus reduces response rates or increase the number of incorrect responses to surveys.
Exit Message Screen	The ability to present an exit message screen is often desirable. Common uses for exit message screens are to thank the participant for completing the survey, or to direct the participant to next tasks such as a review of the

Table 10: Continued

Criteria	Discussion
	results from all participants.
Templates	Many survey systems allow the survey designer to select from among a number of templates that give the resultant survey a different look and feel. I feel it is more important that color be used properly than to have a number of schemes that all do not use color appropriately.
Duplicate Survey	Some survey systems allow previous surveys to be duplicated so that they can be reused. Some systems also provide for a question bank to help build new surveys. Some researchers may find the sharing of their items distasteful.
Password Protect Survey	Some survey systems allow for user authentication through the use of passwords. These passwords are occasionally called tokens. In practice, the researcher provides a password to the user when they inform the participant of the survey's location.
Store Partial Results	Some surveys allow the participant to store partial completed surveys so that they can return to the survey and finish it later. This feature could be useful for long surveys but I wonder whether response rates would increase or decrease when participants can partially abandon the survey. In short, will the participants come back to complete the instrument?
Load Time	Load time is a subjective measure of how long it takes for a survey to load on the participant's computer. Research has found that longer load times directly affect participant abandonment of surveys. Some factors that affect load times are the complexity of the survey code, survey length, and the amount of load the survey system is under.
Progress Bar	Progress bars show participants the percentage of the survey that has been completed. Research in this in the use of progress bars is inconsistent. Some research shows that progress bars increase participant retention while other research finds that progress bars reduce response rates.
Web Page Complexity	Web page complexity is a measure of how much code is created by the survey development system. This code can include HTML, Javascript, and CSS. The greater the complexity of the code, the more likely it is that the page will behave in ways the survey designer does not expect.
Advertisements	Some free web survey systems insert banner advertisements or company logos on the surveys they create. These graphics can distract participants and influence results.
Section 508	Section 508 is the federal code that describes how web pages should be designed in order to be accessible to physically challenged participants.
Pull Down Menus	Perhaps the biggest problem for persons with a physical challenge involving vision is the use of pull-down windows on web pages. Web page reading software has great difficulty reading these menus in a coherent way.
Graphics Instead of HTML objects	HTML and related languages have evolved to the point where it is possible to use many objects, particularly images, in new ways. Unfortunately, using a graphic image instead of a traditional object, such as a button, leads to participant confusion and subsequent deterioration of the quality of the collected data.

Table 10: Continued

Criteria	Discussion
Branching	Branching provides the ability to show or not show items on the survey page depending on previous responses. Branching is often used in scenarios such as when the participant is instructed to skip some items if the response to a previous item is in a certain range. With branching logic, the participant would not even see the questions that are to be skipped. The biggest problem with branching is that it brings into question the commonality of participant experience which in turn brings into question the pooling of the data.

Participant Management

HTTPS	HyperText Transfer Protocol Secure is the protocol for sending secure web pages. When sensitive data is collected, researchers will often want to send surveys using the HTTPS protocol. If there is no need for security the traditional HTTP protocol is preferred as the HTTPS protocol adds to survey sizes and server loads.
Language Underlying Database	Language refers to the computer language that the survey is written in. It is difficult to envision a survey system that does not use some sort of underlying database where participant responses are recorded. The ability of the survey to fulfill its objectives is thus fundamentally associated with the quality of the database it uses.
Hosting Possibilities	It has been found that participant response rates increase when surveys are perceived to come from a trusted source. One area that participants look at in order to distinguish the source of the survey is the Universal Resource Locator (URL) of the survey. Thus it is to researcher's advantage to be able to download and install a copy of the survey system to a server under their control.
Export Data	While a good survey system will provided some data analysis, researchers will often have unique data analysis needs. Thus it is important for the survey system to be able to export results in a format that can be read by advanced statistical programs.
Analysis	Survey systems vary with the amount of analysis that they can perform. Some basic data analysis is very helpful but new and extended features may not be desirable as data analysis should be performed by a program that has been fully tested and found acceptable by the academic community.
Open Source	Open source refers to a practice where some developers provide the original product code with their product. Access to the source code provides survey designers with the option to create modifications and add to the code.
Lock Survey for Editing	Some survey systems provide the option of locking the survey for editing. Participants cannot take a survey that is locked.
Specify Survey Dates	Some survey systems provide the option to limit survey availability by date and time at design time. This may be more convenient to a researcher than simply providing the survey when it is allowable to take it, then removing

Table 10: Continued

Criteria	Discussion
	the survey from public view when additional participation is no longer desired.
Email	The ability for the survey system to send Email directly and in bulk is occasionally a very important criterion in survey design. This feature is also associated with participant tracking.
Email Selected	Survey systems with Email capability should be able to send a single message and/or messages to a subset of the participants.
Bulk Email Addition	The ability to add users and their Email addresses in bulk is very important when a researcher wants to do participant tracking.
Participant Tracking	It is often desirable to track unique participants so as to know the time of last response, or to know if the participant has responded at all. In addition, repeat invitations to participants can increase response rates.
Participants can Change Answers	It is occasionally desirable to allow participants to review previous answers and change their response as they proceed through the survey. This option is particularly useful when the researcher is using the survey system as a tool to monitor the current status of group opinion.
Randomization of Responses	Some researchers consider it important to be able to randomize the order of item options. The ability to change the order is only useful with nominal data and may not be desirable for two reasons. First changing the order would only mask the effect of pattern responses and, when participants do not experiences are different, the commonality of experience is questionable.
Time Taken to Complete	It is often desirable to track the time it took the participant to complete a survey. Note that this number only represents the time from delivery to submittal and does not track the actual time the participant spent completing the survey. For instance, a participant might retrieve the survey, then be distracted by another task, then return to the survey later on.
Public Registration	Public registration provides the ability for participants to register for the survey and be placed in the survey's user tracking system. This feature could help reduce researcher effort as the researcher will not need to do the tedious chore of entering many users.

NEED FOR ANOTHER INTERNET SURVEY SYSTEM

Internet survey systems are essentially a type of Computer Aided Software Engineering (CASE) tools dedicated to the creation of surveys, delivery of surveys, survey data collection, and analysis of the survey results. In addition, Internet survey systems often provide an option to export data to a more robust statistical tool such as SPSS (SPSS, 2004). When a survey is developed using an Internet survey development

tool, the participants' survey experience and the resultant quality of data collected are dependant on the effectiveness that tool. Of equal concern to the researcher is the Internet survey system's capabilities to collect, analyze, and export data.

While there is no single ideal web research system, there are a number of survey system products available that fill important niches. Surveys are used for a variety of reasons and the ideal Internet survey system feature set depends on the researcher's needs. The ideal research tool will both address specific researcher needs and allow the researcher to make fundamental changes and expansions to the Internet survey system feature set as needed.

A recent search (Google, 2006a) for Internet survey systems found over three hundred different Internet survey systems. While there are many Internet survey systems, most were not designed with consideration to creating instruments that reflect best practice as defined by research. In addition, few Internet survey systems are designed so that they can be modified to reflect constantly changing best practices as developed by research and professional practice. Even fewer survey systems are designed in an open source format that allows for researchers or their colleagues to add and modify features to the survey development system to address unique research needs and evolving best practices. Those survey systems that are designed in an open source format are often written in languages that may be hard for some researchers to modify or install/run on the Internet servers available at their institution.

However, not all survey system modifications need to be done by the researchers themselves. Some researchers are fortunate to have access to an information technology

resource center willing and able to create a survey designed to their specifications.

Survey research are active at the University of Michigan, the University of California at Berkeley, Princeton University, and Indiana University. Even those researchers who have access to the information technology centers may discover that, while the technology center may be able to create the desired survey, the resource center may be unaware of many of the important considerations in Internet survey design such as are discussed here.

There are a variety of "free" web survey systems that include hosting but do not provide access to the fundamental code that would allow surveys to be modified. Free and hosted web surveys are usually limited versions of more expensive systems or trial offers. As an example, QuestionPro allows free creation and hosting of surveys up to a hundred responses which is a very small number for Internet surveys. The free version of Survey Monkey (SurveyMonkey.com, 2006) is limited to ten questions and one hundred responses. The professional version of Survey Monkey allows up to a thousand responses a month with additional responses costing fifty cents per response. Zoomerang (Zoomerang, 2006) costs \$350-599 a year for unlimited use and a free version is available with a limit of one hundred responses and ten day availability. The deceptively named FreeOnlineSurvey (Problem Free Ltd., 2006) allows up to fifty responses to twenty questions over a period of ten days. With FreeOnlineSurvey, researchers cannot review the survey results if the response count exceeds fifty or the ten day limit is exceeded unless they pay for a subscription costing \$19.99 a month. It is of critically important to note that the surveys created with all of the above Internet survey systems do

not follow best practices in Internet survey design as defined by research and as discussed in this paper.

For those without access (or with affordable access) to customized survey development services, other survey packages are available which are full featured and some include a free trial. Survey Said (Survey Said, 2005) is an example of a survey package with no trial offer. The price for Survey Said ranges from \$999 to \$2,977 depending on features and there are also a variety of add-ons that can increase the price. Another package, Vista (Vanguard Software Corporation, 2006), includes features such as a very secure environment and reasonable ease of use. However, after the trial period, Vista costs \$199. This price is low compared Survey Said and the cost of using enterprise level system of Perseus (Perseus Development Corporation, 2006) at \$3,000 a year is even higher. Perseus is also associated with considerable and expensive support services (Perseus Development Corporation, 2006). On the other hand, QuestionPro (QuestionPro, 2006) provides a number of survey options at prices ranging \$29 to \$249.

While all of these packages are full featured, they do not allow the researcher access to the source code and few allow the researcher to install the package on their own servers. Participants may be disinclined to respond to a survey that is not associated with the researcher's known web address for a variety of reasons, including lack of trust and an unwillingness to change web addresses.

Very few systems are available which are in open source. Open source software is released with the code that created and the software which may be installed. Open source code allows researchers to install the survey system on their own server, review and adapt

the survey system to insure systems reliability, and add or modify capabilities. Open source combined with a public license to share the code is a desirable feature in Internet survey development. Any survey package is likely to be outmoded quickly by new developments. This combination would make it possible to create a survey package freely available to anyone and to create a community of users and developers that continuously improve and upgrade the package. For \$19, Our Web Survey from Aspin (Index, 2006) comes with open source ASP based code and limited item types. While the price is reasonable, the limited feature set of Our Web Survey reduces its attractiveness and, because it is a commercial, proprietary product any improvements or adaptations made by one user cannot be freely shared with other researchers researcher's modification to the open source code could not be shared with the academic community. Two free and open source Internet survey packages that that are already in use are PHPSurveyor (PHPSurveyor.org, 2006) and Web Survey Toolbox (Mindframes, 2006). PHPSurveyor has a substantial associated community, and is written in the PHP computer language. To run properly, PHPSurveyor requires some substantial and hard to maintain associated software such as a PHP language interpreter, the basics of MySQL database software, and fundamentals of maintaining an Internet server. Most researchers will not be interested in taking on a new career as web designer and support specialist. The typical usage pattern of PHPSurveyor is probably with a team setting the research has access to the technical specialists who can install and maintain the required hardware and software. Web Survey Toolbox is also free, open source, and based on MySQL. While popular, Web Survey Toolbox is currently in an Alpha version which indicates the authors believe there is room for considerable improvement. Web Survey Toolbox is written with the

Java programming language. The usage pattern of Web Survey Toolbox would probably be similar to PHPSurveyor.

A REVIEW OF SELECTED INTERNET SURVEY SYSTEMS

Table 11, Table 12, Table 13, Table 14, and Table 15 review a representative sample of nine survey packages using the rubric developed earlier. While no survey system was found complete or perfect, the PHP surveyor seems to have the most complete feature set.

Table 11: Review of QuestionPro Features

Criteria	QuestionPro
Web Site	http://www.questionpro.com
Item Limitations	None
Participant Limits	Free 1 month and 100 participants, unlimited
Pricing	Free academic use of one survey, 5000 responses, otherwise \$15-\$249 a month.
Number of Item Types	20
MC- One Choice	Yes
MC - MC	Yes
Customizable Scales	Yes
Short Answer	Yes
Adjust text box size	No
Essay	Yes
Adjust Essay area size	No
Semantic Differential	Yes
N/A option	No
Question Batteries	Yes
Unique Item types	No
Date and Time Item	No
Rank Order	Yes
Pages	Yes
Ease of editor use	Slightly Complex
Reorder questions	Yes
Use of JavaScript	Required
Use of color	Busy

Table 11: Continued

Criteria	QuestionPro
Embed Multimedia	Yes
Require Answers	Yes
Exit Message Screen	Yes
Templates	Yes
Duplicate Survey	No
Password Protect Survey	Yes
Store Partial Results	No
Load Time	Slow
Progress Bar	Yes
Web Page Complexity	Complex
Advertisements	No
Section 508	No for some item types
Pull Down Menus	No
Graphics Instead of HTML objects	No
Branching	Yes
HTTPS	Yes
Language	?
Underlying Database	?
Hosting Possibilities	No
Export Data	Excel
Analysis	Extended
Open Source	No
Lock Survey for Editing	Yes
Specify Survey Dates	Yes
Email	Yes
Email Selected	Yes
Bulk Email Addition	Yes
Participant Tracking	Yes
Participants can Change Answers	No
Randomization of Responses	Yes
Time Taken to Complete (seconds)	Yes
Public Registration	No

Table 12: Review of Survey Monkey and Zoomerang

Criteria	Survey Monkey	Zoomerang
Web Site	http://www.surveymonkey.com	http://info.zoomerang.com
Item Limitations	Free 10, Unlimited	Free 30, unlimited
Participant Limits	Free 100, Unlimited	Free 100, unlimited
Pricing	\$19.95 a month for 1,000 responses, \$.05 for each response past 1,000.	\$599 year with 40% academic discount

Survey Item Issues

Number of Item Types	12	9
MC- One Choice	Yes	Yes
MC - MC	Yes	Yes
Customizable Scales	Yes	Yes
Short Answer	Yes	Yes
Adjust text box size	No	No
Essay	Yes	Yes
Adjust Essay area size	No	No
Semantic Differential	Yes	Yes
N/A option	No	No
Question Batteries	Yes	Yes
Unique Item types	No	No
Date and Time Item	No	Yes
Rank Order	Yes	Yes
Pages	Yes	Yes

Survey Design Issues

Ease of editor use	Good	Bad
Reorder questions	Yes	Yes
Use of JavaScript	Required	Required
Use of color	Themes (some awful), but not for organization.	Themes but not for organization
Embed Multimedia	Just a logo	Yes
Require Answers	Yes	Yes
Exit Message Screen	Yes	Yes, with ads for Zoomerang
Templates	Yes	Yes
Duplicate Survey	No	Yes
Password Protect Survey	No	No
Store Partial Results	Yes	No
Load Time	Fast	Fast
Progress Bar	No	No

Table 12: Continued

Criteria	Survey Monkey	Zoomerang
Web Page Complexity	Complex	Complex
Advertisements	No	Zoomerang branding on survey
Section 508	No for some item types	No for some items
Pull Down Menus	No	Yes
Graphics Instead of HTML objects	Yes	Optional
Branching	Yes	Yes
Participant Management		
HTTPS	Yes	No
Language	ASP	?
Underlying Database	?	?
Hosting Possibilities	No	No
Export Data	Excel	CSV
Analysis	Good	OK
Open Source	No	No
Lock Survey for Editing	Yes	No
Specify Survey Dates	Yes	Yes
Email	Yes	Yes
Email Selected	Yes	Yes
Bulk Email Addition	Yes	Yes
Participant Tracking	Yes	Yes
Participants can Change Answers	No	Optionally
Randomization of Responses	No	No
Time Taken to Complete (seconds)	No	No
Public Registration	No	No

Table 13: Review of FreeOnlineSurveys and PHP Surveyor

Criteria	FreeOnlineSurveys	PHPSurveyor
Web Site	http://freeonlinesurveys.com	http://phpsurveyor.org
Item Limitations	None	None
Participant Limits	Free 50, Paid 1,000	None
Pricing	\$19.95	Free

Survey Item Issues

Number of Item Types	9	18
MC- One Choice	Yes	Yes
MC - MC	Yes	Yes
Customizable Scales	Yes	Yes
Short Answer	Yes	Yes
Adjust text box size	No	Yes
Essay	Yes	Yes
Adjust Essay area size	No	Yes
Semantic Differential	Yes	Yes
N/A option	No	No
Question Batteries	Yes	Yes
Unique Item types	No	No
Date and Time Item	No	Yes
Rank Order	Yes	Yes
Pages	Yes	Yes

Survey Design Issues

Ease of editor use	OK	Very Complex
Reorder questions	Yes	Yes
Use of JavaScript	Required	Not Required
Use of color	Themes, but not for organization	OK
Embed Multimedia	Yes	Yes
Require Answers	Yes	Yes
Exit Message Screen	Yes, with ads for FreeOnlineSurveys	Yes
Templates	No	Yes
Duplicate Survey	Yes	Yes
Password Protect Survey	No	Yes
Store Partial Results	No	Yes
Load Time	Fast	Fast
Progress Bar	No	No
Web Page Complexity	Medium	Low
Advertisements	FreeOnlineSurveys Branding	No
Section 508	Yes	Yes

Table 13: Continued

Criteria	FreeOnlineSurveys	PHPSurveyor
Pull Down Menus	No	No
Graphics Instead of HTML objects	No	No
Branching	No	Yes
Participant Management		
HTTPS	No	Optional
Language	ASP	PHP
Underlying Database	?	MySQL
Hosting Possibilities	No	Required
Export Data	Individual responses are emailed	Excel, CSV, Word
Analysis	Basic	Raw
Open Source	No	Yes
Lock Survey for Editing	No	Yes
Specify Survey Dates	No	Yes
Email	Yes	Yes
Email Selected	No	Yes
Bulk Email Addition	Yes	Yes
Participant Tracking	No, but results are emailed	Yes
Participants can Change Answers	No	Yes
Randomization of Responses	No	Yes
Time Taken to Complete (seconds)	No	No
Public Registration	Yes	Yes
Notes	Allows answers in multiple columns	Does not provide for Password protection of editing or data. Must put software on your server.

Table 14: Review of SelectSurvey .NET and Prezza Ultimate

Criteria	SelectSurvey.NET	Prezza Ultimate Survey
Web Site	http://www.classapps.com	http://www.prezzatech.com
Item Limitations	None, must purchase	None, must purchase
Participant Limits	None, must purchase	None, must purchase
Pricing	\$399	\$3,999 plus add-ons

Survey Item Issues

Number of Item Types	21	10
MC- One Choice	Yes	Yes
MC - MC	Yes	Yes
Customizable Scales	Yes	Yes
Short Answer	Yes	Yes
Adjust text box size	No	Yes
Essay	Yes	Yes
Adjust Essay area size	No	Yes
Semantic Differential	Yes	No
N/A option	Yes	No
Question Batteries	Yes	Yes
Unique Item types	No	No
Date and Time Item	Yes	No
Rank Order	Yes	Yes
Pages	Yes	Yes

Survey Design Issues

Ease of editor use	Good	Moderate
Reorder questions	Yes	Yes
Use of JavaScript	Yes	Required
Use of color	Themes only	OK
Embed Multimedia	Yes	Yes
Require Answers	Yes	Yes
Exit Message Screen	Yes	Yes
Templates	Yes	Yes
Duplicate Survey	Yes	Yes
Password Protect Survey	Yes	No
Store Partial Results	No	No
Load Time	Fast	Fast
Progress Bar	Yes	No
Web Page Complexity	Low	Complex
Advertisements	No	No
Section 508	Yes	Yes

Table 14: Continued

Criteria	SelectSurvey.NET	Prezza Ultimate Survey	
Pull Down Menus		No	Yes
Graphics Instead of HTML objects		No	Yes
Branching		No	Yes

Participant Management

HTTPS		Optional	Optional
Language		.NET	.NET
Underlying Database		MS SQL	MS SQL
Hosting Possibilities		Yes	Yes
Export Data		CSV	CSV, SPSS
Analysis		Basic	Basic
Open Source		No	No
Lock Survey for Editing		Yes	Yes
Specify Survey Dates		No	Yes
Email		Yes	Yes
Email Selected		Yes	Yes
Bulk Email Addition		Yes	Yes
Participant Tracking		Yes	Yes
Participants can Change Answers		No	No
Randomization of Responses		Yes	Yes
Time Taken to Complete (seconds)		Yes	Yes
Public Registration		No	No

Table 15: Review of Advanced Surveys and Cool Surveys

Criteria	AdvancedSurvey	Cool Surveys
Web Site	http://www.advancedsurvey.com	http://www.coolsurveys.com
Item Limitations	Limit of 500 Characters in total of questions	1 Question
Participant Limits	None	None
Pricing	Free	Free

Survey Item Issues

Number of Item Types	2	1
MC- One Choice	Yes	Yes
MC - MC	Yes	No
Customizable Scales	Yes	No
Short Answer	No	No

Adjust text box size	No	No
Essay	No	No
Adjust Essay area size	No	No
Semantic Differential	No	No
N/A option	No	No
Question Batteries	No	No
Unique Item types	No	No
Date and Time Item	No	No
Rank Order	No	No
Pages	No	No

Survey Design Issues

Ease of editor use	Moderate	Simple
Reorder questions	Yes	No
Use of JavaScript	Yes	No
Use of color	No	No
Embed Multimedia	No	No
Require Answers	Yes	No
Exit Message Screen	Yes	Yes
Templates	No	Yes
Duplicate Survey	No	No
Password Protect Survey	No	No
Store Partial Results	No	No
Load Time	Fast	Fast
Progress Bar	No	No
Web Page Complexity	Simple	Simple
Advertisements	Yes	Yes
Section 508	Yes	Yes
Pull Down Menus	No	No
Graphics Instead of HTML objects	No	No
Branching	No	No

Participant Management

HTTPS	No	No
Language	ASP	PHP
Underlying Database	?	?
Hosting Possibilities	No	No
Export Data	No	No
Analysis	Very Basic	Very Basic
Open Source	No	No
Lock Survey for Editing	No	No

Specify Survey Dates	Yes	No
Email	Yes	No
Email Selected	No	No
Bulk Email Addition	Yes	No
Participant Tracking	No	No
Participants can Change Answers	No	No
Randomization of Responses	No	No
Time Taken to Complete (seconds)	No	No
Public Registration	No	No
Notes		This site helps you create a survey that can be inserted on a web page. The results popup with an ad.

There is a need for flexible, open source survey system with few technical requirements. While there are many very good Internet survey packages unavailable today, the summaries in the previous tables indicate there is no existing package that meets the following criteria:

1. I based on best practice from the research and practice literature
2. Is freely available without cost to potential users.
3. Is developed using the open source mode that encourages users to contribute to the development process.
4. Has low technical requirements, both for instillation and ongoing maintenance.
5. Is a complete system that supports survey design, survey administration, data collection, data analysis, and/or data export.

The focus of this dissertation is the creation an Internet survey system that meets these requirements.

Balch Internet Research and Analysis Tool (BIRAT) (Balch, 2006b) is a research based system with fewer technical requirements of a research based survey system focused on researcher needs that also meets government standards for web based handicap access (Center for Information Technology Accommodation, 2002). In addition, BIRAT provides a robust and open source online system that offers the current standard item types plus a few experimental items. The open source nature of BIRAT encourages the addition of other item types and features as needs and best practices require. The BIRAT feature set is also at least as comprehensive and extensive as the best of existing open source and inexpensive systems with providing provisions for easy expandability. Finally, the BIRAT is designed to create surveys that meet current best practices in survey design.

CHAPTER THREE: METHODOLOGY/SOFTWARE DEVELOPMENT

There are a number of considerations to be kept in mind in the software development process. First, there must be a need for the new product. The previous chapters in this dissertation have established the need for "another" Internet survey package. Once a need is identified, a development model must be selected, initial product specifications must be defined, a programming environment must be chosen, software developed, as well as progressively more complete prototypes and drafts of the package "completed" product evaluated in the context of their ability to meet user needs.

Another aspect of product development is adoption. Even the best of technologies have no value if they are not used or adopted. Adoption theories focus on user awareness of the application, the utility of the application, and the natural hesitation of potential users to adopt new technology.

However, no software product is ever "finished" or completed in the sense that no more improvements or adaptations are possible. As shown in Figure 34, the coding effort required to provide various participant environments increases exponentially as additional user and environment needs are addressed. In addition, as the number of users increases, modifications are often mandated because expanded usage exposes additional flaws as well as additional needs. Further, user needs change as new methodologies and new capabilities are discovered and endorsed. Thus the process of development,

including adoption and use, can be thought of as a continuous and iterative process (Brooks, 2004).

<p>A Program A program is complete and ready to be used by the author and run on the system for which it was developed. The programming code is not well documented and is difficult for anyone but the author to maintain.</p>	<p>A Programming System A collection of interacting systems coordinated in function so that the entire facility is able to accomplish large tasks. This requires a disciplined format with clearly defined inputs and outputs. Requires three times the effort of creating a program.</p>
<p>A Programming Product A product written in a general fashion that can be used maintained by other programmers. In addition, the program is tested with a number of test cases. Requires three times the effort of creating a program.</p>	<p>A Programming Systems Product The ideal product combining the best attributes of both the Programming System and the Programming Product. Requires nine times the effort of creating a program.</p>

Figure 34: Programming complexity increases as systems address more needs
Note: Brooks Programming System Product adapted from page 5 (Brooks, 1982)

According to Simonelis (2004) the software programming environment has changed considerably over the last few decades. The original binary code was replaced by high-level programming languages that empowered programmers in new ways giving programmers access to more capabilities. Programming models evolved as the languages evolved. For instance, high-level languages first offered the possibility for structured programming, then object-oriented programming, and then client-server/distributed-object programming. Program design and modeling methods have also evolved as programming environments evolved and the software system end-products have become more complex.

Bleicher (2003) offers another lens for understanding software development taxonomies. He suggests that despite the often quoted rigorously linear models of software development, such as the Waterfall model often taught in classrooms, what

actually happened as corporations develop software is a chaotic and organic growth of enterprise software. He suggests this is a result the diversity of user needs, abilities, and roles. Further chaotic development occurs because it is not often possible to start fresh. Enterprise software must often interoperate with a variety of legacy, or older mission critical software applications.

After decades as a professional programmer and computer information systems professor, I have reached a number of conclusions about program development:

- Software development is an art of discovery as well as finding a balance between what is possible, what is wanted, and what is needed.
- Given specific goals and specifications, the programming required to create an application is relatively easy.
- Defining goals and specifications are the most difficult parts of software development.
- The ideal application for any purpose has not and cannot be universally defined, because specific user needs, skills, and environments vary widely.
- Regardless of what is often claimed in computer information systems classrooms, most software development is a fluid, chaotic, and iterative process.
- No reasonably complex programming system product is stable and complete.

SOFTWARE DEVELOPMENT MODELS

It should be noted that software development models provide the framework and guidelines for development, not the programming techniques used to create software applications. Many professional programmers consider models to be only general guidelines and they report that they do not closely follow any particular model for their development (CrystalTech Forums, 2006; Learning Times, 2006). However software and instructional design theory has evolved to reflect current practices. Constructivist, chaotic, and non-linear models that match modern programming environments and user expectations are now available (Willis, 2000; Willis & Wright, 2000). There are a variety of models or methods used to structure and guide the development of software systems and many of these methodologies share similar descriptions.

Software development models may be divided into two classes: process/linear models and chaotic/non-linear models. While there are a number of variations, process models provide a well-defined, process driven, linear, and well-documented process. Chaotic models are very iterative and respond rapidly to changes in stakeholder needs as well as new knowledge and understandings that emerges from the development process.

As shown in

Figure 35, process models share fundamental stages: definition of requirements, program design, implementation or adoption, and testing. Process models vary relative to the amount that they expand and define these stages, differences in the rapidity or existence of iteration, and stage order.

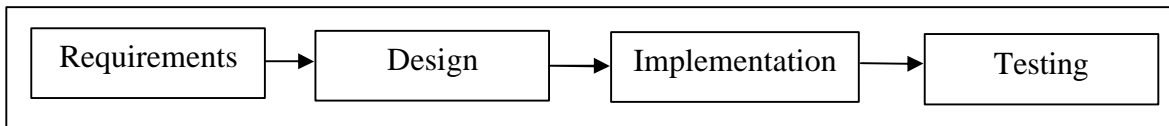


Figure 35: General software development life cycle or process model features

The Waterfall model is one of the most popular representations of the Software Development Life Cycle (SDLC) models (Bleicher, 2003). In the Waterfall model each development stage is completed before the next stage is started. Eventually the development is complete when the last stage is finished much as water flows from one pool to another lower pool. Each pool is filled or completed as the water descends from pool to pool (stage to stage). There is no returning to earlier stages. In other words, the output of each stage (pool) is the input of the next stage. This rigid linear development methodology is useful in making sure that a quality product is developed that exactly meets initial specifications. Yet this methodology also inhibits creativity and can inhibit ongoing participation of eventual program users in the development process. Linear models typically assume the work of software development must be done by experts who have some special expertise. The roles that end users can play are carefully defined and tightly controlled by the experts. End users are generally treated as another source of data rather than as participants in the process of design and development. Alienation of users from the development process is common and can slow eventual adoption of the software product. As shown in Table 16, the waterfall model can be further expanded.

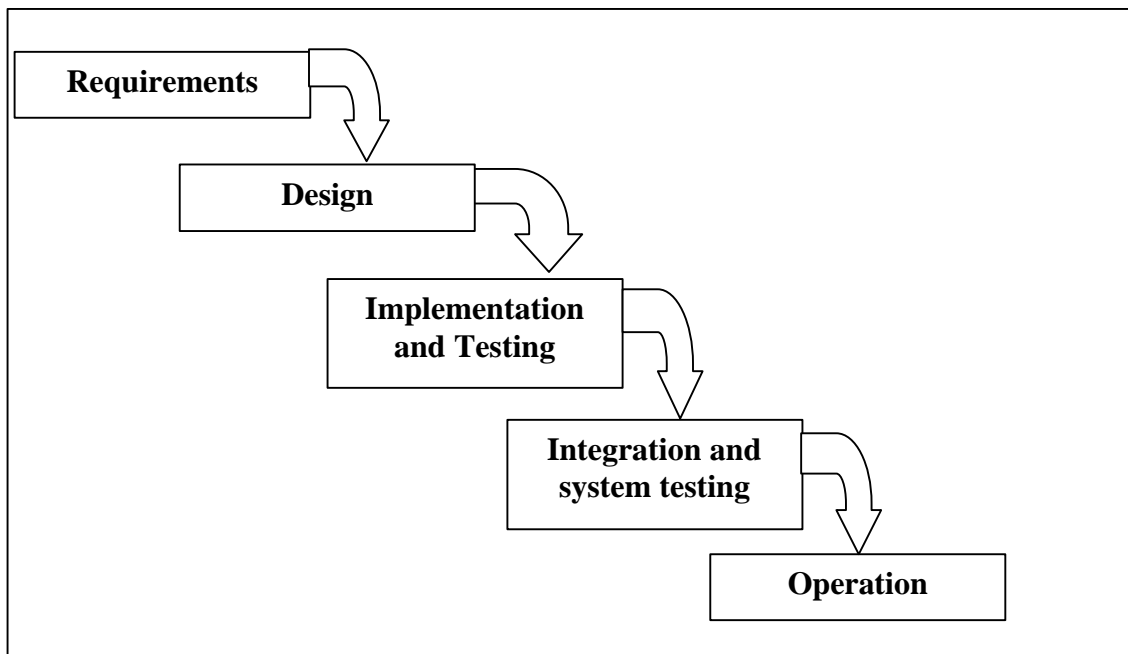


Figure 36: Waterfall Development Model

Inhibiting creativity and maintaining focus on strictly pre-defined specification is occasionally desirable in the software development process. For instance, *feature creep* is the term used to describe programmers' tendency to add additional and often unneeded features to software applications, leading to the expansion of software development projects and a resultant increase in time and costs (Keil, Mann, & Rai, 2000).

Table 16: Expanded Waterfall model of software design from Bleicher (2003)

Stage	Description
Requirements	What does the user need to do?
Analysis	What is the current environment?
Design	Flow chart/Pseudo code programming logic.
Coding	Write the code.
Testing	Test the code with a variety of test cases and confirm output.
Acceptance	Client accepts completed product.
Instillation	Install the software on client's machine.
Deployment	Train end-users
Maintenance	Ensure that software continues to work and meets needs.
End-of-Life	Retire software when it no longer meets needs.

The rigidity in the linear SDLC process keeps the focus on the specifications created early in the process and insures that large teams can effectively communicate on complicated projects. Thus, the waterfall model is particularly well suited to situations where programs are developed for highly regulated industries that require strictly specified outcomes. (Bleicher, 2003; Budgen, 1999; International Organization for Standardization, 2006; Keil et al., 2000; Klaus, 2006). For example, many businesses must adhere to complex and rigid International Standards Organization (ISO) specifications (IEEE Standards Association, 2006) and such specifications can define the type of development model that should be used.

Another strongly process oriented model is defined by ISO 12207 (IEEE Standards Association, 2006). This model rigidly defines the entire software development process and insures that large teams with changing members will use a common language and follow a well-defined plan. The ISO 12207 standard is very complex and particularly popular in the defense industry where it is critical that all specifications are addressed. The areas specified by ISO 12207 are listed below.

- Configuration Management
- Design
- Documentation
- Function Points
- Human Factors
- Integration

- Maintenance
- Medical Device Standards
- Project Management
- Quality
- Requirements Definition
- Safety
- Security
- Test
- Verification and Validation

Another linear model, the Incremental model is a process oriented development methodology that might be thought of as cycling through the Waterfall model. As shown in Figure 36 and Figure 37 the incremental model adds a flow that returns from the operation phase of the development process back to a review of requirements. It could be argued that there is little difference between the incremental and Waterfall model as the Waterfall model also provides for cycles through the use of successive projects (Lewallen, 2003), although it does not provide for return to review of system requirements.

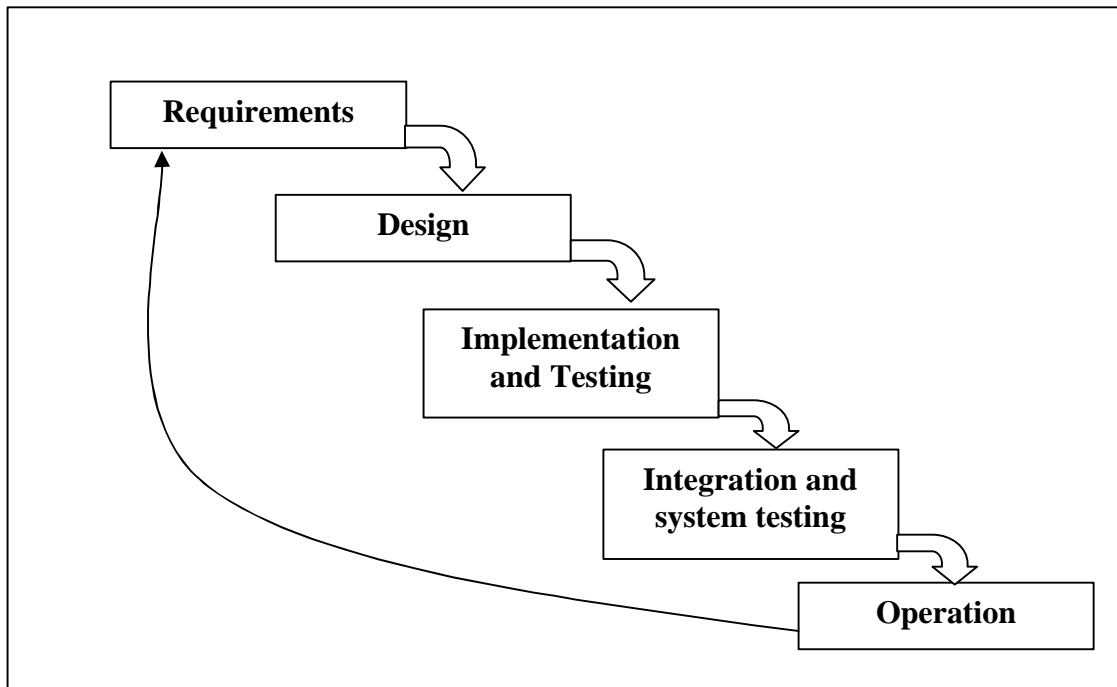


Figure 37: Incremental model

According to Lewallen (2003), the Spiral model is also similar to the Incremental model but with more emphases placed on rapid iteration, cost, and risk analysis. As shown in Figure 38, the Spiral model repeats four phases: planning, risk analysis, engineering, and evaluation. The software project repeatedly iterates or spirals through these phases in iterations (called spirals in this model). In the Spiral model, the angular component represents progress, and the radius of the spiral represents cost.

Iterations of the spiral improve the product and increase costs. The baseline spiral starts in the planning phase where requirements are gathered. In the risk analysis phase, a process is undertaken to identify risk and review alternate solutions. A prototype is produced at the end of the risk analysis phase. Software is produced in the engineering phase, which is then tested in the next phase, evaluation. The evaluation phase allows the customer to evaluate the output of the project to date before the project continues to the next spiral.

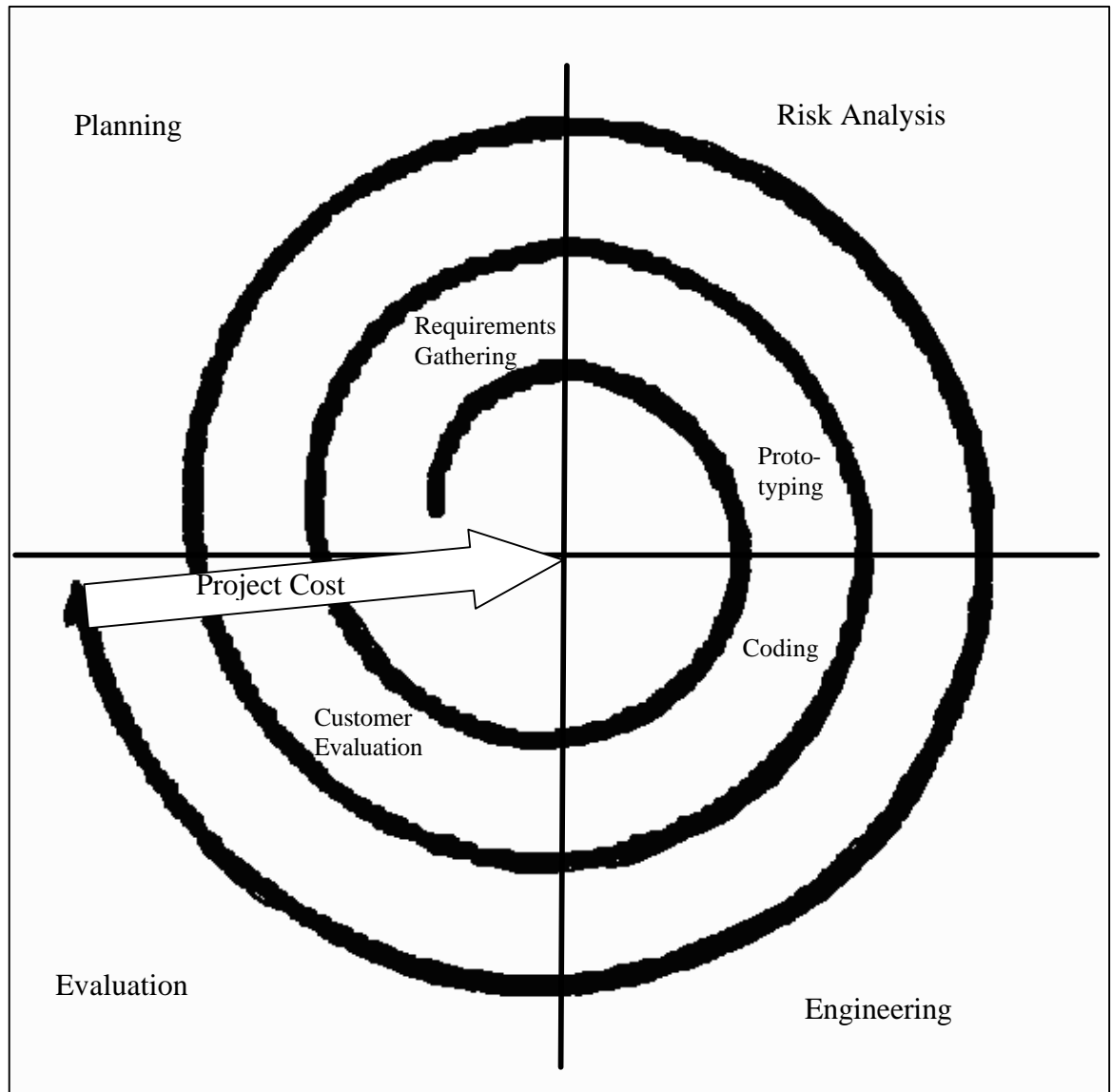


Figure 38: The Spiral model

In summary, process driven models are linear and follow clearly defined stages or steps. These stages insure that all important development phases are covered at the expense of applying a rigidly defined process that can take longer and restrict innovation. The limited ability to adapt and consider new knowledge and understanding of user needs is an inherent weakness of all linear models. For example, according to Klause (2006), while by definition the Waterfall model will meet the original project specifications, it is

more time consuming than most other models and often does not fully address current user needs upon official completion of the project. An often repeated joke among software developers regarding linear models is that the software is obsolete by the time it is finally developed.

CHAOTIC/NON-LINEAR MODELS

Not all software development models are linear, strongly specified, or process driven. It is often desirable to combine various steps chaotically, to review partial results, implement partially developed systems, and to refine them. Chaotic models encourage a rapid change of focus that provides the possibility for developers to interactively address issues as needed, while also allowing for innovation and creativity during the development process.

The evolutionary-delivery model is an example of a chaotic model that reflects changes in how software is currently written (Nerur, Mahapatra, & Mangalaraj, 2005). Evolutionary-delivery models focus on continuous improvement through small teams and rapid feedback during the development process. As such, the evolutionary-delivery model focuses on people and not on the process. The project flow is guided by the interaction of stakeholders and the emerging product features. Stakeholders include the programming team, consultants, and eventual end-users.

Such rapid and responsive development is only possible with modern programming techniques such as object oriented programming that allows for rapid and

significant changes in both the user interface and the fundamental logic that provides the application features.

The R2D2 (Reflective, Recursive Design and Development) model (Willis, 1995; Willis, 2000; Willis & Wright, 2000) is a chaotic and constructivist/interpretivist based design model. R2D2 is particularly appropriate for modeling evolving systems. R2D2 system development encourages non-linear development with:

1. Rapid changes in response to user needs,
2. Participatory teams,
3. Progressive problem solutions,
4. Addressing the need for dissemination including open source models.

Given its strong academic orientation and the large number of design considerations that it has addressed, the R2D2 model was selected as most appropriate as the model for development of the BIRAT Internet survey system.

Table 17: Four principles of the R2D2 model

Principle	Definition
Recursion or Iteration	Decisions are made tentatively and frequently. Developers can revisit any decision, process, or product at any time in a non-linear fashion.
Reflection	Thoughtful, considered design work with feedback that is valued, discussed, and used from many sources.
Non-linear	Design and development work is not linear. Design is chaotic, recursive, and iterative. The development process does not have a fixed starting point. Objectives emerge during the design process and may not be clear until the process is complete.
Participatory	Design includes a team called stakeholders. Stakeholders include all persons who will use the developed product and experts in the subject matter and development process. Context of use is critically important.

With the R2D2 development model selected, it is possible to discuss development methodology from the R2D2 perspectives outlined above.

The first goal was to create a functional system designed in such a way that it can be easily upgraded and expanded. At no point in the developmental process was any part of the system considered "written in stone" and complete. Modular files containing the code for various functions were used to create a flexible code base that is easy to work with. Modules with marginal functionality or lacking in features were replaced with subsystems that demonstrated superior code or capability. It was not possible to predict the order of feature design and development that this reflexive process will direct because of the open and flexible nature of the pieces. For example, dead ends were experienced. Then some components were abandoned or drastically revised during the process.

An important part of the BIRAT design process was a thorough review of relevant Internet survey literature to discover current best practices in designing and conducting Internet surveys. With an understanding of best practices, a system was created to support design and delivery of surveys as well as the analysis of the data collected that meets those best practices.

Another important area of the development process was reflection on the comments from BIRAT users as to their needs and concerns. Towards this end the system needed to be marketed so as to create a base of users. Methods to increase the base of BIRAT users included recruiting LSU faculty and graduate students to use the system, presentations at conferences, and creation of a project area at SourceForge (2006), a popular repository for open source software. Posting on appropriate academic newlists

were another important part of the strategy that was used to increase the BIRAT user base. Presentations at conferences also provided both constructive criticism and a wider user base.

OPEN SOURCE SOFTWARE DEVELOPMENT

The open source software development model may be considered complementary to other software development models and particularly to chaotic models. Open source software development is unique in that systems are mostly developed by large numbers of volunteer programmers, documentation writers, software beta testers, and others who choose their own goals within a specification that is constantly redefined by programmers, end-users, and other stake-holders (Din H-trong & Bieman, 2005).

Unlike commercial development, open source program volunteers often have the freedom to work on any part of the project they wish and there are no deadlines. Open source program volunteers frequently create new project goals and specifications while they are working on a development project. These new goals and new specifications may or may not be accepted by the rest of the open source community associated with the project.

A review of popular large open source applications shows that volunteer programmers are capable creating commercial grade software applications (Din H-trong & Bieman, 2005). Examples of open source software development include many variations of the Linux operating system (Linux, 2006) and Moodle, an online courseware system (Moodle, 2006).

Perhaps the biggest challenges to the development of open source software is finding and facilitating what might be called a "critical mass" of volunteers to develop a particular project. This critical mass depends not so much on the number of volunteers involved but on skilled and active participants that work effectively together, within a framework of common goals and specifications that are well understood by all, are accepted by all, and are adhered to by all in the group. In addition, open source projects need a project leader or committee that keeps track of changes and decides whether to adopt the code and changed specifications suggested by other project members. Another major consideration in open source projects is the use of a programming language environment that volunteer programmers are familiar with.

The BIRAT system is an open source project developed in anticipation that a community of developers will be attracted to and build around the concept of an academically sound and research oriented survey system. BIRAT is licensed under the GNU public license (Free Software Foundation, 2006) which essentially says the author retains copyright but no other privileges. The GNU license is popular in the open source community as the GNU license gives a strong indication that the project will remain in the open source domain. The BIRAT open source project is hosted on the SourceForge (2006) website, a popular repository for open source projects and also provides a number of tools for maintaining projects and tracking changes in project code.

AN ASSESSMENT OF SOFTWARE DEVELOPMENT MODELS

There are perhaps hundreds of models for software development. Most of these models have been evaluated and considered effective in some environment or other. At the programmers' level, models serve as a guideline for a creative process that is unique to each programmer (Mishra & Yong Zhao, 1999; Simonelis, 2004; Trengove & Dwolatzky, 2004).

While there are developers and theorists who believe the model they use is universally applicable and superior, there is in fact no best model. It is more important to consider which model is the best fit for a given project (Budgen, 1999; Moløkken-Østvold & Jørgensen, 2005; Yager, 2004). Some models, such as R2D2 (Willis, 1995; Willis & Wright, 2000), are more encouraging to the creative process and are particularly useful when the specifications of the product under development change during the development, when specifications are not well defined, or when specifications are not well understood. In other words, some models allow for change and adjustment as the development process proceeds. Other models, such as the Waterfall model, are better suited to projects that must exactly match a predefined specification. A non-linear development model, with programming methodologies that allow for frequent and rapid changes, was deemed to be most appropriate for the development of BIRAT, inasmuch as the ideal Internet survey system cannot be defined except through experimentation and iteration.

There is some question about the use of any model at all in program development. I informally polled a professional programming group about their use of models and I

learned that the clear consensus was that these professional programmers did not use *any* software design models (CrystalTech Forums, 2006). The response from most of these professional programmers was that they use bits and pieces of models as they seem appropriate to the task at hand. One exception to this general approach to software development models was a programmer who rigorously used the Waterfall model. This person works on big projects with large teams of programmers for highly regulated companies, for which the Waterfall model is considered most appropriate.

Another programmer's understanding of models may have been so far away from the conventional understanding of models that he did not understand the question. He reported that the software design "model" he used was based on design patterns (DoFactory, 2006). These design patterns are more a discussion of the fundamental structure of all programming languages than a programming methodology. In other words, the respondent equated general program coding methodology with program development methodology. Perhaps the respondent was not confused. While models define a framework for a development process, there are also best practices in writing code and these practices may also be considered models.

All of the methods described above assume that the programmer will follow best programming practices such as structured or object oriented programming and proper use of algorithms. In the next section some techniques that express the chaotic non-linear and open source software development models will be discussed.

RAPID PROTOTYPING CODING TECHNIQUE

Rapid Prototyping is a popular software programming practice where programmers create working or simulated models of the desired application using programming tools that lend themselves to speedy development (Kraushaar & Shirland, 1985). Stakeholders iteratively review and interact with the prototype products and provide suggestions for changes and additions (Bleicher, 2003). Thus, with rapid prototyping, user input guides and constantly changes the programming process as new specifications evolve.

There is a historical trade-off between the use of rapid development tools and the robustness of the resultant program system (Nerur et al., 2005; Simonelis, 2004; Trengove & Dwolatzky, 2004). Unfortunately, the rapid creation of application prototypes has historically resulted in less efficient and bloated products. In some cases an accepted prototype may be used as a specification for the program. In other cases the prototype must be completely rewritten in a more robust language that offers the same user experience but with stronger code (Yager, 2004).

The need to rewrite rapidly prototyped applications to achieve acceptable performance is decreasing, however. With the growing power of computers and improvements in software development systems, the application outcomes of rapid prototyping are often found to be acceptable in the enterprise environment even if they are not as "efficient" as they could be (Kraushaar & Shirland, 1985; Van Tongeren, 2000).

Rapid prototyping is the selected programming technique of choice for the BIRAT system and rapid prototyping is very compatible with the R2D2 software development model which the BIRAT development process uses. In this context, rapid prototyping includes the creation of progressively more sophisticated and usable prototypes based on feedback from both novice and experienced users, balanced with discoveries in academic Internet survey literature that dicusses best practices.

TESTING

Testing to insure that an application works correctly and appropriately is an important part of the development process (Andrews & Whittaker, 2006; Keil et al., 2000; Memon & Qing, 2005; Van Tongeren, 2000). The constant bug fixes and version updates to applications already released by major producers of software underscore that application testing and development is never complete. The need for testing and continual development increase exponentially as application complexity and functionality increase (Brooks, 2004).

According to Andrews and Whittaker (2006), there are a number of areas that need to be tested when developing web based applications. These areas include accuracy of results, ability to function under anticipated user loads, and ability to function in a variety of environments. In addition, it must be realized that complex and flexible systems such as the BIRAT Internet survey development system will be used in ways the designer cannot anticipate. Complete testing requires that the system be used in a variety of environments by both experts and amateurs.

ADOPTION

The best application in the world is of little value if it is not adopted and used. There are numerous theories regarding the technology adoption process. These are perhaps best represented by Rogers' (2003) diffusion of innovation theories and Davis's (1989) concept of perceived usefulness versus ease of use. As shown in Table 18, Rogers (2003) concluded that innovation adopters fall into five categories, each with unique characteristics.

Rogers' (2003) model suggests that the diffusion of innovation requires adoption and acceptance by innovators who then make recommendations to other potential users through a hierarchy of technology adopter categories.

Table 18: Characteristics of Rogers' Technology Adopter Categories

Adopter	Description
Innovators	Venturesome, outsiders with regard to peer networks, able to cope with a high degree of uncertainty about an innovation at the time the decision is made to adopt. Willing to accept considerable risk.
Early Adopters	Look to innovators for advice and information, decrease uncertainty by adopting the innovation and then conveying a subjective evaluation to near peers through interpersonal networks. Willing to accept minor to moderate risk in return for improved capability.
Early Majority	Deliberate, adopt new ideas and technology before the average member of a system; interact frequently with peers but seldom hold positions of opinion leadership, most numerous of the adopter categories.
Late Majority	Skeptical, adopt new ideas and technology only after they are adopted by average members of a system. Adopt from economic necessity or as the result of increasing peer pressure.
Laggards	Traditional, last to adopt an innovation, possess almost no opinion leadership, point of reference is the past.

Davis (1989) provides another useful perspective on the process of technology adoption with the suggestion that potential users make technology adoption decisions based on the perceived effort required to learn, balanced against the perceived potential benefits to them of adoption. Thus, technologies perceived as both very easy to learn and very useful to the potential adopter are most likely to be adopted.

The BIRAT development process takes the Davis (1989) adoption perspective into account. The BIRAT user interface was designed to be extremely easy to use and intuitive. Ease of use requires some trade-off in features available to the researcher. In designing BIRAT some features that would complicate the design, delivery or analysis phase of survey research were rejected. This was especially true of features that were not supported in the literature. For example, branching systems were avoided because they require a user interface that is difficult to learn and branching systems for surveys have not been proven to significantly improve survey results (Redline et al., 2005; Smyth et al., 2005; Smyth et al., 2004).

Another example of a feature that was not included is the ability to randomize options. While the ability to randomize options is arguably useful (Reips, 2002b), randomizing options adds complications to the review of data, requires a more complicated survey design interface, and increases the possibility of researcher error when randomization is applied to inappropriate item types such as those where the item options are ranked.

SELECTION OF METHODOLOGIES

Rapid prototyping and the R2D2 development model supplemented with Open Source software development techniques were selected as best practices for the creation of the BIRAT Internet survey development system. The R2D2 model insures that the product is useful and the Open Source techniques insure that future researchers will be able to build upon and adapt the product to their needs. Further, the Rogers and Davis adoption models provide guidance to increase the likelihood that the resultant Internet based survey system is adopted and used.

Given the very fluid nature of both R2D2 and rapid prototyping, it is reasonable to expect that many changes will occur early and throughout the development process, while at the same time preserving functions fundamental to the project. Over the history of software package, a complete rewrite of the package may be necessary as the original programming approach does not prove adaptive to changing specifications. In most cases, however, changes or additions will occur in a particular component of the product, such as the creation of a new item type or changes to the survey methodology as suggested by academic research. These changes will also occur in response to stakeholder input and the will represent incremental changes in BIRAT rather than revolutionary changes such as a ground up rewrite of the software in a completely different programming environment.

CHAPTER FOUR: RESULTS

STATUS OF BIRAT

BIRAT is a fluid, changing and adaptable system that is in current use at its website, <http://birat.net>. While BIRAT is a new and relatively unadvertised system, an impressive number of surveys have been created and distributed from the BIRAT website. As an active system, the following usage information will continue to change. However, these numbers do represent the current status of BIRAT in the Fall of 2006 and are thus useful.

BIRAT consists of 51 code or module files which in turn contain 8,698 lines of code for an average of 170 lines of code per file. In comparison, this dissertation currently has 4,317 lines of text. In addition to the code, there are 33 navigation images, 22 images related to explaining statistics, a Favicon (a small icon used by web browsers to brand web pages), an Access Database, and, as shown in Figure 39, an associated file structure.

The BIRAT website includes 133 files in 6 folders requiring an aggregate of 14.9 megabytes of storage. However BIRAT's actual size is considerably smaller as the website includes large files that are not associated with the distribution package such as an active database and uploaded image files. The distribution package contains 89 files in four folders with an aggregate size of 909 Kilobytes. The zipped distribution is a mere 147 Kilobytes.

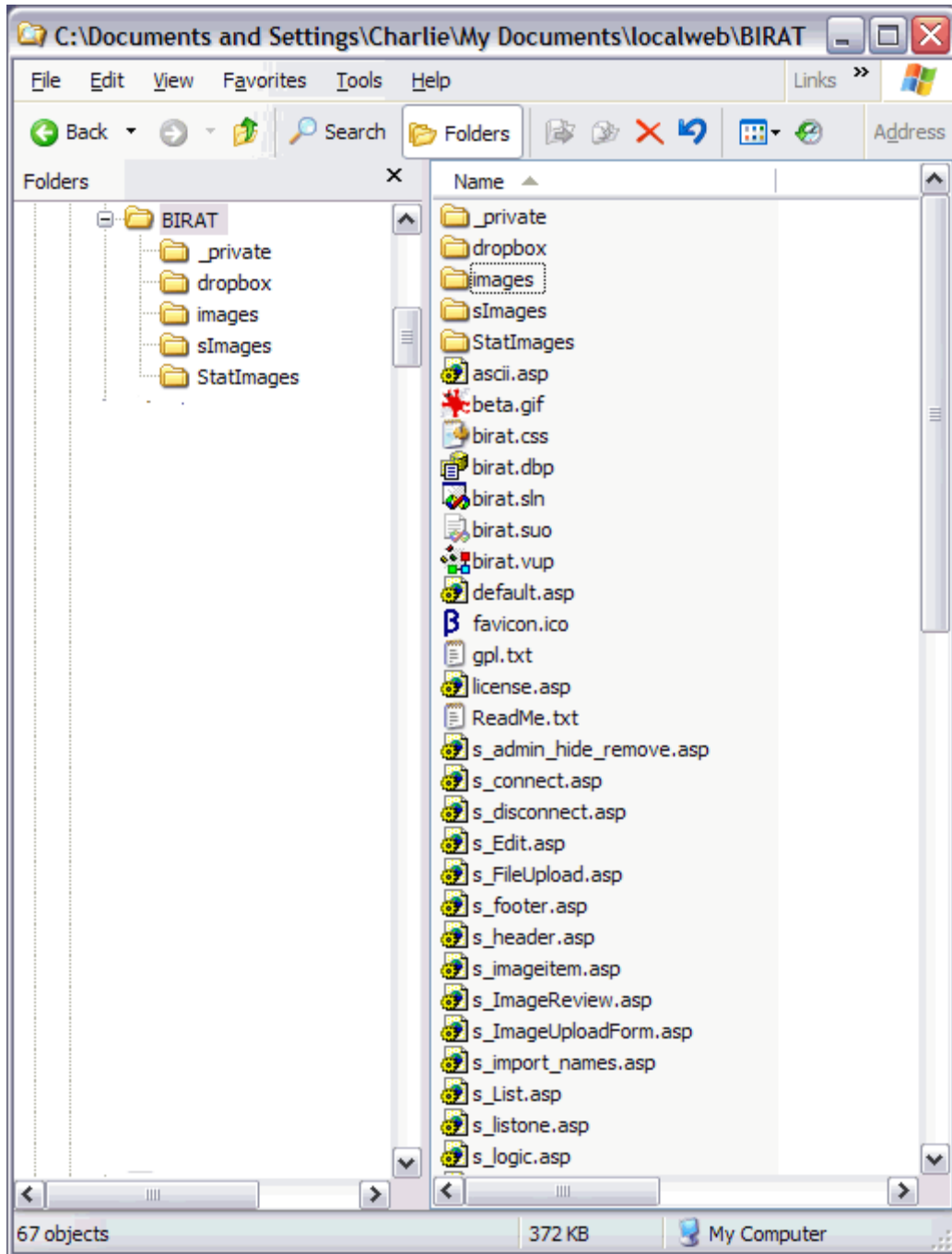


Figure 39: BIRAT File Structure

BIRAT hosts 934 surveys which in turn contain an aggregate of 1,418 items. However, many of the hosted surveys are blank or unused and were probably created by persons who merely wished to evaluate the survey system and then abandoned the survey without using it. It is not illogical to assume that persons, having evaluated the BIRAT

survey system will come back and create a survey that they will deploy. Blank surveys are defined as those surveys that contain no items. Blank surveys indicate that the reviewer stopped early in the evaluation process. Procedures to clean up the survey list and improved navigation of the list as it grows are under review. At present surveys that contain no items and thus no responses are administratively deleted from time-to-time. Of the created surveys, 102 remain active. While it is possible to detect when a researcher reviews their data, out of respect for the confidentiality of the instruments and participant responses, there is no way for me to discover if instruments are no longer in use.

A review of the BIRAT database shows that a total of 2,084 participants have provided 98,078 item responses to surveys created in the BIRAT system. The actual number of participants is likely to be less, as some participants may have taken more than one survey, or some may have taken the same survey more than once. Both the confidentiality of the data and settings the survey designer elected to use make it impossible to discover the true number of survey participants.

BIRAT is a synthesis of a number of different programming languages including the popular Active Server Page (ASP), Hypertext Markup Language (HTML), Javascript, Cascading Style Sheets (CSS), and Structured Query Language (SQL). The BIRAT programming code is written in such a way that BIRAT is portable and may be easily installed on other systems.

The BIRAT project follows the common practice of providing complete instructions for installing the software in the ReadMe.txt file included with the distribution. In addition, BIRAT may be installed in any directory of a web server so long

as the child directory structure is maintained. The two associated third party products, ASPEmail and ASPIImages, are common to many servers and the BIRAT code is written in such a way that similar alternative products may be substituted by a competent programmer with little effort.

BIRAT SCREEN SHOTS AND DESCRIPTIONS

The following screen shots describe the researcher and survey participant BIRAT experience. All BIRAT screens display the current version and my name with a link to my home page which contains a short biography and contact information. As defined by best practices in website design (Nielsen, 2001) and as shown in many of the figures below, all screens have a navigation path showing the viewer where they are in relation to the home page.

There are several ways to navigate through the BIRAT system. While some of BIRAT's screens are potentially shared by both the researcher and survey participants, it is possible for the researcher to provide survey participants with a link that bypasses the need for the participant to go directly experience the survey list. Providing the participant with the ability to go directly to a particular survey avoids potential problems such as delay and confusion as the participant attempts to find the appropriate survey in a long list of available surveys. It is also possible for the researcher to provide a link that directly displays survey results or even provides access to the survey editing area. The utility that permits participants to modify the survey area is discussed later.

BIRAT HOME PAGE

As shown in Figure 40, the BIRAT home page provides immediate access to system functions through a link that lists instruments, a link that provides the opportunity to create a new instrument, and a link that leads to a system help file. There is also a link that provides access to a review of BIRAT and other web survey systems. In addition, the home page offers a short introduction to the system, an Email contact, and the legal terms for the use of BIRAT. BIRAT is licensed under the GNU General Public License (Free Software Foundation, 2006). The BIRAT home page is intentionally kept simple so as to encourage potential users to directly use the BIRAT system functions.

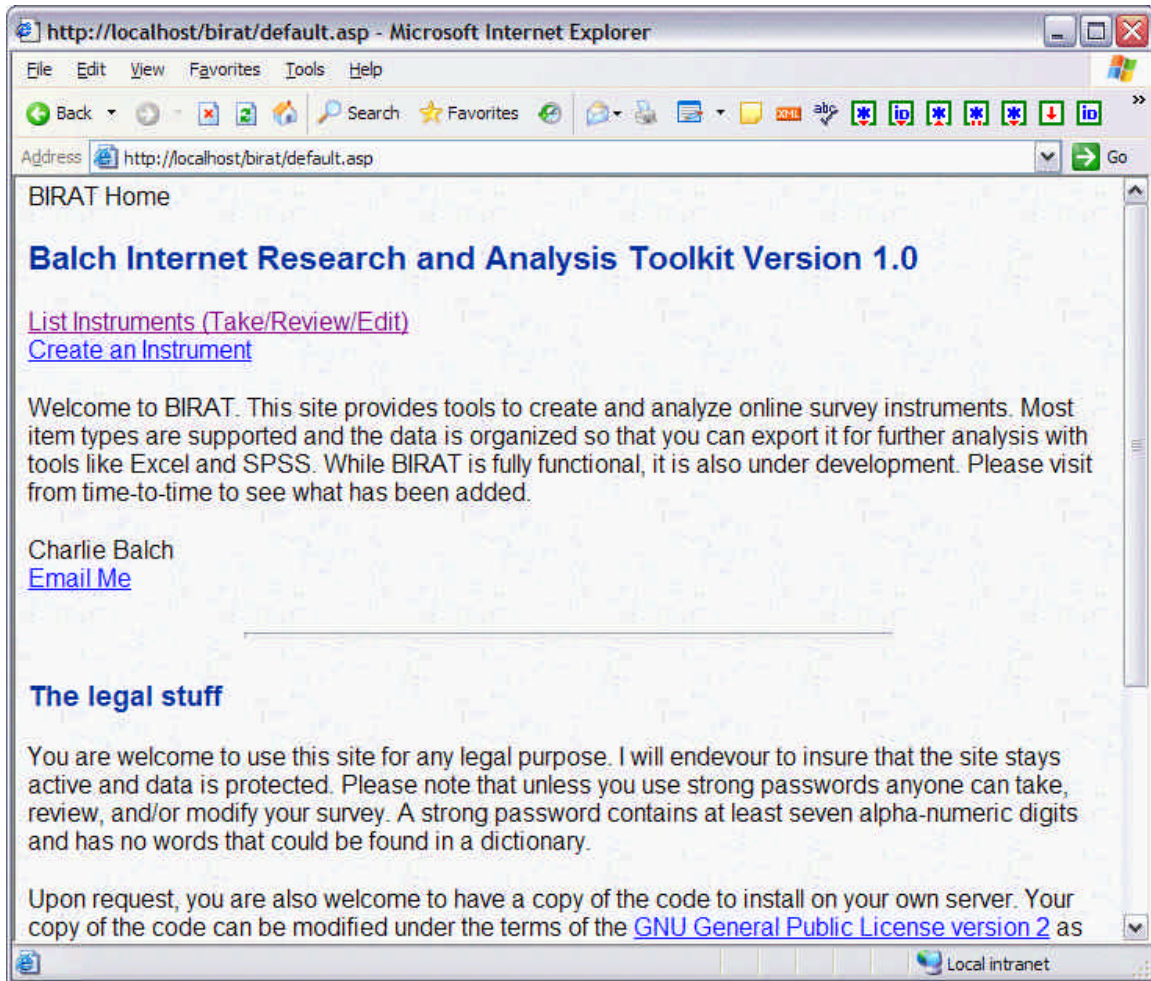


Figure 40: BIRAT Home Page

INSTRUMENT LIST AREA

Clicking the "List Instruments (Take/Review/Edit)" link takes the visitor to the Instrument List area as shown in Figure 41. This area alphabetically lists all active instruments. If the survey designer provides additional information about the survey, an "Info" button appears to the right of the survey title letting visitors know that additional survey information is available with a click to the button. If the author has not provided any additional information, the button is hidden. In addition to the possibility of an "Info"

button, every survey has three associated buttons. These buttons provide the possibility to "Take" or participate in the survey, "Edit" the survey, and "Review" survey results.

As is shown below, survey designers have the option of individually password protecting the Take, Edit, and Review areas. The access button to a given area is colored red and an additional button labeled "PW" button appears when the area is password protected. Pressing the PW button launches a help screen explaining that the selected survey function is password protected.

As of September 2006, there were 97 active instruments listed. As we will see shortly, the editor of a survey can remove the survey from the active survey list page by deleting it using the "Delete" button in the editing area. Deleting a survey removes it from the list and prevents participants from taking the survey. Deleting a survey also prevents review of the results and prevents survey editing of the given survey. However, the survey is not actually deleted and an administrator with access to the database could resurrect the survey if needed.

[BIRAT Home](#) ▸ Instrument List

Survey Name	Info	Participate	Edit	Results
!A BIRAT Movie	Info	Take	Edit	Review
!An Example	Info	Take	Edit	Review
00	Info	Take	Edit	Review
2005 Longevity Desire Profile	Info	PW Take	PW Edit	PW Review
2507 final		Take	PW Edit	Review
ACCESS TO CARE NEEDS ASSESSMENT	Info	PW Take	PW Edit	PW Review
Ag Comm Survey	Info	UID Take	Edit	PW Review
An Example Survey	Info	Take	Edit	Review
An Example Survey to Play With Too	Info	PW Take	PW Edit	PW Review
Another Test Too		Take	Edit	Review
are1687@birat.net	Info	Take	Edit	Review
Barker Test Fall 2005	Info	Take	PW Edit	PW Review

Figure 41: BIRAT List of Current Instruments

Clicking on a password protected button takes the visitor to a screen requesting the associated password as shown in Figure 42. The password request area also displays the title of the survey and, if it has been provided, a description of the survey. In this example taken from a live survey on BIRAT, the survey author elected to provide visitors with the password required to take the survey in their description of the instrument. It would be interesting to learn why the survey designer elected to provide the password in the survey description area as providing the password in the survey description somewhat defeats the purpose of having a password for taking the survey. However, as the BIRAT information line above the password entry textbox shows, the page displayed in Figure 42 is requesting a password for the edit area of the survey and it is probable that the survey editor did not use the same password for both areas.



Figure 42: BIRAT Password Request Page for a Protected Area

CREATE AN INSTRUMENT

The BIRAT home page provides a "Create an Instrument" link as shown in Figure 40. Clicking the Create Instrument link takes the visitor to the page that begins the survey creation process as shown in Figure 43. When the appropriate information has been entered and the "Create Instrument" button is pressed, the survey author is automatically taken to the survey editing area which is described below.

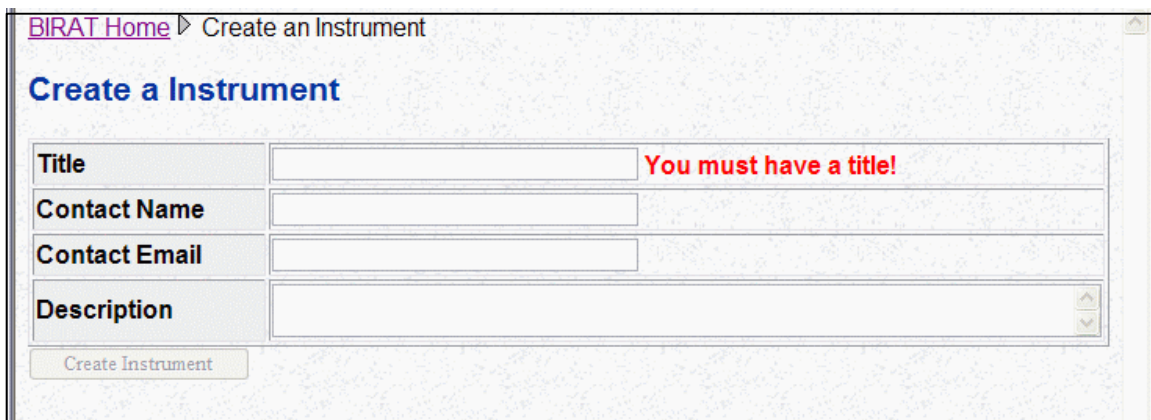
The only entry required for the survey creation page is that the instrument title. The title is automatically displayed in the survey list area. On entry, there is a large red message proclaiming the "You must have a title!" message and the "Create Instrument" form submit button is not active. When any text is entered in the "Title" field area, the warning that a title is needed is removed and the "Create Instrument" form submit button is activated.

The strong measures used to insure the entry of a title were introduced when it was discovered that many users were not providing titles for their instruments. This in

turn resulted in their not being able to find their surveys they had created earlier among other non-titled surveys when they wished to return to the instrument they created.

Duplicate titles are allowed.

"Contact Name," "Contact Email," and "Description" are all optional data entry areas on the survey creation page as I could foresee times when a researcher would wish to remain anonymous. In this context, it should be noted that that BIRAT can be used in both academic and non-academic fields. I trust that academic researchers will be well aware of the information they must provide to potential participants. As pointed out earlier, the survey list area displays an icon indicating that a description of the survey is available when a description was entered by the survey designer. This screen provides an area where the survey description may be added.



BIRAT Home > Create an Instrument	
Create a Instrument	
Title	<input type="text"/> You must have a title!
Contact Name	<input type="text"/>
Contact Email	<input type="text"/>
Description	<input type="text"/>
<input type="button" value="Create Instrument"/>	

Figure 43: The First Page of the Instrument Creation Process

Note: The survey designer is informed that a title must be provided.

BIRAT Home ▸ Create an Instrument

Create an Instrument

Title	<input type="text" value="A Sample Survey"/>
Contact Name	<input type="text"/>
Contact Email	<input type="text"/>
Description	<input type="text"/>

Figure 44: The Create an Instrument Page after Text is Entered in the Title Area
Note: Once a title is entered the reminder is removed.

SURVEY DESIGN AREA

After creating the instrument, survey designers enter the survey design area shown in Figure 45. The view shown in Figure 45 is not completely representational as the window was adjusted to a narrower format for reproduction purposes here than would typically be viewed by survey designers on a computer screen. The narrow screen image was selected to insure that text and other objects would be clear when shown in this paper. Screen shots from a wider format result in text that is too small to read. Unfortunately the narrow window also causes some text to "scrunch up" and thus flow differently than it would normally on a computer screen. Thus, many areas show up on two lines instead of one resulting in a representation which in turn longer vertically than it would normally be on a computer screen.

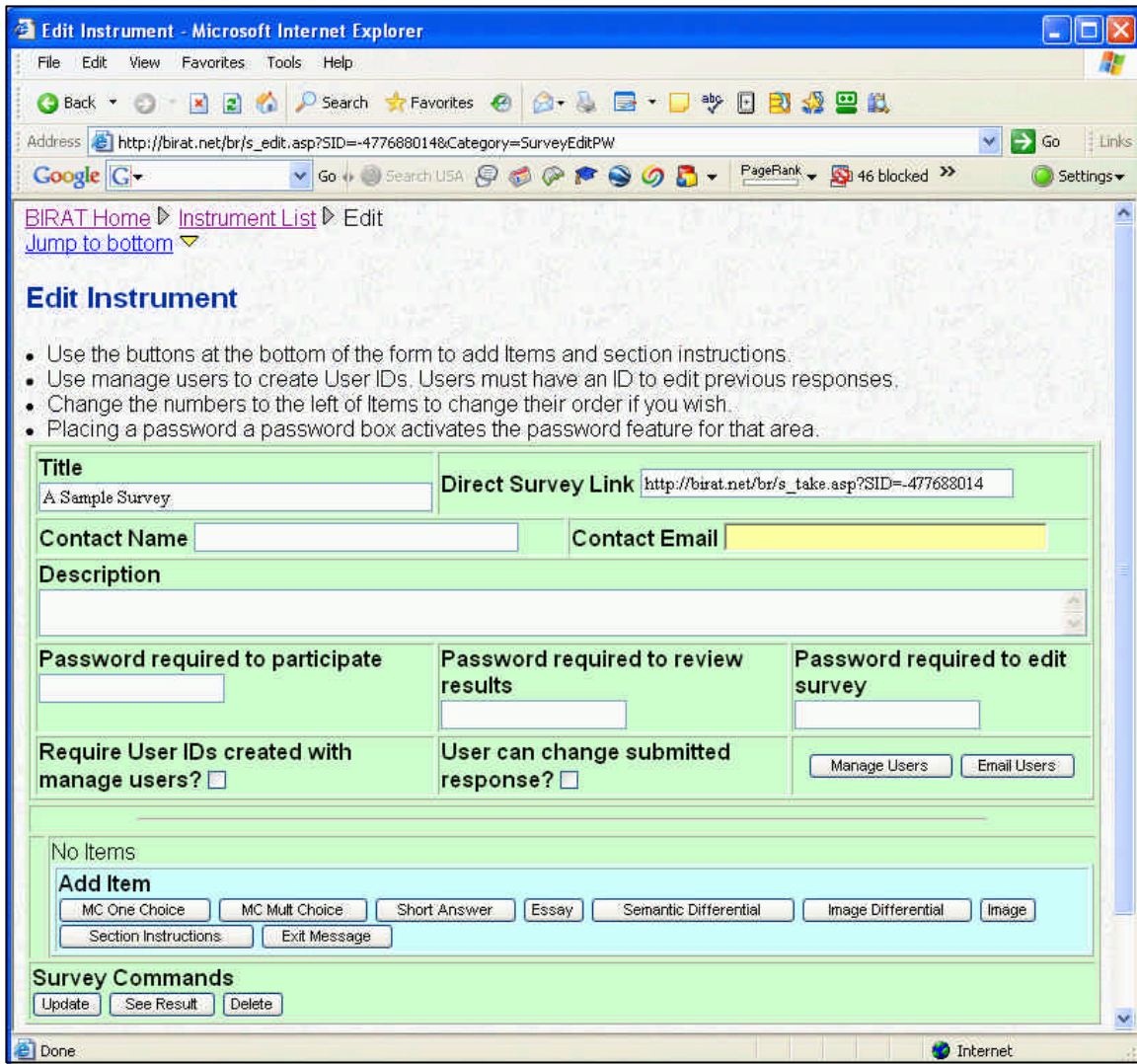


Figure 45: The Survey Design Area

The survey design window will be described from the top to the bottom of the computer screen. Note that color is used to identify the various operational areas. Light green represents administrative tools, light blue delineates the item administration area, and yellow identifies items. Unfortunately, printed copies of this document will not show these colors.

Help Options

Beyond the descriptive nature of the various controls and color defining the control areas, there are three kinds of help in the edit area: (1) The four lines of text at the top of the screen have been sufficient for most users to understand the various options. This area locates and defines the use of the item creating buttons, identifies the area to manage users, explains how to change item order, and explains how the password system works. (2) Moving the mouse over any of the item creating buttons provides a brief description of that button's function at the bottom of the screen. Figure 45 shows the result of this help feature when the survey designer's mouse is placed over of the "MC One Choice" option. (3) BIRAT also provides warnings when the survey designer attempts to do something that would cause the survey to not function correctly. For instance, as shown in Figure 46, if the survey designer attempts to create a survey that allows users to edit previous responses without also requiring user identification, the system provides a warning message that explains that user identification is required to enable the user to edit previous responses.

The possibility that a survey designer could allow users to edit their previous responses without enabling user identification is the only known area among the BIRAT control options where the designer could create a survey that is not operationally functional. The option to require user identification and the option to allow user editing of previous response controls could not be combined as it is possible that the survey designer would like to use the user tracking features but not allow participant editing of previous responses. Of course BIRAT does not and cannot prevent design flaws such as

poor item construction. User tracking and user editing features are discussed later in this paper.

The survey design area warning message is the result of BIRAT support requests. For example, a researcher's survey was not working and he had not thought about the impossibility of allowing users to go back to their survey responses without first identifying the user. After explaining the error, I added the highly visible warning message in the system to help other survey designers who might also make similar design errors. That incident caused me to think carefully about the consequences of adding new features and the resultant loss usability that might occur.

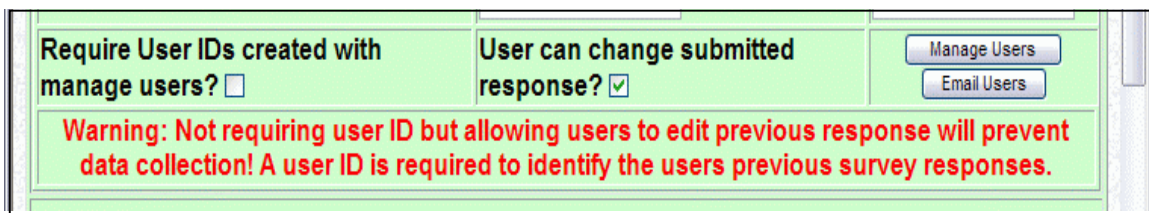


Figure 46: Survey Design Area Warning Message

Note: The warning message appears when the user can change submitted response option is selected but the User ID option is not selected.

Jump to Bottom

Just below the page path within BIRAT is the "Jump to bottom" option with an associated down triangle located at the top of the screen. A click on the jump to bottom link takes the survey editor to the bottom of the survey editing screen. The jump to bottom option is another one of many improvements to BIRAT that resulted from suggestions received from persons using the system. In this case, a survey designer creating long surveys complained that, with long surveys, it was tedious to scroll to the bottom of the survey being edited each time an item was added. In response, the "Jump to

bottom" link at the top of the page was created that allows the researcher to jump to the bottom of the screen.

Survey Information Options

The survey information options Title, Contact Name, Contact Email, and Description provided in the create area are duplicated in the survey edit area so that survey designers may add or change survey description information as they desire.

Direct Survey Link

A textbox labeled "Direct Survey Link" provides the survey designer with a direct link to the survey which the survey designer may in turn provide to potential participants through a number of means including print, Email, and web pages. Thus, this link allows the researcher the option to let participants avoid the survey list area discussed previously and go directly to the correct survey.

Survey Passwords

The BIRAT "Edit instrument area" provides for three types of survey passwords. As noted in the help area, entering a value into any of these textboxes activates the password feature for that area. Conversely, removing the password text removes the password protection for that area. The three types of survey password protection used in the BIRAT system are: (1) "Password required to participate" which forces participants to enter the password selected by the survey designer before they can experience the survey and provide responses. (2) A value placed in the "Password required to review results"

area presents potential visitors to the data analysis area with a request for a password. (3) As shown in Figure 42, a value placed in the "Password required to edit this survey" presents potential survey editors with a request for the password requirement for editing.

Require User IDs Created with Manage Users

When the "Require User IDs created with manage users" option is selected, the URL that participants use to take the test must include a unique value created and stored by the BIRAT survey system. The BIRAT survey system does not allow access to instrument which requires a unique user ID if the URL to access the survey does not contain a correct used ID value. This user ID value represents a "needle in the haystack" method of security in that it does not necessarily require a combined user identification and password. The range of possible user ID values is large in that it represents a random value between 999,999,999 and -999,999,999. Even with large surveys having many users and thus many user ID numbers, it is not likely that an assigned user IDs will be discovered by outside parties seeking entrance into the survey through discovery of a user ID. However, for additional security, the survey designer may also password protect the instrument, requiring both the unique value and a password to confirm participant identity before participants are permitted to participate in the protected survey.

User can Change Submitted Response

The "User can change submitted response?" option provides the survey designer with the possibility of allowing users to change their answers even after the survey has been submitted. This option also allows a participant to save the results of a partially

completed survey and return later to complete the survey. This option also allows the participant to change their answers in response to external events. This last possibility suggests that BIRAT can be used as a tool for consensus building where members of a survey discuss what the best answer should be for a given item and perhaps persuade others to change their response.

Manage Users

The button marked "Manage Users" takes the survey editor to the "Create/Modify User List" page as shown in Figure 47. The create/modify user list page allows the survey editor to add, delete, and modify potential survey participants. Note that, in this example, the "Last Response" column is empty. This is because none of the users have responded to the survey. If a participant had responded to the survey, the date of the last response would show there. Knowing the date of an identified participants' last response may be of great use to researchers in ways that include analysis of response time lags and increasing participation rates by contacting participants who have not responded.

It is important to note that only the date of last response is shown. One of BIRAT's options is for the survey designer to allow participants to return to the survey and change their answers. It is anticipated that the focus of most researches will be on whether there was a response at all. While all responses are kept, BIRAT does not currently provide a mechanism to review historical answers.

The "Del" button stands for delete and removes the user from the user list. Responses from removed users are discarded when statistics are calculated. As with other

areas that can be "deleted" in BIRAT, the actual responses are hidden but not actually "deleted."

The "Close Window" button closes the Create/Modify User List window.

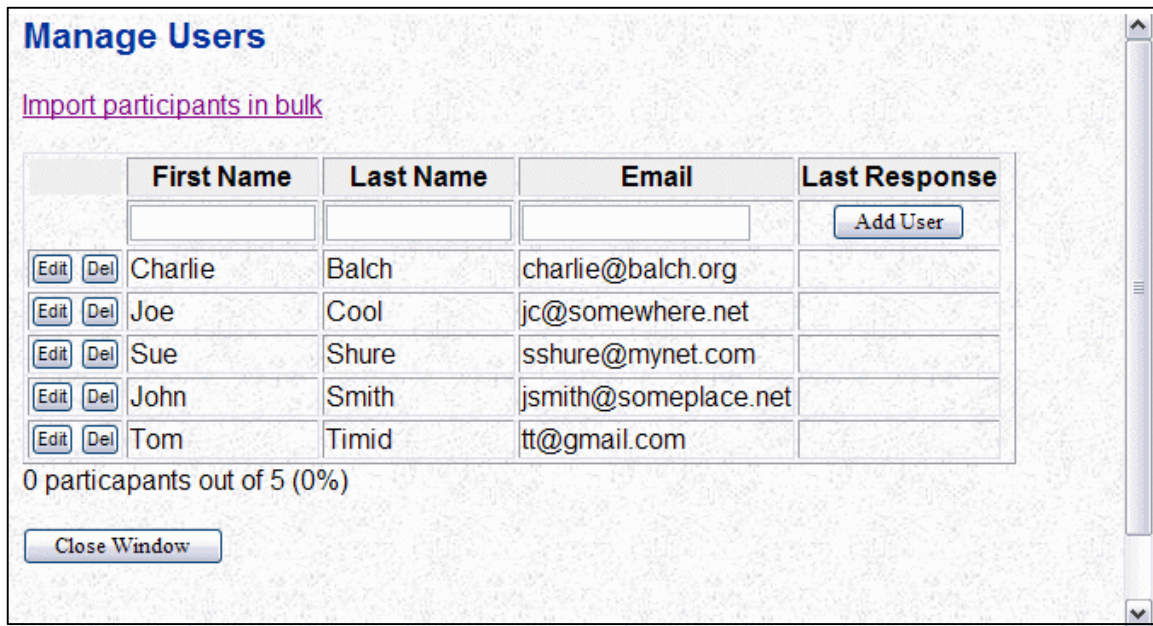


Figure 47: Manage Users Window

Manage Users: Edit Button

Pressing the "Edit" button opens the Edit user window as shown in Figure 48. This window allows the survey designer to change potential participant's information. The unique link required for the participant to take the survey is also provided for copying and pasting should the researcher so desire. There is also a convenient area for the researcher to record notes about the participant.

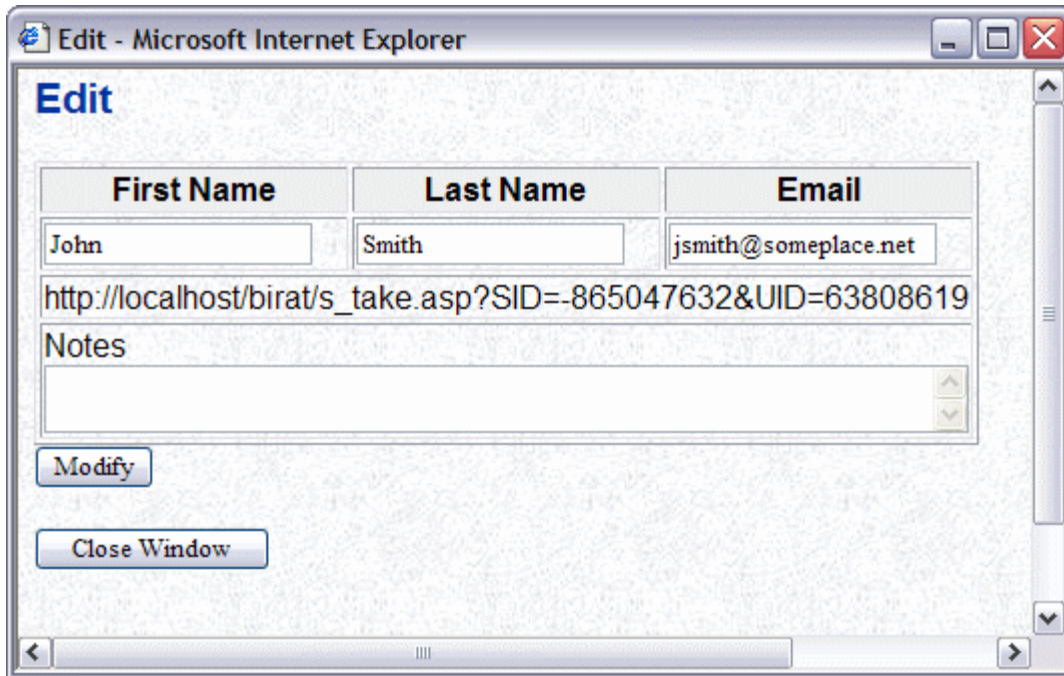


Figure 48: The Edit User Area

Manage Users: Import Users in Bulk

As shown in Figure 49, the "manage user" page provides an "Import participants in bulk" link which allows the survey designer to enter a list of potential participants in bulk. With this option, the survey designer may add numerous users by simply entering them in the tab delimited format shown. The tab delimited data entry format was selected so that the lists could be entered with a simple copy and paste option available in most popular spreadsheets. After the names have been pasted, the survey designer enters them with the "Post Names" button. The Post Names button takes the survey designer to a confirmation window as shown in Figure 50. At this point the survey designer can accept the addition of the names or cancel the addition and reevaluate the entered data. If accepted, the names are immediately available to those parts of the BIRAT system that track unique users.

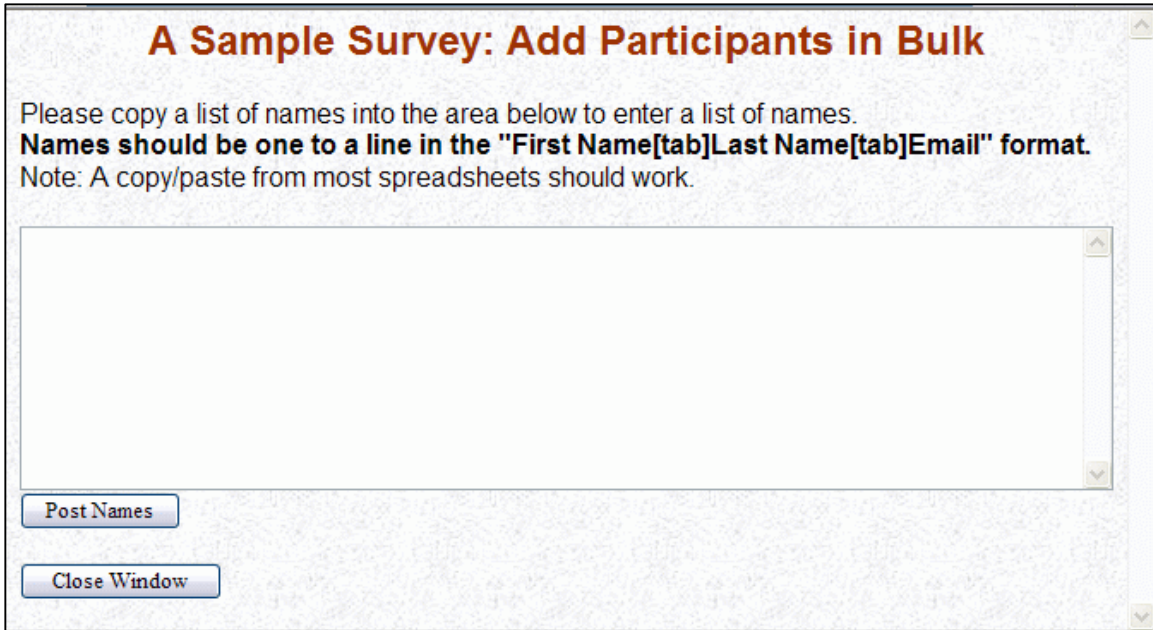


Figure 49: The Bulk Name Addition Window

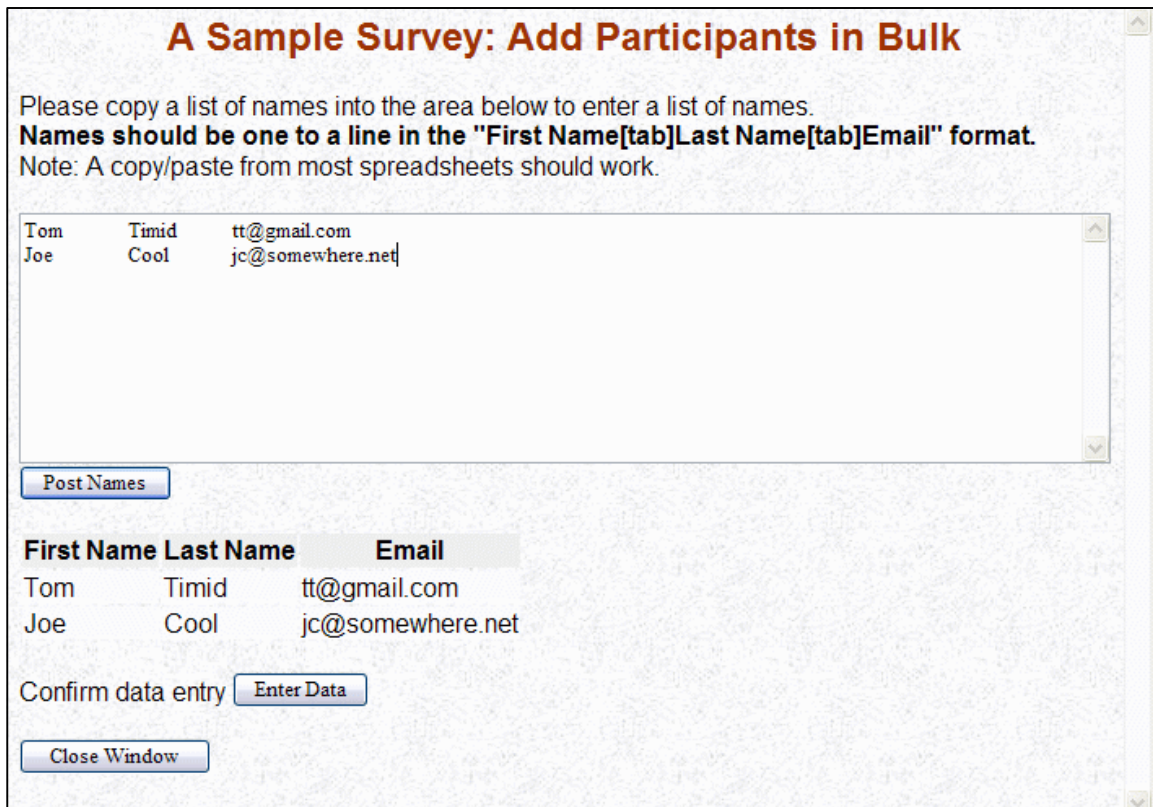


Figure 50: The Bulk Name Entry Confirmation Window

This completes the options provided by the in the "Manage Users" button.

Email Users

We now return to the Edit Instrument page to review the options provided by the "Email Users" button. Pressing the "Email Users" button brings the survey designer to the Email Users web page depicted in Figure 51. This page provides an area for the survey designer to enter a subject and a message for an Email that may be sent to selected participants or to all survey participants whose names have been previously entered in the "Manage Users" area as discussed above. Note that this area also provides information about the date of last response. The participant list is sorted by participant's last names.

The last message sent is automatically retained and displayed on reentry into the Email Users window. In addition, a message can be changed or recorded without sending any Emails using the "Update Message" button. To send Email messages, the researcher selects a recipient or recipients by placing a check mark in the boxes next to their name(s) and then send messages to the selected users by pressing the "Send to Selected" button. The researcher may also send a message to all participants using the "Send to All Users." The option to send to all users who have not responded was not included in BIRAT as I feel the ability to repeatedly send Email to persons who declined to respond to an earlier message has great potential for creating spam. For this reason, I did not want to provide the researcher with the temptation.

At this point, it should be noted that BIRAT Email is all addressed as coming from the BIRAT administrator. Current spam fighting measures prevent the sending Email from commercial mail servers which follow best practices unless the sender is has an account on the machine sending Email. Unfortunately, spammers do not have this

limitation of following best practices and they often "spoo" return addresses and send Email with a false sender address. Desire to send Email with the researcher's own Email address is another reason that a researcher might wish to install BIRAT on their own server. Of course the researcher can always include their address in the body of the Email message being sent.

With BIRAT, Email is sent in text format for maximum compatibility with different Email clients. It is important to note that the user's unique survey identification number is included in the form of a clickable link within the Email that BIRAT sends. Great care has been taken to insure that the included URLs would not exceed the length of one line as URLs that wrap around lines often do not perform properly, and this, in turn, would decrease response rates.

Email Users

Subject:

Message

Note: The user connection link will be added to the message.

	First Name	Last Name	Email	Last Response
<input type="checkbox"/>	Charlie	Balch	charlie@balch.org	
<input type="checkbox"/>	Joe	Cool	jc@somewhere.net	
<input type="checkbox"/>	Sue	Shure	sshure@mynet.com	
<input type="checkbox"/>	John	Smith	jsmith@someplace.net	
<input type="checkbox"/>	Tom	Timid	tt@gmail.com	

Figure 51: The Email Users Web Page

GENERAL SURVEY BUTTONS

Moving down the Survey Edit Window, we arrive at a three button general survey command area as shown at the bottom of Figure 45.

Update Button

The "Update" button records all changes made in the survey edit area. The update button is somewhat redundant because actually pressing *any* button in the survey edit area will save all changes in the survey editor as well. The capability of all buttons to save data was provided to insure that no data was lost in case a survey designer pressed a design button requesting some new feature without thinking about possible consequences to their unsaved editing in other areas. The update button, however, does uniquely allow survey editors to record changes to text boxes.

See Result

The "See Result" button opens a new window showing the survey window as participants would experience it if they were presented with the survey as currently designed. Thus the See Result button allows the survey designer to insure that the survey will be perceived by the survey participant exactly as the survey designer desires. After the "See Result" button is pressed, an example of the participant survey is put into a new window. With the survey design area in one window and the participant survey result in different windows, the survey designer can alternate between the participant view and design view of the survey. Thus the results of editing in the survey may be viewed with a simple refresh of the sample participant survey screen.

Delete Button

The "Delete" button deletes the survey but the survey is not lost. As noted earlier, no data in BIRAT is ever actually deleted. Instead, a delete action indicates that the survey designer wants to remove the item from both public view and their own view. A deleted survey can only be retrieved by an administrator with ability to directly edit the fundamental database, knowledge of the needed changes, and access to the database.

ADD ITEM AREA OF THE SURVEY EDITING PAGE

We will now review the options provided in the "Add Item" area of the instrument editing area. As shown in Figure 52, there are nine options in the add item area. Seven of these options add items and two add other forms of survey content. As each of these

options provide unique functions, they will be discussed individually. As previously noted, brief help on these options is provided at the bottom of the screen when the survey designer's mouse moves over any of these items.

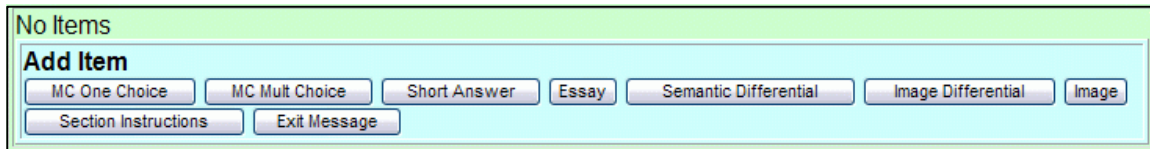


Figure 52: BIRAT Add Item Buttons

Multiple Choice with One Choice Item Type

Pressing the "MC One Choice" button creates a multiple choice item type that allows only one option response. In other words, the options are mutually exclusive such as those used for true/false or multiple choice test questions. In this context it should be noted that some survey systems rate themselves as having more items when they include True/False and other mutually exclusive item types separately. Figure 53 shows a cutout view of the of the edit page with just the item editing area shown. With BIRAT, the entire editing page and its options are always accessible to the researcher.

To the top left is a box with a value of "1." This value represents the items order in the instrument. This value is entered automatically by the BIRAT system but the order can be changed by the survey designer. As noted in the on-screen help, the survey designer can change the order of items by changing their associated numbers.

To the right of the question order box is a "Del" button. Pressing this button will remove the item from the survey. If the survey is active, values associated with the deleted item will no longer be shown in the data analysis area.

Text box item and entry areas are created with a blank value but some text has been entered in this example for illustrative purposes. The text of questions goes into the top text box. Below this box are buttons that allow the survey designer to add options as they are needed. The additional buttons allowing more than one option at a time to be added are the result of a survey designer creating items with large numbers of options who found it tedious to enter options one at a time. Option order may be changed by changing the values in the text boxes to the left of each option. Pressing the associated "Del" button deletes the option.

Option descriptions go in the text area associated with each option. Both the question and the option descriptions areas will increase in size if more than two lines of text are placed in them by the survey designer. This allows for larger amounts of question or option text, while keeping the question area small should the extra room for question or option text not be needed.

Figure 54 shows how a participant would experience the item if they took the survey. Note that this item type is displayed with the mutually exclusive radio item type. In addition, the survey is labeled with the title of the survey. The question is offset from the options and the "Record Answers" button is clearly marked.

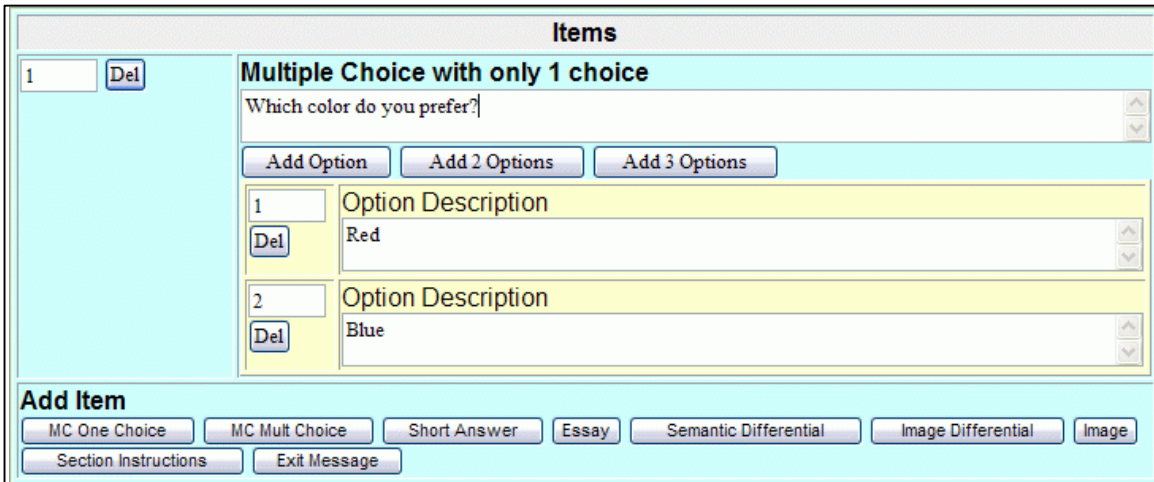


Figure 53: The Edit Area for the Multiple Choice One Choice Item Type

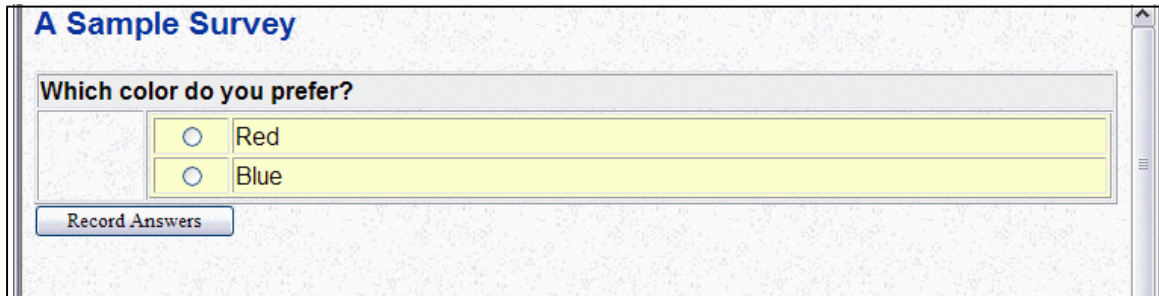


Figure 54: Participant View of a Multiple Choice with only One Choice Item
 Note: This item type uses the radio button

Multiple Choice with Multiple Choices Item Type

Figure 53 shows the "MC Mult Choice" option which creates a multiple choice item allowing the participant multiple choices. The previous item is kept in the figure of the cropped image of the survey window to illustrate item numbering. In addition, I pressed the "Add Option" button to show the resultant addition of an item option, in this case with a result of three options. Each item is clearly marked with its item type in this case "Multiple Choice with only 1 choice" and Multiple Choice with multiple choices. Figure 56 shows the resultant survey. Participant view of the survey provides items that

are clearly and cleanly organized and that the multiple choice item with multiple choices provides a checkbox response type.

Figure 55: Survey Editor's view of the Multiple Choice Item with Multiple Options

The screenshot displays the 'Items' section of a survey editor. It contains two items:

- Item 1:** Titled 'Multiple Choice with only 1 choice'. The question is 'Which color do you prefer?'. It has two options: '1 Red' and '2 Blue'. Each option has a 'Del' button. Below the options are buttons for 'Add Option', 'Add 2 Options', and 'Add 3 Options'.
- Item 2:** Titled 'Multiple Choice with multiple choices'. It has three empty options, each with a 'Del' button. It also has buttons for 'Add Option', 'Add 2 Options', and 'Add 3 Options'.

At the bottom, there is an 'Add Item' section with the following buttons: 'MC One Choice', 'MC Mult Choice', 'Short Answer', 'Essay', 'Semantic Differential', 'Image Differential', 'Image', 'Section Instructions', and 'Exit Message'.

A Sample Survey

Which color do you prefer?

Red

Blue

Which clubs do you plan to join?

Chess

Debate

Art

Record Answers

Figure 56: Participant's View of a Survey with Multiple Choice one Choice and Multiple Choice Multiple Choice Item Types
 Note that the multiple choice item type with multiple choices provides check boxes for answers.

Short Answer Item Type

Figure 57 shows the survey editor's view of the instrument editing area after pressing the "Short Answer" button. As research has shown that users responses change as a result of the size of the of provided answer area (Christian & Dillman, 2004), an option is provided for the survey designer to specify the answer length. If no length is given, the resultant text box answer area is created at the windows default size, with a character entry width of about 20 characters. The option area is typically kept blank but this space may be useful when an item has multiple answers grouped in a matrix format. Figure 58 shows the participant's view of the short answer item type.

3 Del

Short Answer (less than < 250 characters) Answer Size 0

Add Option Add 2 Options Add 3 Options

1	Del	Option Description
---	-----	--------------------

Figure 57: Survey Editor's View of the Short Answer Item Type

A Sample Survey

Which color do you prefer?

Red

Blue

Which clubs do you plan to join?

Chess

Debate

Art

What is your favorite sport?

Record Answers

Figure 58: Participant's View of the Short Answer Item Type

Essay Item Type

Figure 59 shows the survey editor's view of the essay item type. This item type creates an area where participants can provide lengthy responses. Like the short answer item type, the option description is not usually used but is provided should the researcher find a use for the additional descriptor. Also, as with the short answer type, the survey editor may change the size of the answer space to reflect expected participant answer length or to encourage a desired answer length. Unlike previous items, there is no possibility for the multiple response areas in the Essay area. Figure 60 shows the participant's view of the essay item type.

4 Del **Essay (< 15 pages):** Number of Answer Lines 3

1 Option Description

Del

Figure 59: Survey Editor's View of the Essay Item Type

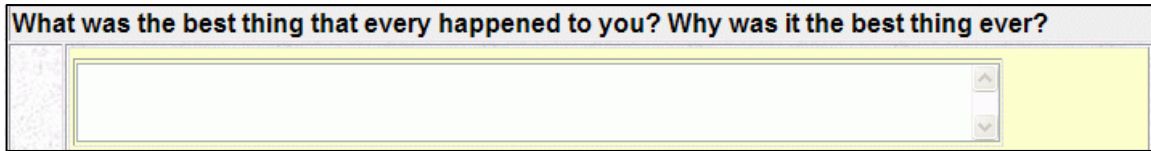


Figure 60: Participant's View of the Essay Item Type

Semantic Differential Item Type

Figure 61 shows the survey editor's view of the semantic differential item type. Note that the survey editor can enter any scale size but five is the default size. The check box to allow a N/A option on this item was added after one of the first field tests of the BIRAT system. Some users reported they had either skipped or responded incorrectly to items as none of the options were correct for them. Figure 62 shows an example of a participant's view of the semantic differential item type with the N/A option activated.

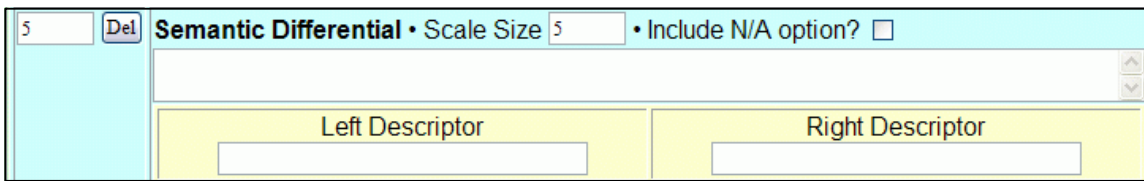


Figure 61: Survey Editor's View of the Semantic Differential Item Type



Figure 62: Participant's View of the Semantic Differential Item Type

Image Differential

Figure 63 shows the survey editor's view of the image differential item. The image semantic differential is one of BIRAT's experimental types. The image differential item type is patterned after the "feeling thermometer" item type occasionally used on paper surveys (Alwin, 1997; Wilcox et al., 1989). In practice, with image differentials,

the survey participant makes a mark on a graphic which represents a scale indicating their opinion.

As shown in Figure 64, when a participant clicks on an image differential item, they leave a mark on the image. The BIRAT system then records both the horizontal and the vertical location of the mark. The horizontal scale is measured to a resolution of 500 units. The vertical resolution is 24 units. The units are pixels of the picture.

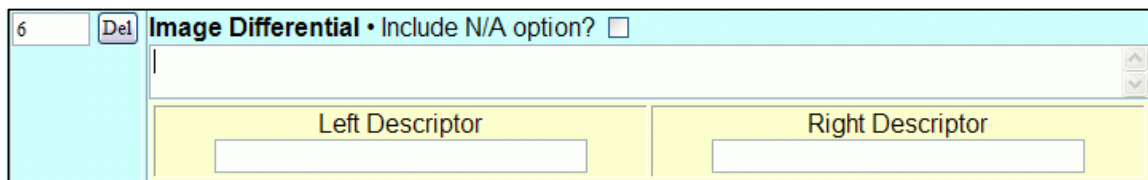


Figure 63: Survey Editor's View of the Image Differential Item Type

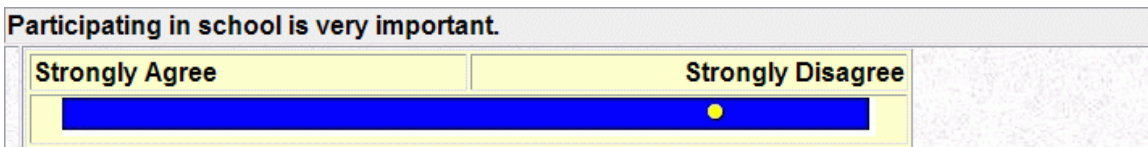


Figure 64: Participant's View of the Image Differential Item Type

Image Item

Figure 65 shows the survey editor's view of the image item. Image items are another item type that illustrates BIRAT's focus on exploring survey item types that are enabled by the Internet technologies. The image item type allows the collection of user clicks on an image. These clicks can then be displayed en masse on the image much as would be done with a Scatterplot. The "Image Upload" button takes the researcher to an area where they can browse their local computer environment for the image they wish to upload. Figure 66 shows the survey editor's view of the image item type entry area after an image has been uploaded.

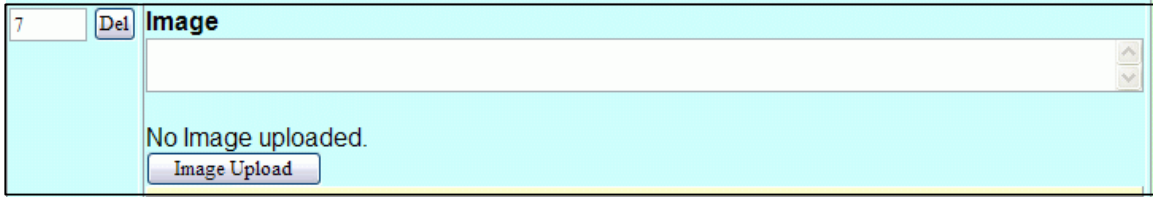


Figure 65: Survey Editor's View of the Image Item Type Before an Image is Loaded

Figure 67 provides an example of the participant's view of the image item type. In this example, I have provided a yellow dot to indicate the sample participant has selected a student as the most important part of the learning environment.

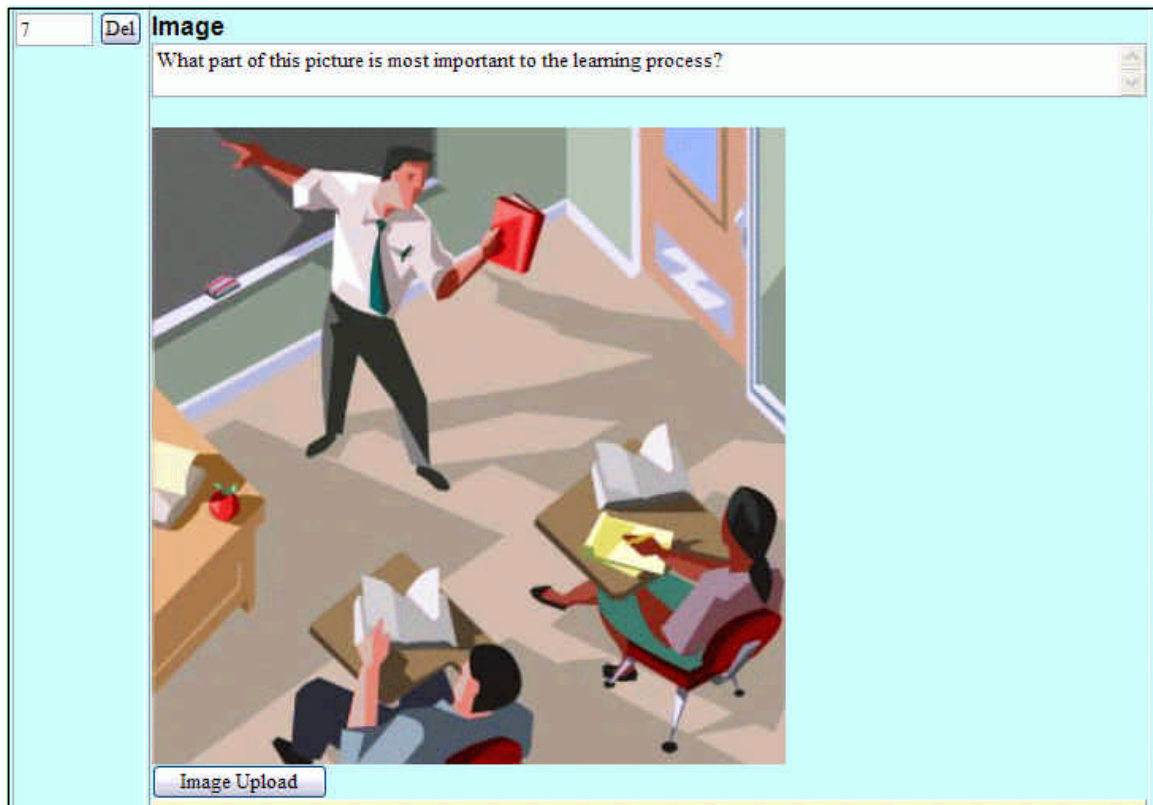


Figure 66: Survey Editor's View of the Image Item Type After an Image is Loaded



Figure 67: Participant's View of the Image Item Type

Note: The dot on the image above shows an example of participant response to the question that was asked.

Section Instructions

Survey designers often need to be able to provide instructions for the next section of the survey. Figure 68 shows a survey designer's view of the "Section Instructions" area of the item control area. Figure 69 shows the participant's view of the section instructions.

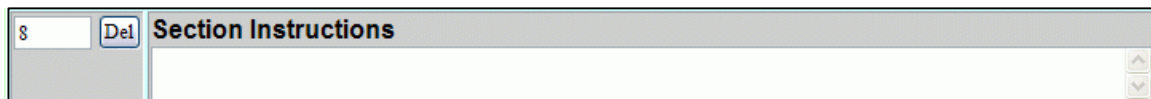


Figure 68: Survey Designer's View of Section Instructions Text Entry Area

For the following questions, please click on the appropriate place on the image.

Figure 69: Participant's View of Section Instructions

Exit Message

The exit message option gives the survey designer an option to present a message in a new screen after the participant has completed the survey. The exit message screen offers many possibilities. This area has been used to provide further contact information for the researcher, to thank the participant for completing the survey, and to provide a link to the results area so the participant can see how others answered the survey. As the survey designer can enter any text they wish in this area, there are few limits to how the exit are may be used.

If the survey designer elects not to create an exit screen, BIRAT provides a generic, "Thanks for taking the survey!" screen as shown in Figure 70.

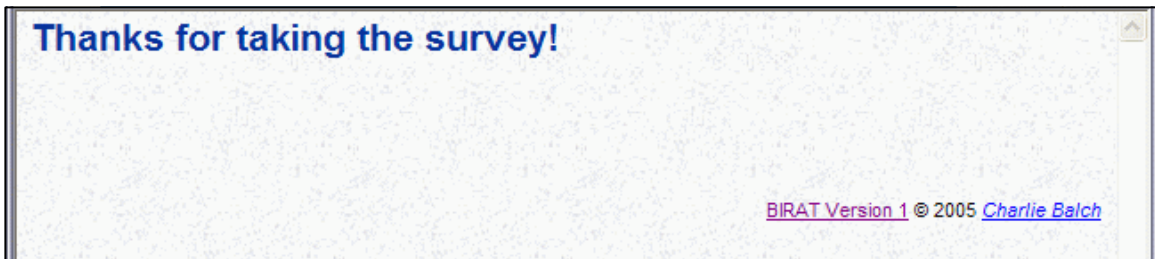


Figure 70: Generic Thanks for Taking the Survey Exit Screen

REVIEWING SURVEY RESULTS

As shown in Figure 41, the BIRAT survey list provides a "Review" button that the survey designer can password protect for their survey. The review button takes the researcher to the Review window as shown in Figure 71. The seven possibilities for data

analysis shown in this window are discussed below. Each option will be explored using sample data entered into the survey created for discussion purposes above.

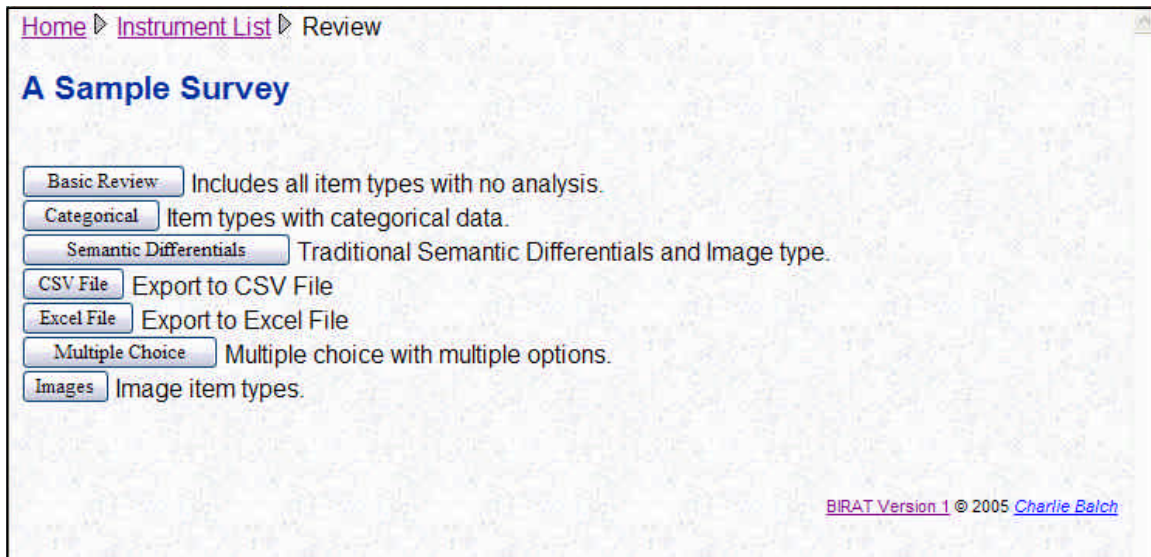


Figure 71: Survey Review area.

Basic Review

The basic review button provides a simple summary of all the survey results as appropriate for each item type. The basic review area does not review the image item types but does provide information about all the other item types. This area is particularly useful for reviewing text responses. In case the responses are numeric, the text response area attempts to do some basic math on the responses.

This area gives you some quick-n-dirty descriptive statistics. For more serious statistics, you may wish to use the matrix option and do further processing in Excel and/or SPSS.

Which color do you prefer?

Red	Blue	Count
4	4	8

Which clubs do you plan to join?

Chess	Debate	Art	Count
5	2	4	11

What is your favorite sport?

Fishing, Bowling, Car racing, None, Swimming, Chess, None
Items: 7
Math Count: 0
Total: 0
Avg: 0

What was the best thing that every happened to you? Why was it the best thing ever?

Catching a big fish. My dad never caught one so big.
Getting a perfect score bowling. This was important because very few people do it.
Graduating from high school. I thought I'd never make it.
The day I got to cook thanksgiving dinner for the whole family. Letting me cook that important meal proved that my parents trusted me.
They day I convinced my parents to buy me a car. It was the best because I could finally get around on my own.
Finding a hundred dollar bill on the ground so I could take my girlfriend out to a special dinner.
Being able to drive my own car.
When I finally got my own car.
Count: 8

Participating in sports is very important.

Scale = 5 (1=Strongly Agree, 5=Strongly Disagree)
1, 2, 1, 0, 5, 1, 3, 5
Items: 8
Math Count: 8
Total: 18
Avg: 2.25

Participating in school is very important.

Scale = 500 (1=Strongly Agree, 500=Strongly Disagree)
409, 92, 422, 31, 28, 109, 474, 50
Items: 8
Math Count: 8
Total: 1615
Avg: 201.88

Figure 72: Basic Review of Results Screen One

Categorical Review

The categorical review area provides information about the responses of Multiple Choice single choice and semantic differential item types. Some additional basic data analysis is also provided. Figure 73 shows the top of the categorical review screen where the user is provided with some basic instructions and information about their data. As noted, blanks indicated that the participant did not respond to the question and a Zero (0) indicates a "N/A" response by the participant. Note that the questions are included at the bottom of the review area.

SPSS will not accept a cut-n-paste of this information but Excel will. So to get to SPSS, copy and paste the a table into Excel then copy/paste again to SPSS. Item names are listed after the matrix. You may also click on the Item heading for more information in a pop-up window. This area does not include information from short answer, checkbox, image differential, or long answer Item types. Notes:

- Item numbers represent the order Items were presented but are not consistent across different review methods. User assigned numbers are in brackets[].
- Blanks are no response. Zero (0) represents a N/A response. Information on those Item types is available in the basic review area.

[Charlie](#)

There are 8 responses.

Multiple Choice and Semantic Differential type Items

Raw Data		
ID	Q1	Q2
1	1	1
2	2	2
3	1	1
4	1	5
5	2	3
6	2	5
7	1	1
8	2	0

Figure 73: Categorical Review Screen One

Figure 74 shows the remainder of the result when the categorical button is pressed. Basic descriptive statistics include sum of the response, count of participant

response, mean of responses, frequency of response to each item option, and percentage of response to each item. Each question has a hyperlink at the top of its column.

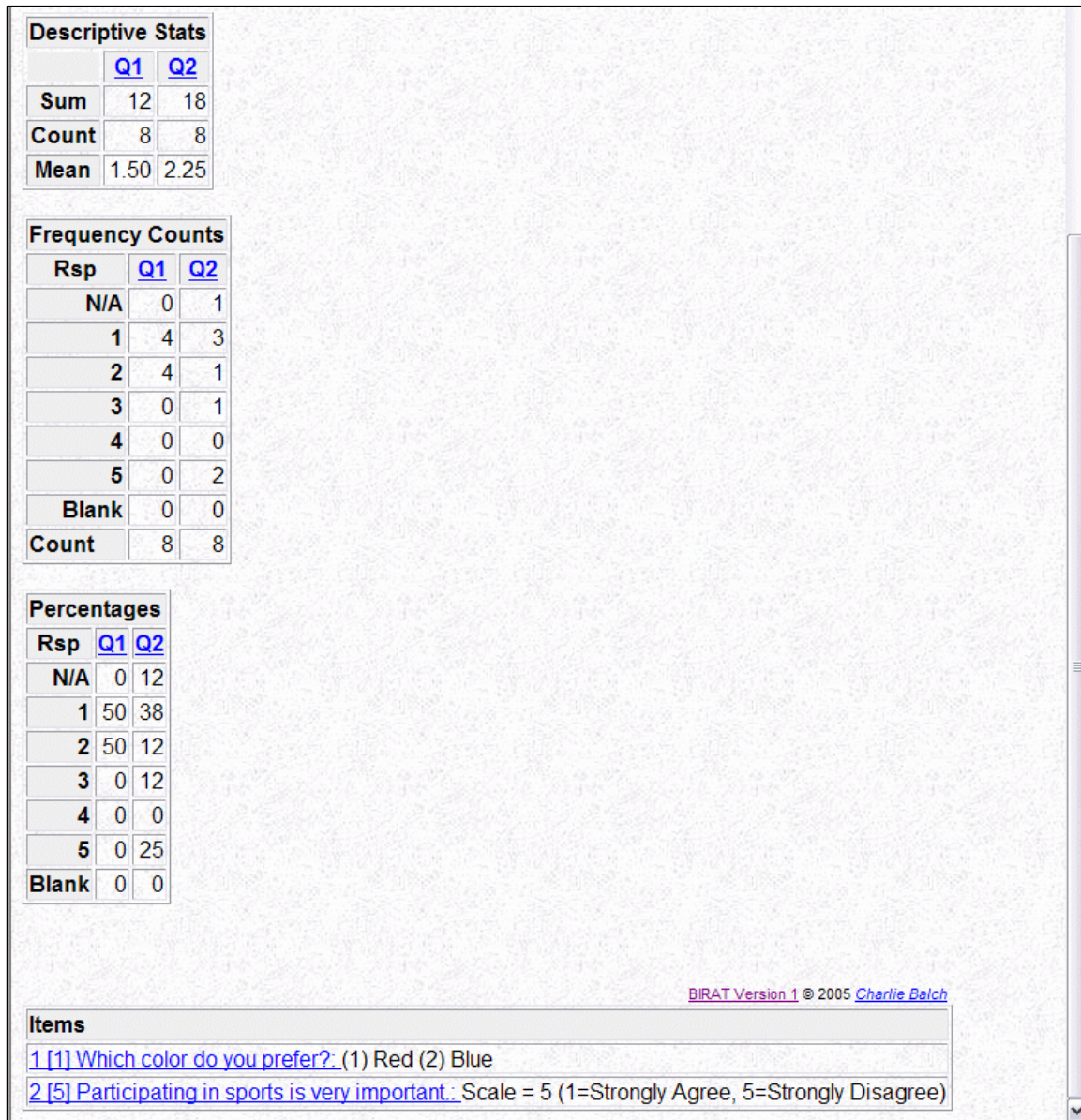


Figure 74: Categorical Review Screen Two

Clicking on a item hyperlink provides additional information about the item response pattern and the item's complete wording. The additional information about the

response pattern includes a histogram of the responses, percentages with and without blank or no responses, count of blanks, mean, standard deviation, skew, and kurtosis.

The bottom of the categorical review screen provides a list of the questions reviewed.

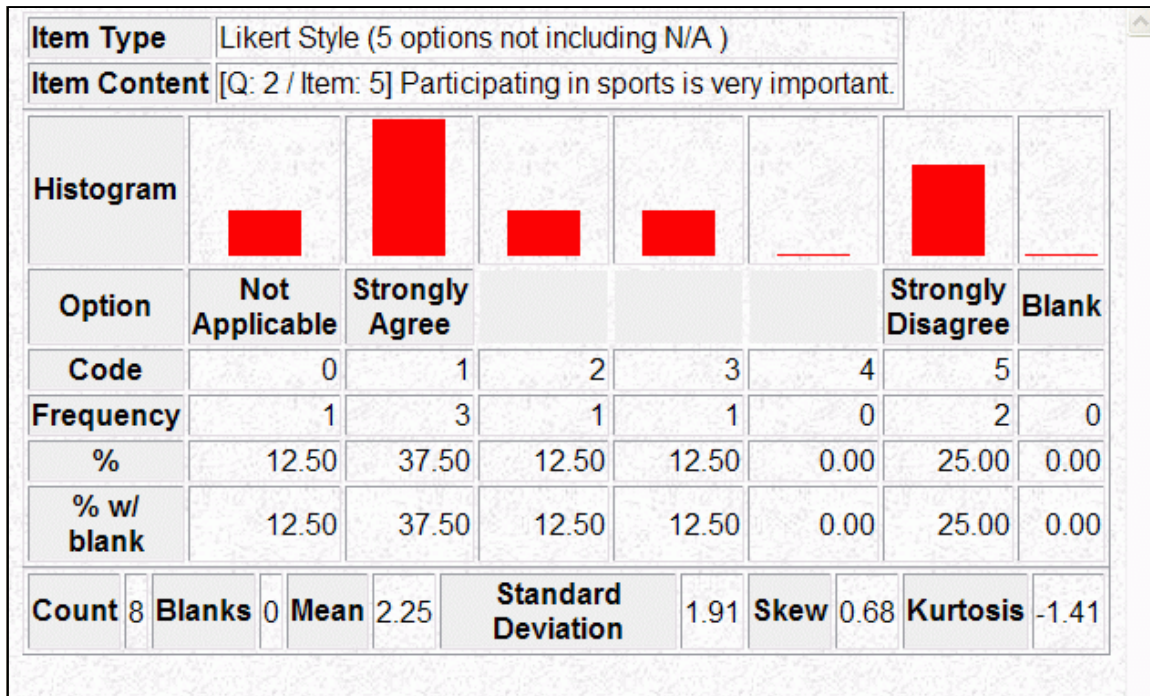


Figure 75: Question Focus Shows Additional Information

Semantic Differentials

Pressing the "Semantic Differentials" review button provides a list of all the items that are either traditional or image semantic differentials. BIRAT provides raw responses and basic statistics such as sum, count, and mean. As with the basic categorical review, clicking on a question provides more information about the selected question.

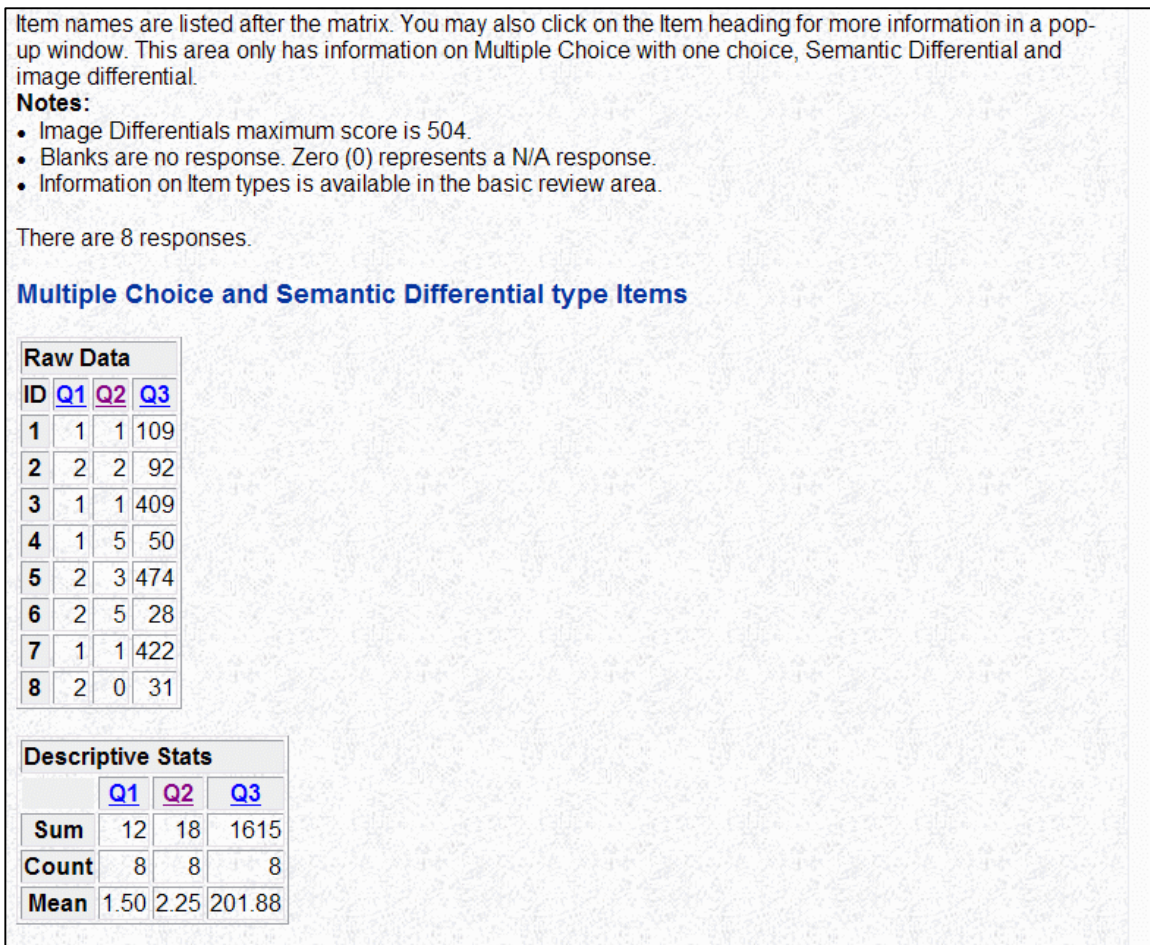


Figure 76: Semantic Differentials Review Area

Comma Separated Value (CSV) File Export

The "CSV File" button was created as an export option after a member of my dissertation review committee suggested that Comma Separated Values (CSV) was the best format for data export to a variety of applications. As a result, the most recently added data analysis option is the CSV button. The CSV file export option provides the researcher with a dialogue box to save or open the file as shown in Figure 77. Note that Windows identifies the CSV file type as an Excel file while BIRAT saves the data in the CSV format as defined by rfc4180 (Shafranovich, 2005). The application that opens the CSV file will depend on the researcher's system configuration.

Figure 78 shows an example of BIRAT's CSV output. Both the CSV file output, and the Excel file output which follow, illustrate an interesting aspect of data output from multiple choice questions where multiple choices are allowed. In order to properly export, each option of a question is considered a unique question. Also note the "User" area only has zeros in the data place. If the survey had used user tracking, the unique user ID would be placed in the user column. The file export option also provides the IP address of the participant and the date and time of the submittal. This information may be of use in detecting multiple submittals when user tracking is not activated.

BIRAT is unique among Internet survey design systems in that it includes both questions and question numbers with its export to Excel and CVS file export formats. This means that all BIRAT file datasets are self documenting in the sense that they provide both the raw response data and the questions associated with the data.

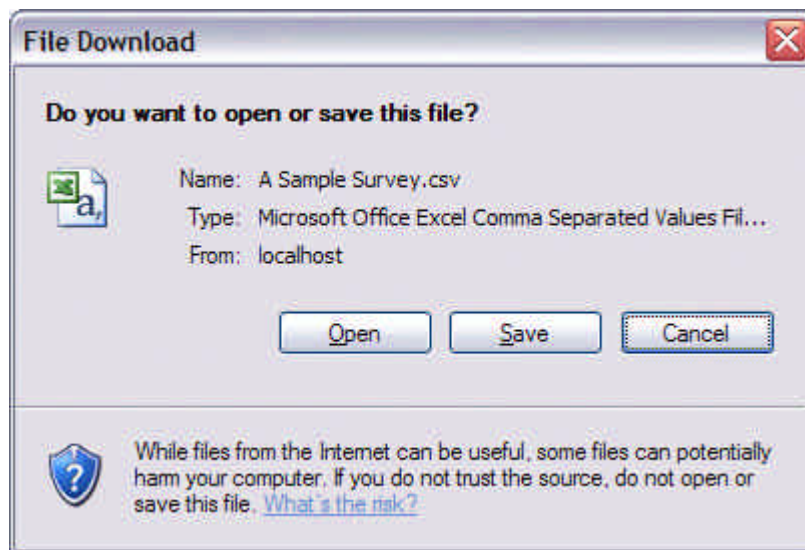


Figure 77: The Windows File Dialogue Box

```
Count,RKey,User ID,Time,IP,1,,2,2.1,2.2,2.3,,3,,4,,5,,6,,7
1,-310375392,0,10/1/2006 8:12:55 PM,127.0.0.1,1,1,,Fishing,Catching a big fish. My dad r
2,-482525050,0,10/1/2006 8:13:51 PM,127.0.0.1,2,1,1,,Bowling,Getting a perfect score bowli
3,486217677,0,10/1/2006 8:14:51 PM,127.0.0.1,1,1,,,,Graduating from high school. I thought
4,754955469,0,10/1/2006 8:17:55 PM,127.0.0.1,2,,1,,Car racing,The day I got to cook thank:
5,325359522,0,10/1/2006 8:19:27 PM,127.0.0.1,2,,1,,None,They day I convinced my parents to
6,-987789331,0,10/1/2006 8:22:00 PM,127.0.0.1,1,1,,Swimming,Finding a hundred dollar bil
7,-152614772,0,10/1/2006 8:22:55 PM,127.0.0.1,2,1,,,,Chess,Being able to drive my own car.,
8,-247249781,0,10/1/2006 8:23:49 PM,127.0.0.1,1,,1,,None,When I finally got my own car.,5,

Item List
1) Which color do you prefer? |
2) Which clubs do you plan to join?
  2.1) Chess
  2.2) Debate
  2.3) Art
3) What is your favorite sport?
4) What was the best thing that every happened to you? Why was it the best thing ever?
5) Participating in sports is very important.
6) Participating in school is very important.
7) What part of this picture is most important to the learning process?
```

Figure 78: Sample CSV Output

Excel File

Pressing the "Excel File" button creates an Excel file download dialogue. Figure 79 shows an example of the resultant Excel file.

A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	
1	Count	RKey	User ID	Time	IP	1	2	2.1	2.2	2.3	3	4	5	6	7
2	1	-310375392	0	10/1/2006 20:12	127.0.0.1	1		1		1	Fishing	Catching a big fish. My dad never caught one so big.	1	409	379-244~1~1~slimages/663167297.jpg
3	2	-482525050	0	10/1/2006 20:13	127.0.0.1	2		1	1		Bowling	Getting a perfect score bowling. This was important because very few people do it.	2	92	228-74~1~1~slimages/663167297.jpg
4	3	486217677	0	10/1/2006 20:14	127.0.0.1	1		1				Graduating from high school. I thought I'd never make it.	1	422	349-298~1~1~slimages/663167297.jpg
5	4	754955469	0	10/1/2006 20:17	127.0.0.1	2				1	Car racing	The day I got to cook thanksgiving dinner for the whole family. Letting me cook that important meal proved that my parents trusted me.	0	31	31-55~1~1~slimages/663167297.jpg
6	5	325359522	0	10/1/2006 20:19	127.0.0.1	2			1		None	They day I convinced my parents to buy me a car. It was the best because I could finally get around on my own.	5	28	311-264~1~1~slimages/663167297.jpg
7	6	-987789331	0	10/1/2006 20:22	127.0.0.1	1		1		1	Swimming	Finding a hundred dollar bill on the ground so I could take my girlfriend out to a special dinner.	1	109	377-285~1~1~slimages/663167297.jpg
8	7	-152614772	0	10/1/2006 20:22	127.0.0.1	2		1			Chess	Being able to drive my own car.	3	474	173-374~1~1~slimages/663167297.jpg
9	8	-247249781	0	10/1/2006 20:23	127.0.0.1	1				1	None	When I finally got my own car.	5	50	155-48~1~1~slimages/663167297.jpg
10	Item List														
11	1) Which color do you prefer?														
12	2) Which clubs do you plan to join?														
13	2.1) Chess														
14	2.2) Debate														
15	2.3) Art														
16	3) What is your favorite sport?														
17	4) What was the best thing that every happened to you? Why was it the best thing ever?														
18	5) Participating in sports is very important.														
19	6) Participating in school is very important.														
20	7) What part of this picture is most important to the learning process?														

Figure 79: Excel File Screen Shot

Multiple Choice

The "Multiple Choice" button provides a review of responses to multiple choice questions with multiple options (MCMO) items. As discussed previously, each option in MCMO items provides a column where a one represents an answer. Figure 80 shows a data table created by the Multiple Choice button. In this table a column provides the sum of total participant responses and a row at the bottom provides a sum of responses in each column.

This area breaks out the responses to Items that allows multiple choices. The row numbers represent the number of persons who responded to the Item. Note: Blank rows where there was no response to the Item by the participant are removed.

Which clubs do you plan to join?

ID	Chess	Debate	Art	Sum
1	1		1	2
2	1	1		2
3	1		1	2
4			1	1
5	1			1
6		1		1
7	1			1
8			1	1
Sum	5	2	4	11

Figure 80: Multiple Choice Screen Shot

Image and Image Differential Item Types

Images are an experimental item type provided by the BIRAT system into two categories. The image item type allows the survey designer to provide an image that is either a traditional picture or an image bar. No Internet instrument survey system that I have reviewed provided these possibilities for image item types. With image item types, the participants' pressing or clicking on the "Image" area results in collection of the

location on the image that the participant clicked on. The researcher is provided with both a summation image showing a montage of all participant responses (dots) and a table of the X and Y participant click coordinates.

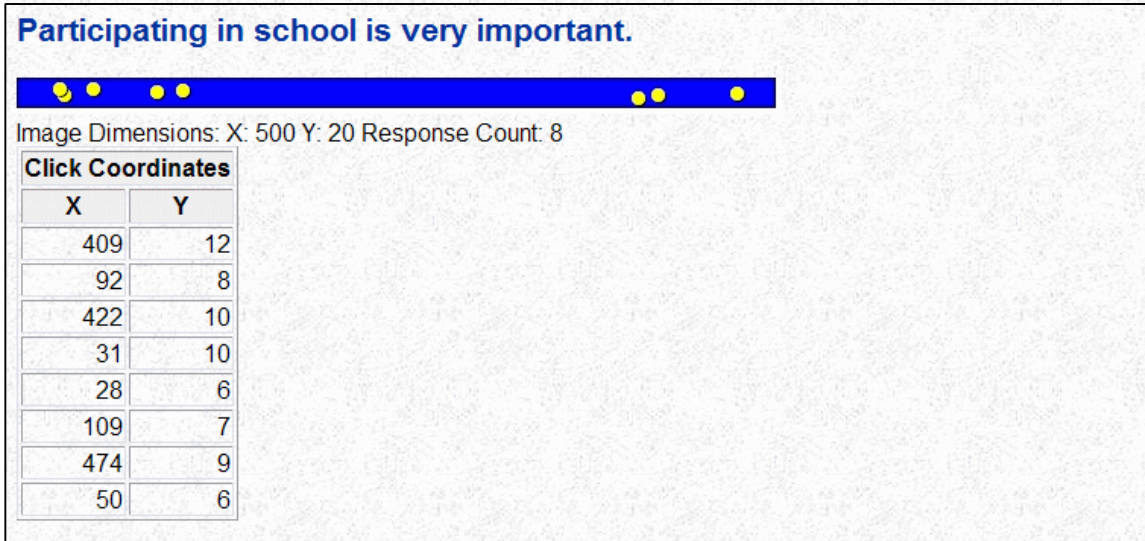


Figure 81: Image Differential Item Type

What part of this picture is most important to the learning process?

Response Count: 8

Click Coordinates	
X	Y
379	244
228	74
349	298
31	55
311	264
377	285
173	374
155	48

Figure 82: Image Item Type

This concludes our visual and operational tour of the BIRAT Internet information collection system.

SPECIAL BIRAT FEATURES

The development of BIRAT and trials with researchers led to the creation of some special features.

USER TRACKING

The ability to optionally and uniquely track participants is an important requirement in Internet survey design (Track Marketing Group, 2002). BIRAT (Balch, 2006b) system design considerations included optimal flexibility in user tracking and for the possibility of minimal user tracking. Optional password protection is provided.

BIRAT also follows best practices in online data collection which suggest that all collected data should be time stamped with the Internet Protocol address of the sender. This information provides for rigorous analysis of survey participants.

Should the researcher require tracking at the participant level, BIRAT uses the survey's Email list to generate Email lists with a unique link to all potential participants. BIRAT also provides an area where researchers can track participant responses to these survey links. Further, BIRAT allows the researcher to send Email to persons who have not responded. Personalized follow up requests to participants who failed to respond initially have been found to increase response rates (Heerwegh et al., 2005; Joinson et al., in press).

DYNAMIC VOTING

Surveys are often used to collect votes that represent a snapshot of participant and thus population opinion. Your author considered the possibility that a more dynamic picture of participant opinion might be of interest to researchers. With BIRAT, at the survey developer's option, uniquely identified participants can change their response to a BIRAT survey at any time until the researcher elects to turn this feature off. The ability to

change previous responses combined with the possibility that all participants could be given access to the editing area, creates something unique to the Internet survey environment. It might be called a hybrid of surveys and Wikis. Of course, with BIRAT, all responses are preserved for possible historical analysis. While BIRAT provides the possibility of using instruments with changing items, analysis of instruments with changing instrument items is a challenge for Internet survey researchers that BIRAT does not address. BIRAT provides item analysis of the most current version of the selected instrument.

The option to change previous responses allows both the survey designer and the survey participants to continuously measure a group's feelings and thus develop a consensus. For example, the option to change previous answers was used by a group of graduate students to achieve a consensus definition of leadership. Over a period of weeks, various definitions were proposed and discussed on a companion Wiki. From time-to-time a vote was called and students would revisit the survey with the possibility of changing their votes on best definition as various definitions were added and previous definitions were changed. This was found to be a very useful capability.

SECURITY

Internet researcher should consider three types of security: (1) controlled access to the instrument so that only targeted participants respond to the survey, (2) control of instrument results to insure that sensitive data is not made public, and (3) and use of best

practices in data storage so that results will not be lost. All three types of security are critical to the survey's success.

BIRAT allows for three instrument access control options: (1) The researcher may password protect access to the survey instrument with a single password and optionally combine this password with a unique identification number for selected participants, (2) The researcher may password protect the results of the survey, and (3) The researcher may password protect the ability to edit the instrument. These options provide some unique flexibility. For instance, a researcher could allow participants access to both their answers and the content of the instrument thus allowing a constructivist or Wiki-like approach to survey design where participants could change the survey.

The ability for participants to change the content of survey items is an area ripe for further research. In particular, the methodology to compare responses to items whose wording has been changed or when items added creating a scenario where different participants experienced different surveys creates challenge for the researcher. Research in consensus building is quite worthwhile but it will require an Internet survey system like BIRAT that the researcher can adapt and monitor in a variety of ways.

The technology for insuring that participant responses will not be discovered by third party Internet observers is well established. BIRAT is designed to work equally well in a variety of server environments including the high security HyperText Transport Protocol Secure (HTTPS) environment. Participants may be aware of this protocol which provides a locked padlock icon at the bottom of their browser window. Other than this icon indicating that data transfers are secure, security is transparent to the researcher and

participants. In this context, it should be noted that HTTPS security requires more resources from both the participants' browser and the researchers' server.

While insuring the security of data transmitted over the Internet is important, survey designers need to take exceptional care to protect databases. BIRAT follows best practices in the protection of its data (Andrews & Whittaker2006). The BIRAT database is maintained in a uniquely named subdirectory which has no HTTP access. In addition there is no area in BIRAT where code such as used for Structured Query Language (SQL) injection might be inserted. SQL injection is a type of attack where a malicious person provides a response that, when data are analyzed, includes some SQL code that can, in a worst case, erase an entire database.

The greatest threat to BIRAT security is Denial Of Service (DOS) attacks where a malicious person directs tens of thousands of zombie computers to send repeated content requests in an attempt to overload the BIRAT system. There is very little that any site on the Internet can do to protect itself against denial attacks of this kind. What can be done to protect the BIRAT system has been done including a secure firewall and a server that is monitored 24x7 by professional Internet technicians (CrystalTech, 2006).

Another area of security concern is insuring that data is collected. There have been problems with data collection in BIRAT. For example, BIRAT was used to deliver and analyze a class designed instrument that provided a rubric to explore usability of websites. Many participants reasonably elected to complete the instrument as they reviewed the websites. Unfortunately, at that time BIRAT used a system default time of twenty minutes before it timed out and would no longer record responses. Some students

exceeded the time limit and thus experienced the very frustrating experience of losing the data they had submitted. As a result of this experience, the BIRAT time limit to complete surveys has been extended to two hours. There have been no other further reports of lost data.

HISTORY OF BIRAT'S DEVELOPMENT

The first usable version of the then unnamed survey system became available in July of 2004. The system was created in order to complete a class project, a survey of graduate programs of a department at Louisiana State University (Balch & Doise, 2004). Since that time there has been continual and iterative development as features were added and refined.

The BIRAT name results a desire the author's desire to create a memorable name that was also available as website. It has become very difficult to find available website names. The BIRAT website, <http://birat.net>, was registered in January of 2005. The first BIRAT survey was created about 24 hours before the paper discussing the survey results was due. It is fortunate that one of the attributes of Internet surveys are that the researchers benefit from have very fast responses.

The feedback from participants to that first BIRAT survey about the survey system itself was so positive that I decided to improve it from a marginally functional system to the full featured system that BIRAT is today. Since that first survey, a number of participants and researchers have provided feedback and requests for new features they would find useful. In example, I learned from participants of that first survey that a N/A

option was needed for Likert style questions as many participants reported that they had no appropriate response for some questions. For some participants, the lack of appropriate response options resulted in their providing spurious responses in the belief that they should answer all questions. The N/A option is not available on most of the other Internet survey systems.

The use of common Cascading Style Sheets (CSS) in February of 2005 gave the whole project a unified look and feel. CSS also made it possible for a survey administrator to change the entire look and feel of the BIRAT system simply by changing the CSS sheet. This also provides the possibility of using templates or "Skins" where a researcher could select a particular look or feel. The possibility of opening up CSS for templates has not been explored as there is no research that indicates that such templates improve the quality of the data collected.

ADOPTION

Rogers' (2003) model suggests that innovation diffusion requires adoption and acceptance by innovators who then make recommendations to other potential users through a hierarchy of technology adopter categories. With Rogers' theories in mind, I had some success in attracting new users to the BIRAT system.

As shown in Figure 83, there have been brief flurries of interest and a steady increase in the creation of new instruments over the last two years. The first major surge in survey creation occurred when BIRAT was mentioned in the Distance Education Online Symposium (DEOS) newsletter on the 27th of March, 2005. As a result, BIRAT

was mentioned two days later by Stephen Downes in his very popular OLDaily newsletter (Downes, 2005). This rapid growth was enhanced by a conference presentation at THE Forum introducing BIRAT (Balch, 2005).

The conference presentation proved fortuitous in a number of ways. Various members of the audience elected to adopt BIRAT for their research purposes, several members provided a review of the BIRAT interface concluding that it was excellent, and BIRAT was mentioned in the concluding remarks at THE Forum.

The next increase in the adoption and use of BIRAT occurred after another author mentioned it in the DEOS list (Balch, 2006c). The last major mention of BIRAT was a thread, where BIRAT was mentioned several times in the American Association of Internet Researchers (AOIR) newsletter (Balch, 2006a; Reips, 2006).

The current relatively flat rate of growth of BIRAT results from a necessity of a focus by the author on writing this dissertation instead of promoting BIRAT. I will once focus on promoting BIRAT when this dissertation is complete. In this context, I also look forward to using BIRAT as a research instrument.

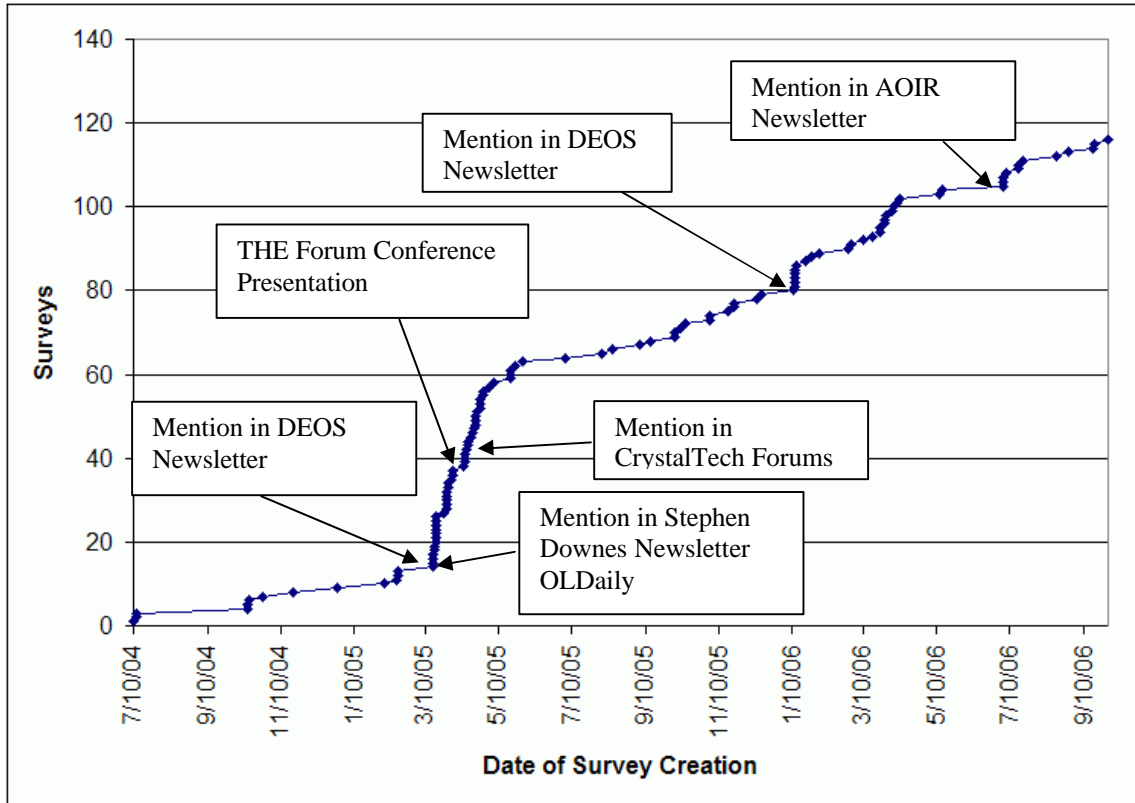


Figure 83: Cumulative Graph of Active Surveys Created in BIRAT

Figure 84 shows the growth in number of participants using BIRAT with a total of 2,084 participants when this chapter was written in October, 2006. The stair-like shape of the line indicating the increase in the number of participants likely reflects the addition of new surveys with a large number of participants. I am aware of at least one large university department outside of LSU that uses BIRAT for surveys.

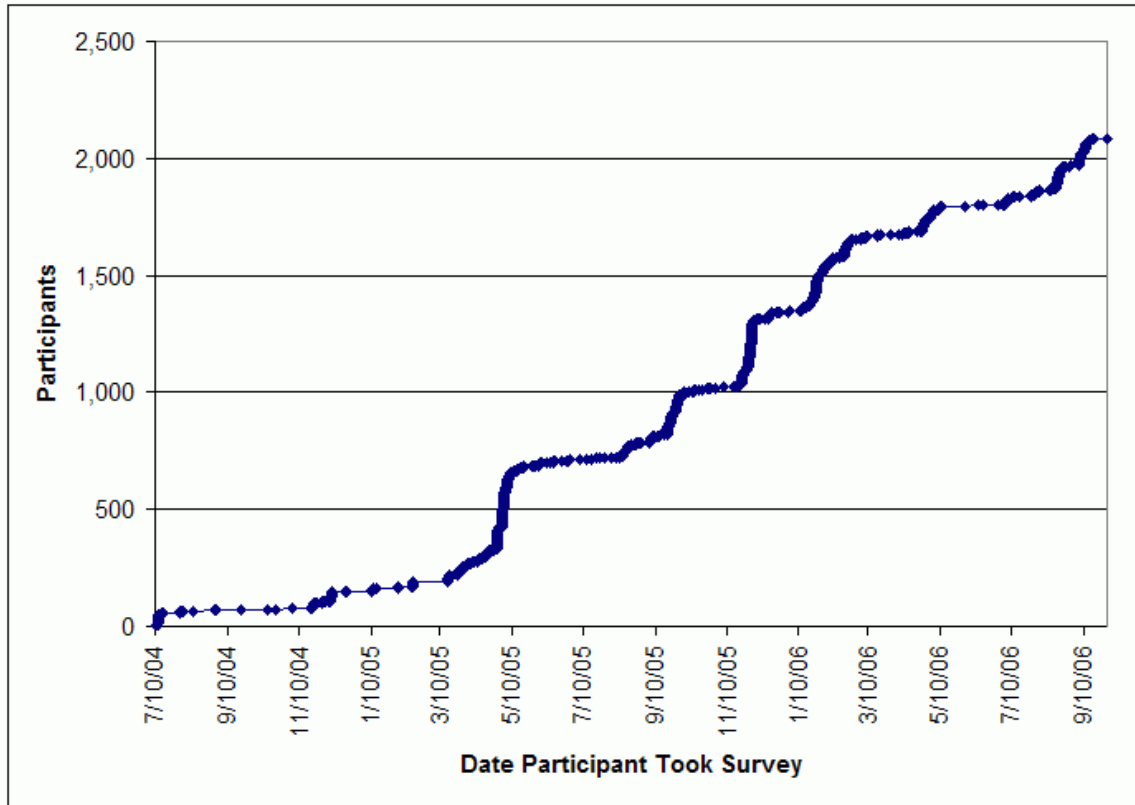


Figure 84: Cumulative Graph of Participants Responding to a BIRAT Survey

Figure 85 shows the cumulative number of responses to the BIRAT system. The stepped pattern suggests the occasional large survey. The likely reason that many of these responses do not line up with increases in number of participants is that BIRAT allows participants to be recorded so the addition of participants could have been done in batches over time. In addition, it is possible that the same participants were repeatedly given the same surveys. Confidentiality features of BIRAT prevent me from discovering and reporting the actual case.

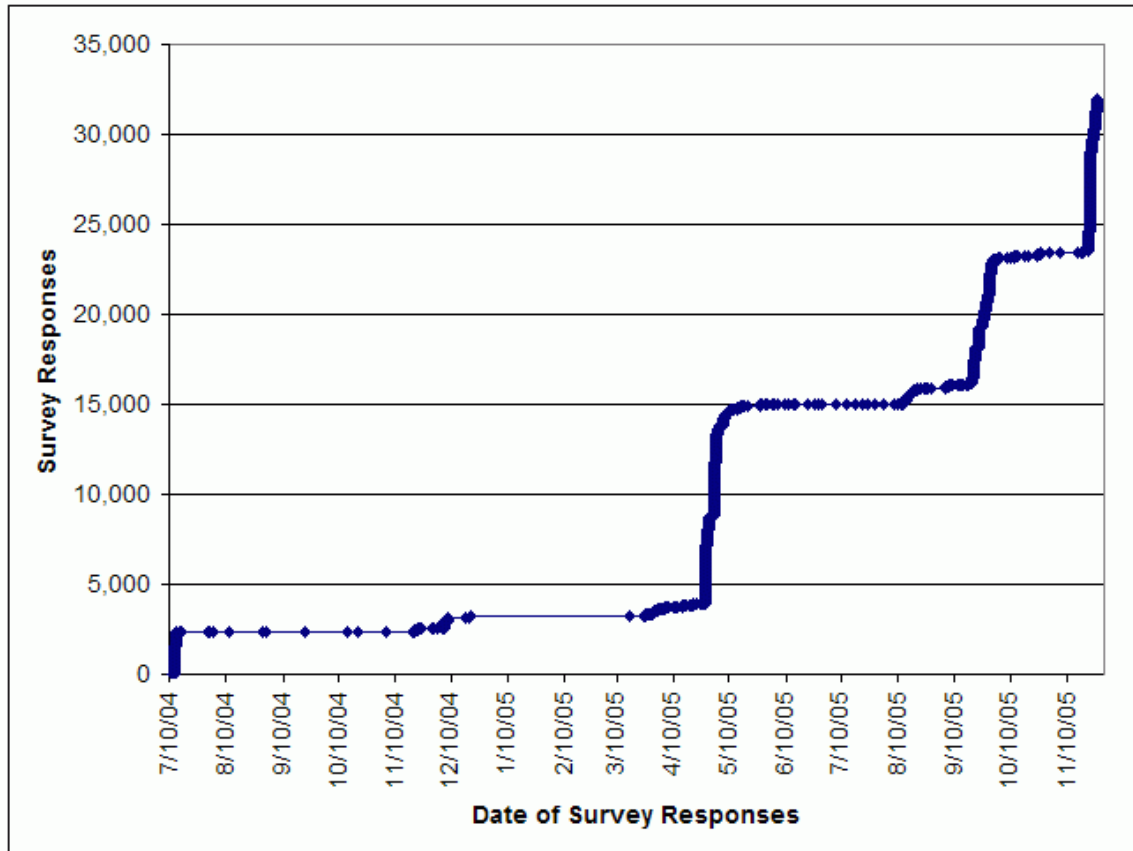


Figure 85: Cumulative Graph of Participant Responses to a BIRAT Survey

PROGRAM DEVELOPMENT

The first working version of BIRAT appeared in the Summer of 2004. This code was completely rewritten in the Fall of 2004 as it became clear that there were some essential flaws that would severely limit growth. These flaws centered on not creating sufficient modularity in the initial programming structure and problems with the database design that were preventing effective queries. The decision to abandon altogether the project code and begin again was not made lightly. I suspect that, in response to advances in computer technology and evolving demands on the system, another full rewrite of the BIRAT code will be needed in a year or two. The most difficult part of creating software

that explores new ground is usually discovering what the software should do and how the application should interact with the end users.

At no point in the developmental process was any part of the BIRAT system considered "written in stone" and complete. Even with the rewrite, many subsystems were created with marginal functionality, then later replaced with superior code and capability as needs became apparent. One area that has continually needed improvement is the processing of data into reports. The efficiency of the system in this area could still be improved.

Decisions on the direction of the BIRAT software development have come from a variety of sources and influences. First the author constantly reflected on what he was learning in his graduate classes, particularly those classes that involved statistical methods and software development. Other improvements came as a result of classes where the system was used and reviewed in the class.

Other changes emerged from the suggestions of colleagues and professors. At the request of a professor (Dr. Christine Distefano), I incorporated the intriguing feeling thermometer concept into the BIRAT system and renamed the item type as image differential. The image differential concept is particularly attractive to Internet researchers as no more additional effort is required to collect the location values of a click on an image than is required for any other item type. Historically, while the results of paper surveys that used feeling thermometers indicated that feeling thermometers are effective, the item type never became widely popular. The lack of popularity of the feeling thermometer item type may be due in part to how tedious it is to record the

results. To record the results of feeling thermometers, the researcher or their (graduate) assistant must carefully measure the placement of the mark and then record the value. I was unable to find any instance where this item type has been used on the Internet. Much of the data export functions were added at the request of researchers who wanted easier methods to work with their data.

Image items are another item type that illustrates BIRAT's focus on exploring survey item types that are especially suited to Internet technologies. The BIRAT image item type allows participants to place a dot on an image indicating the area the participant considers most important.

COMPARISON OF BIRAT TO DEVELOPED RUBRIC

Table 10 on page 106 introduces a rubric for review of online survey systems is duplicated here in Table 19. A review of BIRAT's ability to address these features is provided in the table.

Table 19: A Review BIRAT's Features with Discussion of the Features

Criteria	BIRAT	Discussion	Description
Web Site	http://birat.net	BIRAT provides a signature website and provides for the researcher to download the application and install on their own website.	The Internet address of the survey development system.
Participant Limits	None	The only limit to the number of participants in a BIRAT survey is the limit of table size in Microsoft Access which is currently two gigabytes.	Many free or low cost survey systems limit the number of participants. Limiting the number of participants can be a problem to researchers using surveys with self-subscribed participation.
Item Limitations	None	The only limits to the number of items that a researcher may create in a BIRAT survey are based related to system hardware and the researchers understanding of what is acceptable to participants..	While in practice it is not usually a good idea to create a survey that had a large number of items because lengthy surveys discourage participation, researchers and survey designers need a survey system that provides a reasonable number of items. I would say that fifty is a reasonable number. All of the reviewed survey systems either provided no limitations on item numbers or had limits so low (n=10) that that the survey system would not be useful to many researchers.

Table 19: Continued

Criteria	BIRAT	Discussion	Description
Pricing	Free	BIRAT is free under the GNU public license.	Many researchers are on minimal or no budgets. A review of Internet websites indicates that price is very loosely related to quality.
Survey Item Issues			
Number of Item Types	10	BIRAT provides all of the usual survey item types.	My review of the number of reported item types indicates that there are wide discrepancies between how Internet survey designers measure the number of item types in their offerings. For example, multiple choice with only one choice may be described as semantic differential style items or a horizontal variation of multiple choice with one choice.
MC- One Choice	Yes	Included	Multiple choice with only one choice is the most common item type offered on Internet surveys. This item type includes the possibility of polling for the most popular response.
MC - MC	Yes	Included	Multiple choice with multiple choices provides the participant with the possibility to include more than one response to a list of options. This item type should provide the survey designer with the possibility of selecting other and a text box for the participant to include their alternative

Table 19: Continued

Criteria	BIRAT	Discussion	Description
Customizable Scales	Yes	Included	response category. The number of options on a scale is very important to many researchers.
Short Answer	Yes	Included	Short answer provides the opportunity for respondents to provide an open-ended response. This possibility is very important for Internet survey research and design.
Adjust text box size	Yes	Included	The response area for this item is measured in characters. As the size of the response area influences the participant response, it is important that the researcher be able to change the size of the response area.
Essay	Yes	Included	Essay response areas provide the participant with an opportunity to give a lengthy open ended response.
Adjust Essay area size	Yes	BIRAT provides for the possibility to adjust the survey Essay size area. Few of the reviewed surveys provide for this possibility.	The response area of this item type is measured in lines. As the size of the response influences the participant response, it is important that the researcher be able to change the size of the response area.
Semantic Differential	Yes	Included	Many of the reviewed survey systems did not consider semantic differentials a unique item type. Instead, they provide the possibility for horizontal and vertical multiple choice with one

Table 19: Continued

Criteria	BIRAT	Discussion	Description
Semantic Differential N/A option	Yes	Included	response option. The horizontal option provided the possibility for semantic differential type questions. It is occasionally desirable to allow participants to respond with N/A to a semantic differential question.
Question Batteries	Yes	Included	Question batteries or matrices provide the ability to provide a common set of questions with grouped instructions.
Unique Item types	Yes	BIRAT provides for the possibility of unique item types.	Does the Internet survey design system provide unique item types?
Date and Time Item	No	BIRAT does not provide for a unique item type that collects date or time information. This may be an area for future development.	Does the Internet survey design system provide for an item type that is specially suited to receiving date and time information?
Rank Order	Yes	BIRAT does provide for the possibility of rank order type items through the use of multiple items in the short answer question. However, there is no logic to enforce the user to properly respond.	Does the Internet survey design system provide for an item type that is specially suited to receiving ranking information? Some survey systems provide background logic to insure that the participant accurately responds to the ranking specified by the researcher.
Pages	No	BIRAT does not provide for the controversial page feature.	The ability to present Internet surveys in multiple screens or pages is controversial. On one hand multiple screens control presentation and thus the participant experience. On the

Table 19: Continued

Criteria	BIRAT	Discussion	Description
			other hand multiple screens can delay participant experience and thus reduce responses.
Survey Design Issues			
Ease of editor use	Very Easy	A primary consideration in the design of BIRAT was that the editor should be easy to use.	While any editor is relatively easy to use once it has been learned, the amount of time it takes to learn to use the editor is a very important criteria in survey system selection.
Reorder questions	Yes	BIRAT provides for the ability to reorder questions.	A good survey editor should allow the survey designer to change the order of the questions.
Use of JavaScript	Not Required	BIRAT's use of Javascript is limited to areas where it is not mission critical that the user have Javascript enabled.	While Javascript provides the opportunity to monitor participant responses, researchers should not depend on participants allowing Javascript on their browsers.
Use of color	Good	Careful consideration of the use of color to coordinate and direct the participant experience was an essential consideration in BIRAT's design.	Proper use of color can instruct and guide participants through a survey.
Embed Multimedia	No	While a sophisticated survey designer could use HTML code to embed multimedia, this option is not provided in the design interface.	The ability to include multimedia, such as images, is occasionally desirable to survey designers.
Require Answers	No	There is no the controversial provision of requiring participants to provide answers.	The ability to require that a question be answered is often desirable to researchers. This function is somewhat controversial in that requiring answers can antagonize

Table 19: Continued

Criteria	BIRAT	Discussion	Description
Exit Message Screen	Yes	BIRAT provides an area where survey designers can provide an exit message of their choice.	participants and thus reduces response rates or increase the number of incorrect responses to surveys. The ability to present an exit message screen is often desirable. Common uses for exit message screens are to thank the participant for completing the survey, direct the participant to next tasks such as a review of the results from all participants.
Templates	No	BIRAT does not provide for color templates as the current combination is considered optimal. However, this is an area that would be easy for a researcher to adjust.	Many survey systems allow the survey designer to select from among a number of templates that give the resultant survey a different look and feel. I feel it is more important that color be used properly than to have a number of schemes that all do not use color appropriately.
Duplicate Survey	No	BIRAT does not provide for this feature. While sharing of times on a public server is controversial. This may be an area for future development.	Some survey systems allow previous surveys to be duplicate so that they can be reused. Some systems also provide for a question bank to help build new surveys.
Password Protect Survey	Yes	Survey designers can password protect participation, editing, and review of surveys.	Some survey systems allow for user authentication through the use of passwords. These passwords are occasionally called tokens. In practice, the researcher provides a

Table 19: Continued

Criteria	BIRAT	Discussion	Description
Store Partial Results	Yes	Participants can record a partially completed survey and return later to complete the survey.	password to the user when they inform of the surveys location. Some surveys allow the participant to store partial completed surveys so that they can return to them. This feature could be useful for long surveys but I wonder whether response rates would increase or decrease a when participants can partially abandon the survey. In short, do the participants come back to complete the instrument?
Load Time	Fast	BIRAT creates a survey that uses the minimum of code thus reducing the size of the created file and the related survey load time. In addition, the code that creates the survey is optimized so as to reduce the amount of time required to load the survey.	Load time is a subjective measure of how long it takes for a survey to load on the participant's computer. Research has found that longer load times are directly related to participant abandonment of surveys. Some factors that affect load times are the complexity of the survey code, survey length, and the amount of load the survey system is under.
Progress Bar	No	BIRAT does not provide for a progress bar as some researchers have found that this "feature" reduces participant response.	Progress bars show participants the percent of their survey completion. Research is conflicting in the use of progress bars as some research shows that progress bars increase participant retention while other research finds

Table 19: Continued

Criteria	BIRAT	Discussion	Description
Web Page Complexity	Low	BIRAT does not employ web page features that are browser specific.	that progress bars reduce response rates. Web page complexity is a measure of how much code is created by the survey development system. This code can include HTML, Javascript, and CSS. The greater the complexity, the more likely the page is behave in ways the survey designer does not expect.
Advertisements	No	There are no advertisements associated with BIRAT.	Some free web survey systems insert banner advertisements or logos on the surveys they create. These graphics can distract participants and influence results.
Section 508	Yes	BIRAT addresses and meets all appropriate federal code and suggestions.	Section 508 is the federal code that describes how web pages should be designed in order to be accessible to physically challenged participants.
Pull Down Menus	No	BIRAT does not use pull down menus or pull down selection boxes.	Perhaps the biggest problem for persons with a physical challenge involving vision is the use of pull-down windows on web pages. Web page reading software has great difficulty reading these menus in a coherent way.
Graphics Instead of HTML objects	No	BIRAT use appropriate HTML objects.	HTML and related languages have evolved to the point where it is

Table 19: Continued

Criteria	BIRAT	Discussion	Description
Branching	No	BIRAT does not provide for controversial branching options.	<p>possible to use many objects, particularly images, in new ways. Unfortunately, using a image instead of a traditional object, such as a button, leads to participant confusion and subsequent deterioration of the quality of the collected data.</p> <p>Branching provides the ability to conditionally show items depending on previous responses. Branching is often used in scenarios such as when the participant is instructed to skip some items if their response to an item is in a certain range. With branching logic, the participant would not even see the questions. The biggest problem with branching is that it brings into question the commonality of participant experiences which in turn brings into the question of pooling data.</p>
Participant Management HTTPS	Optional	BIRAT allows for secure connections with a server.	<p>HyperText Transfer Protocol Secure is the protocol for sending secure web pages. When sensitive data is collected, researchers will often want to send surveys using the HTTPS protocol. If there is no need for</p>

Table 19: Continued

Criteria	BIRAT	Discussion	Description
Language	ASP	BIRAT is coded in the very popular ASP language to insure that researchers will be able to adapt the system as needed.	security the traditional HTTP protocol is preferred as the HTTPS protocol adds to survey sizes and server loads. Language refers to the language that the computer language that the survey is written in.
Underlying Database	MS Access	The popular Microsoft Access database is used to record surveys and their responses.	It is difficult to envision a survey system that does not use some sort of underlying database where participant responses are recorded. The ability of the survey is thus fundamentally associated with the quality of the database it uses.
Hosting Possibilities	Optional	Researchers may create and deliver surveys at the BIRAT site or they may download BIRAT and install it on their own server.	It has been found that participant response rates increase when surveys are perceived to come from a trusted source. One area that participants look at in order to distinguish the source of the survey is the Universal Resource Locator (URL) of the survey. Thus it is to researcher's advantage to be able to download and install a copy of the survey system to a server under their control.
Export Data	Excel, CSV	BIRAT provides for the popular Excel and CSV data export functions.	While a good survey system will provides data analysis, researchers often have unique data analysis needs.

Table 19: Continued

Criteria	BIRAT	Discussion	Description
Analysis	Basic	BIRAT provides some basic data analysis functions while providing the possibility for more analysis with data export.	Thus it is important for the survey system to be able to export results in a format that can be read by advanced statistical programs. Survey systems vary with the amount of analysis that they can perform. Some basic data analysis is very helpful but extended features may not be desirable as data analysis should be performed by a program that has been fully tested and found acceptable by the academic community.
Open Source	Yes	The BIRAT project is hosted at http://BIRAT.SourceForge.net	Open source refers to a practice where some developers provide the original product code with their product. Access to the source code provides survey designers with the option to create modifications and add to the code.
Lock Survey for Editing	Password	BIRAT allows the researcher to password lock the survey to prevent further editing.	Some survey systems provide the option of locking the survey for editing. Participants cannot take a survey that is locked.
Specify Survey Dates	No	While, BIRAT does not explicitly provide the survey designer with the option to make surveys accessible over a certain date range, survey access can be controlled through password protection which would allow the survey designer to control	Some survey systems provide the option to limit survey availability by date and time at design time. This may be more convenient to a researcher than simply providing the

Table 19: Continued

Criteria	BIRAT	Discussion	Description
		access..	survey when it is allowable to take it and removing the survey from public view when additional participation is no longer desired.
Email	Yes	BIRAT provides the possibility to Email participants.	The ability for the survey system to send Email directly and in bulk is occasionally a very important criteria in survey design. This feature is also associated with participant tracking.
Email Selected	Yes	Selected participants may receive Email.	Survey systems with Email capability should be able to send a single message and/or messages to a subset of the participants.
Bulk Email Addition	Yes	Participant names and Email addresses may be added in bulk.	The ability to add users and their Email addresses in bulk is very important when a researcher wants to do participant tracking.
Participant Tracking	Yes	Participant responses are tracked.	It is often desirable to track unique participants so as to discover the time of last response or if participant has responded at all. In addition, repeat invitations to participants can increase response rates.
Participants can Change Answers	Optionally	Survey designers can optionally allow participants to change their answers.	It is occasionally desirable to allow participants to review previous answers and change their response. This option is particularly useful when the researcher is using the

Table 19: Continued

Criteria	BIRAT	Discussion	Description
Randomization of Responses	No	BIRAT does not provide for this controversial option.	survey system as a tool to monitor the current status of group opinion. Some researchers consider it important to be able to randomize the order of item options. The ability to change the order is only useful with nominal data and may not be desirable for two reasons. First changing the order would only mask the effect of pattern responses and, when participants do not experiences are different, the commonality of experience is questionable.
Time Taken to Complete (seconds)	No	BIRAT does not currently record the time the participant took to complete the survey. This is in part as it is impossible to tell how much time between the start and finish of the survey was directly spent taking the survey.	It is often desirable to track the time it took the participant to complete the survey. Note that this number only represents the time from delivery to submittal and does not track the actual time the participant spent completing the survey. For instance, a participant might retrieve the survey, be distracted by another task, then return to the survey.
Public Registration	No	BIRAT does not currently provide the possibility for participants to register themselves before taking a survey.	Public registration provides the ability for participants to register for the survey and be placed in the survey's user tracking system. This feature could be help reduce researcher effort

Table 19: Continued

Criteria	BIRAT	Discussion	Description
			as the researcher will not need to do the tedious chore of entering many users.

As Table 19 indicates, BIRAT meets the criteria proposed in Chapter 3 and has features, options, and flexibility that make it superior to existing Internet survey packages.

CHAPTER FIVE: DISCUSSION

The science of surveys involves far more than simply asking a few questions and tabulating the results. Beyond the content of the questions are factors such as item presentation that are also critical to collecting valid data. New modalities, such as the Internet, present both research opportunities and research challenges. Researchers must discover how the new medium can best be employed to expose information in unique and valid ways in an environment that is constantly changing.

In my review of best Internet survey design practices, I found a few consistent themes: (1) Internet surveys should provide the participant with a clean and simple interaction consistent with common web page design principles. (2) Internet surveys should not depend on the use of technology which may not be enabled or present on potential participants' computers. (3) The survey system itself should be easy to use while providing the researcher with all traditional options.

BIRAT achieved two major development goals: (1) Provide a full-featured Internet survey system for researchers who wish to use an instrument that reflects best practices in Internet research. (2) Provide an open source platform for development of Internet survey systems that allows researchers to explore new possibilities for item types and survey methodology.

LIMITATIONS ON BIRAT USE

The ASP language and Microsoft Access database were selected because they are widely available and familiar to most researchers. However, there is a balance between the ease with which technology is deployed and the extent to which it is robust.

The current version of BIRAT would not be suitable for surveys where a very large number, or very rapid responses, are expected. Unfortunately, in this context "very large" and "very rapid" are terms that cannot be well defined as response capability would depend on the hosting server. It may well be that the needs for large scale research projects will require that BIRAT be rewritten in another programming language and/or with a more robust backend database. Fortunately, the SQL commands, which are arguably the most difficult area to code, will need little alteration if a different database program is selected.

While computer instructions or code are written in a variety of computer languages such as ASP, PHP, and Java, potential participants and researchers also communicate in a variety of written and spoken languages such as Chinese, English, French, and German. A future release of BIRAT will consider the common open source software option of multi-lingual capability.

BIRAT, like most Internet survey systems, provides the traditional survey item types. BIRAT also goes beyond traditional survey possibilities to provide item types that are not often used with traditional survey media. These item types include image differentials, which are tedious to score when used on paper surveys.

The skills and understandings required to develop system software are often different from the abilities needed to use the resultant software systems. In this context, Bleicher (2003) offered the analogy of installing a kitchen sink as opposed to cooking a meal to system software development. Many chefs are probably not aware of, nor do they need to know about fundamental plumbing issues - unless faulty plumbing makes the sink inoperable for their special needs. For instance, few plumbers are gourmet chefs and gourmet chefs may have needs that are different from "usual" kitchen users that plumbers are not aware of. Internet survey system designers need to address the mutually exclusive possibilities of encouraging best practices in system design and the exploration of new design possibilities.

To extend the kitchen/plumber analogy further, the complexity of a gourmet kitchen increases the chances of an amateur creating a bad meal while at the same time increasing the possibilities for a gourmet chef creating a superior meal because of their unfamiliarity and inexperience with all that is in a gourmet kitchen. Thus, gourmet kitchens are not appropriate for amateur cooks as they provide greater possibility for errors in the creation of a meal just as complex survey design systems provide greater possibility for errors in survey design. On the other hand, when a system is used by a knowledgeable researcher, a more complex survey design system may provide the opportunity for a superior instrument and thus superior results.

The simplified BIRAT interface was developed at the expense of adding some features. Unfortunately, even with a simplified interface, there is no way to automatically and completely prevent researchers from creating flawed instruments. There is, however, some possibility of creating survey design systems that discourage flawed instruments.

Program authors should carefully consider each added feature to the applications they develop in the context of both the feature's ability to provide more accurate understandings and the possibility that the feature will be misused. An important goal in the BIRAT development process was that the interface should discourage mistakes in Internet survey design while encouraging the development of surveys that provide superior results.

Finding the balance between encouraging current best practices and facilitating innovative research is difficult. In version 1.0 of BIRAT I have tried to build in best practices as much as possible while giving users the flexibility to go beyond standard formats and practices. Also, making BIRAT open source means researchers with some programming expertise can develop new BIRAT modules and improve others. The best of these can then be incorporated back into the main development stream.

As stated earlier, I do not consider the BIRAT code to be either static or complete. In particular, there may be a need to rewrite BIRAT, which is already in its second generation, to address more demanding research needs. These research needs may include the ability to accept a very high response rate, to analyze large data sets, and to provide a program written in a language that is more acceptable to the open source development community. However, with Version 1.0 BIRAT has met and surpassed its design specifications.

In many unique ways, Internet Survey participants are giving the Internet researcher more than the gift of their time. They are also giving a gift of trust. It is important not to violate participant privacy for both ethical and validity considerations.

There are a number of types of privacy that Internet surveys can violate intentionally or by accident. Cho and LaRose (1999) point out that there are threats to survey result integrity when privacy is breached. For example, individuals and groups may boycott the survey or provide false information when they feel the survey attempts to violate their privacy.

Privacy concerns are further complicated by personal safety concerns which are well known problems on the Internet. Phishing occurs through misrepresentation of the sender where the recipient is encouraged to give information that allows their financial accounts to be compromised. For example, the ever increasing number of phishing identity theft attempts should make both survey creators and potential participants all the more careful about web survey design and content and what the participant may be exposing themselves to when they agree to take a survey (Cho & LaRose, 1999). Another area of popular concern is the increased use of the Internet by child predators to identify their victims. Any system, including BIRAT, should be designed to use the most up-to-data practices for preserving privacy and for ethical research procedures.

Another issue that can be most serious with Internet surveys is sampling bias. There is a sampling bias inherent with any survey methodologies. Much of this bias results from what portions of the population are excluded from the survey or those portions of the population that are over-sampled. The challenge of achieving a representative sample with Internet surveys may be somewhat overcome. Even though the population of Internet users is increasing, it is not reasonable for researchers to assume that the population they wish to investigate is adequately represented. Indeed researchers must

take special care to insure that participants have equal chance of being reached or discovered (Couper et al., 2001; Davis, 1997; Eaton, 1997; McConkey et al., 2003).

Online surveys have shown equivalent validity to other survey methods. For example, Einhart (2003) found equivalent predictive accuracy with phone and Internet surveys in areas such as predicting the results of presidential elections. Similarly equivalent results were found in the comparison of paper and Internet surveys.

FUTURE VERSIONS

Much like the parable of the "same" ax that has been in the family for generations where the ax head has been replaced twice and the ax handle replaced three times, it is anticipated that BIRAT will undergo many fundamental changes "under the hood." However, the core concept of creating a survey system with a focus on best practices in Internet surveys plus the ability to explore and discover new best practices in Internet research methods will remain the fundamental philosophy guiding future development of the BIRAT system.

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VITA

Charles Vickroy Balch was born in Norfolk, Virginia but, as the son of a traveling professor he developed a desire to see new places and grew up spending more than a year in California, Georgia, Mississippi, Louisiana, and the United States Virgin Islands, and Copenhagen, Denmark. The majority of his life has been in Northern California and the United States Virgin Islands. Charles managed to attend twelve different K-12 schools without being expelled from any of them. Charles graduated from the University of California at Davis in 1984 with a degree in Psychophysiology, a degree that he developed. Charles also earned a Masters in Education with an administrative emphasis from the University of the Virgin Islands in 1991 and a Masters in Business Administration in 1996, also from the University of the Virgin Islands. He has held a variety of jobs including ten years as faculty teaching computer information systems at the University of the Virgin Islands, computer consultant and computer programmer. Charles is currently a Professor of Computer Information Systems at Arizona Western College in Yuma Arizona. His current research interest is in the use of computer system to facilitate collaborative decision making.