exists, no estimate on the population size exists, no previous research exists, so all of the issues related to random sampling are really not appropriate. The goal of such a survey would be to establish the baseline data. In a case like this, the goal should be to simply get as large a response as possible. See the Computer Usage Patterns of People with Down Syndrome sidebar to see an example of where surveys were used to explore how young adults with Down Syndrome use computer technology.

Research In Practice

Computer Usage Patterns of People with Down Syndrome

A search of multiple digital libraries and databases resulted in the determination that no research studies existed that examined how young adults with Down Syndrome use computers and the Internet. In fact, no published research studies existed in 2005 that specifically examined computer usage in individuals of any age with Down Syndrome.

Only one design case study, where a website was being built to assist children with Down syndrome in learning about computers, was known to exist and be moving towards publication (Kirijian, Myers and Charland, 2007). A large-scale survey was needed, simply to gather baseline data about this user population. A 56-question survey was developed, covering demographic information, usage patterns, interaction techniques, and use of other electronic devices. Because it could be challenging to get accurate survey data from young adults with Down Syndrome, it was decided that parents of children with Down Syndrome would be recruited to respond to the survey.

The survey was placed on the web using surveymonkey (a web-based tool), and responses were solicited through two organizations in the United States: the National Down Syndrome Congress and the National Down Syndrome Society. A total of 561 surveys were collected, which provides a rich foundation of data on which other studies and research projects can be built (Feng *et al.*, 2008).

In communities where limited research has been done in the past, it may be challenging to find and recruit individuals to take part in the survey. There may be a lack of knowledge on the part of researchers, individuals may be reluctant to participate, or there might even be existing distrust.

Sometimes, snowball sampling can assist with getting survey responses. Snowball sampling is when individuals may not only respond to a survey, but also recruit someone else (usually a friend or colleague) to take part in the survey (Sue and Ritter, 2007). In a way, the role of contacting and recruiting participants shifts from the researchers to the survey respondents themselves. This method may work well when the population of interest is very small and hard to "break into," and individuals in the population of interest may know each other well. An outside researcher, coming into a community of individuals may not have a high level of credibility, but another community member suggesting participation in a survey may come with a high level of credibility.

5.6 Developing survey questions

Once the goal and strategy for using a survey has been decided upon, the next step is to develop a survey tool. As mentioned earlier, some describe the survey tool itself as a "questionnaire". The main challenge is to develop well-written, non-biased questions. The questions in a survey can often lead to answers that do not represent what the researchers were actually asking. Since a majority of surveys are self-administered, they must be easy enough to understand that users can fill them out by themselves. In a limited number of situations, an interviewer may ask survey questions. For more information on interviews, read Chapter 8.

It is important to understand that there are two different structures in a survey: the structure of single questions and the structure of the entire survey. More information on overall survey structure is presented in Section 5.7. Most survey questions can be structured in one of three ways: as open-ended questions, closed-ended questions with ordered response categories, or closed-ended questions with unordered response categories (Dillman, 2000).

5.6.1 Open-ended questions

Open-ended questions are useful in getting a better understanding of phenomena, because they give respondents complete flexibility in their answers. However, aside from the obvious drawback of more complex data analysis, open-ended questions must be carefully worded. Otherwise, they may lead to responses that either don't really help researchers address the root question, or responses that simply don't provide enough information. Consider the following open-ended question:

> ***Why did you stop using the Banjee Software product?***

This open-ended question provides no information about the possible causes; instead it requires the respondent to think deeply about what the causes might be (Dillman, 2000). The respondent may be too busy to come up with a complete response or may simply say something like "I didn't like the software." It is a very broad question. More specific questions might be:

> ***How did you feel about the usability (ease of use) of the Banjee software?***
> ***Did the Banjee software allow you to complete the tasks that you wanted to complete?***

These questions address more specific topics: ease of use and task completion. The respondents can't simply answer "I didn't like it," although they could just answer "yes" to the second question.

What is your impression of using the website for www.veggieland.com?
Please circle one number
Frustrating Satisfying
1 2 3 4 5 6 7 8 9
(question from the QUIS, see http://www.lap.umd.edu/quis/)

Figure 5.1 A closed-ended question with an ordered response. (Source: QUIS, see http://www.lap.umd.edu/quis/).

5.6.2 Closed-ended questions

There are two types of closed-ended questions. One type has ordered response categories, and other type does not. An ordered response is when a number of choices can be given, which have some logical order (Dillman, 2000). For instance, using a scale such as "excellent to poor" or "strongly agree to strongly disagree" would be an ordered response. Likert scale questions, which often take the form of a scale of 1 to 5, 7, or 9, ask users to note where they fall on a scale of "strongly agree" to "strongly disagree." Typically, closed-ended questions with an ordered response request respondents to choose only one item (see Figure 5.1).

Closed-ended questions with an unordered response allow for choices that do not have a logical order. For instance, asking about types of software applications, hardware items, user tasks, or even simple demographic information such as gender or type of internet connection are unordered, but closed-ended questions. Figure 5.2 is an example of a closed-ended, unordered question.

With unordered, closed-ended questions, you can often ask respondents to select more than one choice. On paper, this is not a challenge. However, it is important to note that, if you are creating an online survey, different interface widgets must be used. Option buttons only allow one choice, whereas checkboxes allow for many choices. Figure 5.3 is an example of a question that allows multiple responses.

Which application do you use most often for text editing? (please select only one)
__ MS-Word
__ WordPerfect
__ Notepad
__ Emacs
__ TextEdit
__ Pico

Figure 5.2 A closed-ended question with an unordered response (single selection).

When using my computer on a daily basis, I use the following input devices or methods (Select as many as apply)
__ Keyboard
__ Mouse
__ Trackball
__ Touchpad
__Voice recognition

Figure 5.3 A closed-ended question with an unordered response (multiple selection).

5.6.3 Common problems with survey questions

It is important to note that there are a number of common problems with survey questions. Researchers should carefully examine their questions to determine if any of these problems are present in their survey questions (Babbie, 1990):

- A "double-barreled question" asks two separate, and possibly related, questions. These questions need to be separated.
- The use of negative words in questions (e.g. "Do you agree that the e-mail software is not easy to use?") can cause confusion for the respondents.
- Biased wording in questions (such as starting a sentence with "Don't you agree that . . .") can lead to biased responses. If a question begins by identifying the position of a well-respected person or organization (e.g. "Oprah Winfrey [or David Beckham] takes the view that . . ."), this may also lead to a biased response.
- "Hot-button" words, such as "liberal", "conservative", "abortion", and "terrorism", can lead to biased responses.

5.7 Overall survey structure

Well-written questions are important, but so is the overall structure of the survey instrument. The questions don't exist in a vacuum, rather, they are part of an overall survey structure. For instance, a survey, in any format, must begin with instructions. These instructions must make clear how the respondent is to interact with the survey (Babbie, 1990). For instance, in a paper survey, are there ovals or checkboxes? Should a checkmark be placed in them, should an X be placed in the box, or should the box be filled in? Should items be circled? Are respondents to fill out all of the questions? These directions must be made clear. In addition, it is sometimes useful to put in a description, as a reminder, of who should be filling out the survey (for instance, you must be aged 65 years or older). If a survey is separated into multiple sections, then those divisions, and who should fill those different portions, must be made clear. Each section should be given an appropriate heading. Just as it is important to provide navigation on a website, a survey should provide navigation to the reader, whether

the survey is paper, e-mail, or web-based. The user (respondent) needs to know where on the survey they should go, in what order. Sometimes, it is also helpful to provide contact information if the respondent has any questions (such as a telephone number or e-mail address). If the survey is a web-based survey, links are often provided directly in the survey, so that the respondent can click on the link and get a pop-up window with more detailed information. While pop-up windows are generally not good interface design, they work very well for giving short bits of information to users while they are in the process of responding to a survey.

If the survey is a paper survey, it is important to make sure that there is enough white space so that the respondent does not feel overwhelmed by the amount of information on a page (Babbie, 1990). Obviously, a balance needs to be struck. While respondents may worry if they see a 30-page survey, on the other hand, stuffing all of the survey questions onto two pages may prove to be problematic. Only white paper should be used, and a large enough font, in standard text, should be used (Dillman, 2000). Booklet printing (with two staples in the middle of the booklet) is preferred to one staple in the upper left hand corner, but that is still preferred to any type of unusual folding or paper shapes that users may have trouble understanding (Dillman, 2000). In addition, do not use abbreviations to cut down on the amount of space needed, as they may cause confusion among respondents (Babbie, 1990).

Survey questions generally may be asked in any order which makes sense in the context of the research. However, it is important to keep in mind that questions relating to a similar topic or idea should be grouped together (Dillman, 2000). This tends to lower the cognitive load on respondents and allows them to think more deeply about the topic, rather than "switching gear" after every question. Because some questions may require knowledge or details presented in other survey questions, it is generally hard to randomize the order of questions (Babbie, 1990). Rather, provide interesting questions at the beginning of the survey, to help motivate people to read the survey and complete it. Generally, it is a good idea to leave demographic questions until the end of the survey, as these are the least interesting (Babbie, 1990). Also, if there are any sensitive or potentially objectionable questions (relating to income, health, or similar), then they should be placed near the end, once the respondent has already become interested in the survey (Dillman, 2000). Note that survey length is an important consideration. While you want to include as many questions as possible on the survey, at some point, a survey becomes too long for many people to complete, and very long surveys can lead to very low response rates. Try to ask all of the questions that you need, but be reasonable when it comes to the amount of time that individuals need to set aside to respond to the survey.

The easiest type of survey is when all respondents should answer all questions. But frequently some questions do not apply to all respondents. For instance, imagine that you are running a survey to learn more about the e-mail usage habits of users over the age of 65. You may ask if they use Microsoft Outlook 2007. If the answer is "yes", you may

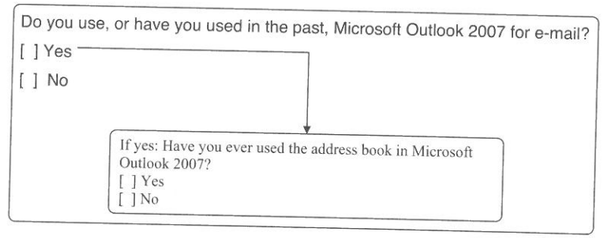

Figure 5.4 A contingent question on a paper survey.

want them to answer a set of additional questions; if the answer is "no", you want them to skip to the next set of questions. This is sometimes called a "contingent question" (Babbie, 1990) because the respondent's need to respond to the second question is contingent on their response to the first question. This can be cause for confusion: if the directions and layout are not clear enough, a respondent who does not use Outlook 2007 may start reading questions relating to Outlook 2007 usage and be unsure of how to respond. On a paper survey, there are a number of ways to manage this. Babbie suggests using an indented box, with an arrow coming from the original question (see Figure 5.4). For a web-based survey, it may be possible either to provide a hyperlink to the next section (e.g. "If you answered no, please click here to move on to the next section"), or to automatically make a section of the survey "disappear", so that the next question presented is the one relevant to the respondent. This is similar to the "expand and collapse" menus that exist on many web pages. On a further note, the first question of the entire survey should always be a question that applies to everybody (Dillman, 2000).

5.8 Existing surveys

It is important to note that there are many existing surveys that have already been tested and validated in the research literature in human–computer interaction. If a survey tool has already been developed, there is no need to create one from scratch.

For most research purposes, there will be a need to create a new survey tool. However, for tasks such as usability testing and evaluation, there are already a number of existing survey tools. Usually, these tools can be modified in minimal ways. For instance, one section of the survey tool can often be used independently of others. See Table 5.1 for a list of established survey tools.

For more information about existing surveys, the reader is encouraged to visit http://oldwww.acm.org/perlman/question.html or http://www.hcirn.com/atoz/atozu/usaques.php.

Tool	Citations
Computer System Usability Questionnaire (CSUQ)	Lewis (1995)
Interface Consistency Testing Questionnaire (ICTQ)	Ozok and Salvendy (2001)
Perdue Usability Testing Questionnaire (PUTQ)	Lin, Choong and Salvendy (1997)
Questionnaire for User Interaction Satisfaction (QUIS)	Chin, Diehl and Norman (1988) Slaughter, Harper and Norman (1994) http://www.lap.umd.edu/quis/
Software Usability Measurement Inventory (SUMI)	http://www.ucc.ie/hfrg/questionnaires/sumi/
Website Analysis and MeasureMent Inventory (WAMMI)	http://www.ucc.ie/hfrg/questionnaires/wammi/

Table 5.1 Survey tools in HCI.

5.9 Paper or online surveys?

An important question is to determine if you want to distribute surveys using paper, the web, e-mail, or a combination of the three. The traditional method is to use paper-based surveys. A benefit of this is that a majority of individuals can use a paper survey, however people who are blind, visually impaired, or have a reading impairment will not be able to use a paper survey (see Chapter 15 for more information on doing research with computer users with impairments). If you only use an electronic survey (web or e-mail), you are automatically cutting out any potential respondents who do not have access to a computer and a network, which may include users who are economically disadvantaged, or ethnic or racial groups that have lower base rates of computer access (Andrews, Nonnecke and Preece, 2003). In addition, if you are creating an electronic survey, you must make sure that the interface is usable by a wide range of individuals who may respond to your survey (such as users with impairments and older users).

In reality, the relative strengths and weaknesses of online and paper surveys generally do not influence which one is used. The greatest influence on which method (or combination) is used is how the researchers have best access to the user population of interest. In some cases, the best access is to visit individuals at a weekly meeting where paper surveys can be passed out. In other situations, if a list of postal mailing addresses exists for potential respondents, paper surveys can be mailed. If a list of e-mail addresses exists, e-mailed surveys may be best. If it's known that nearly all potential respondents have web access (Sue and Ritter, 2007) or if there is a website that attracts potential respondents, then a web-based survey is best!

Sometimes, a combination of paper and web-based surveys can be used to make sure that all portions of a target population are reached (Lazar, Tsao and Preece, 1999). It is also sometimes helpful to offer respondents a choice between a paper and an electronic version of the survey, as some recent research suggests that some people may simply prefer filling out surveys on paper (Schonlau, Asch and Du, 2003). These mixed-model designs, in which paper, e-mail, and web-based versions of a survey instrument are used together, can help improve the response rate, but caution must be taken to make sure that no biases are introduced into the data collection process (from three survey instruments that, in fact, do have minor differences) (Couper, 2005).Obviously, paper surveys must be used to study questions such as "why don't people go online?" and other research questions related to non-use of technology (Lazar and Preece, 2001). Another potential complication is that you may need to offer your survey in multiple languages. In countries where there are multiple official languages, this may be a legal requirement. In other cases, you may be interested in studying a group of computer users who do not share the same primary language. If so, you need to ensure that the surveys in two or three different languages are in fact asking the same questions and that there are no mistranslations.

There are benefits to electronic (both e-mail and web-based) surveys. Copying costs, mailing and related postage costs can be eliminated with electronic surveys. While the set-up costs may be high for a web-based survey, as the number of responses increases, web-based surveys may be the most cost-effective in terms of time and expenses (Sue and Ritter, 2007). In many cases, web-based surveys and even e-mailed surveys can automatically have responses saved in a spreadsheet or database, eliminating the need for time-consuming data entry and eliminating many data-entry errors (Lazar and Preece, 2001). While response rates in online surveys may sometime be lower, the speed of response is certainly higher (Sue and Ritter, 2007).

The question is often asked if the responses from electronic surveys are as trustworthy or valid as paper surveys. There is no evidence to suggest that people are more dishonest in online surveys than in paper surveys, as people can lie easily in both. However, there is evidence that people, when delivering bad news, are more honest in online communication than face to face (Sussman and Sproull, 1999). There is also evidence that people, when they care about a topic, are likely to be very honest. If the surveys can be submitted anonymously, this may also lead to an increased level of self-disclosure (McKenna and Bargh, 2000; Spears and Lea, 1994). Therefore, web-based surveys can sometimes be superior to e-mailed surveys (which clearly identify the respondent) for dealing with sensitive information (Sue and Ritter, 2007). In addition, respondents to self-administered surveys tend to provide more honest answers to sensitive questions than in interviews (Couper, 2005). Overall, the likelihood that someone will lie in an electronic survey is the same as the likelihood that someone will lie in a paper-based survey.

In traditional paper-based surveys, individuals may have to sign a "informed consent form" (also known as an institutional review board (IRB) form), acknowledging that they are aware that they are taking part in a research project and giving their consent. There is a question as to how individuals can give informed consent when they respond to a survey online. For more information on informed consent online, please see Chapter 14.

5.10 Testing the survey tool

After a survey tool is developed, it is very important to pre-test it, to help ensure that the questions are clear and unambiguous. There are really two separate types of survey testing: one type of testing focuses on the questions themselves. The other type of testing focuses on the interface of the survey. While the interface features primarily refer to web-based or e-mailed surveys, there are also interface features on paper-based surveys. For instance, on a paper survey, there should be an examination of issues such as the font face and type size, spacing, use of grids, and cover designs (Dillman, 2000). While these are theoretically different testing sessions for the questions and for the layout, in reality, they take place at the same time. See Chapter 10 for more information on usability testing of a computer interface.

Dillman (2000) suggests a three-stage process of pre-testing a survey, while noting that it is rarely done thoroughly. The three stages are:

1. review of survey tool by knowledgeable colleagues and analysts;
2. interviews with potential respondents to evaluate cognitive and motivational qualities in survey tool;
3. pilot study of both survey tool and implementation procedures.

The idea of this three-stage process is that you start first with people who are knowledgeable, but are not potential respondents. (Note that you start first with expert non-respondents, just as in usability testing (Chapter 10)). You begin with expert evaluations before involving any representative users. You then ask a few potential respondents about the clarity and motivation of the questions in the survey. Finally, you do a pilot study where actual respondents complete an entire survey and the researchers can note any flaws. While this three-stage process is ideal, in reality, most research in HCI involves either a few colleagues examining the survey tool or a few users reading over the survey tool and giving some feedback.

These efforts are aimed at determining the validity of the survey, that is, does the survey measure what it is claiming to measure? (Babbie, 1990; Ozok, 2007). When a few people respond to the survey in the pilot testing (Dillman's stage three), there are usually a few common problems to keep an eye out for. For instance, questions that were not answered; questions where multiple answers were given (when only one was expected); and questions where respondents filled out "other" (Babbie, 1990). All of these are signs that a question might need to be re-worded. In addition, respondents in the pilot testing should be encouraged to give direct feedback on the questions (Babbie, 1990).

A different type of evaluation can take place at a later time. When a survey instrument has been used to collect data multiple times, then the reliability of that survey can be established. Reliability is the determination of whether a survey measures constructs consistently across time (Babbie, 1990; Ozok, 2007). Methods for measuring the internal reliability of questions, such as having the same question asked multiple times in a different way, can be used. The Cronbach's Alpha Coefficient is often used in that situation (Ozok, 2007).

Another approach to evaluating survey questions after data is collected from multiple people, especially if the survey has a large number of questions, is *exploratory factor analysis*. In factor analysis, statistical software creates an artificial dimension that would correlate highly with a set of chosen survey question data (Babbie, 1990). Researchers then determine how important the specific survey question is, based on the factor loading, which is the correlation level between the data item and the artificial dimension. Survey items with high factor loadings have high correlation, and are likely to be more predictive, and therefore, more relevant (Babbie, 1990). Exploratory factor analysis can help to cut down the number of questions in a survey (Ozok and Salvendy, 2001). For instance, in the research project described in the Flickr sidebar, the survey questions were validated using an exploratory factor analysis of 193 users. "Items showing factor loading higher than 0.6 and cross-loadings lower than 0.4 were retained, and others were dropped" (Nov *et al.* 2008, p. 1098).

5.11 Response rate

A good sampling method and a well-written survey tool are important. However, those steps alone do not guarantee a sufficient number of responses to a survey. One of the main challenges of survey research is how to ensure a sufficient response rate. Other research methods tend to have fewer users taking part and higher incentives for taking part, than in survey research. For instance, If 70 people take part in an experimental research study, they may each be paid $100 for their participation. Obviously, this is not feasible when thousands of individuals are responding to a survey. Also, surveys are generally self-administered, regardless of whether they are paper, e-mail or web-based. Individuals often need to remember where the survey is located (the URL or where they have put the paper) and complete it in a timely manner, with the caveat being that they may not receive any major incentive for doing so. So it is important to motivate people to respond to surveys.

There are a number of tried and tested ways to increase the response rate to a survey. For all types of survey (paper, e-mail, web-based), there should be some type of introductory letter, letting individuals know that they have been selected for inclusion in a survey study. The letter should tell people: who is sponsoring the research study, why it's important, what the expected timeframe is, and hopefully establish some authority or credibility. This is not the same thing as an informed consent form, this is all about establishing the importance and credibility of the survey study, to motivate people to respond. For instance, if an individual that is a trusted authority within the community of individuals helps to introduce the survey, this may help increase the response rate. Or if the survey comes from a well-respected government source, this should be clearly identified to help establish authority.

Aside from establishing the credibility of a survey, another method for increasing the response rate is to increase the ease in returning a survey. For instance, a paper survey should be accompanied by a self-addressed return envelope with postage included.

A multi-step contact process tends to increase the response rate. Researchers should make multiple contacts with respondents. For instance, (Dillman, 2000) suggests the following process for paper surveys, but it could easily be modified for e-mail or web-based surveys:

1. Send a pre-contact letter (usually with information from a trusted authority, as stated above), before the actual mailing.
2. Send a postal mailing, which includes the actual survey.
3. Send a thank you postcard (which thanks people for their time and serves as a reminder).
4. Send a replacement survey to non-respondents 2–4 weeks after the original one was sent.
5. Make a final contact using a different mode. If the original survey was sent using postal mail, then maybe a phone call or e-mail should be used. If the survey was electronic, maybe a postal letter or phone call should be used. The idea is to have a different delivery method for the final contact that gets the attention of the respondent.

Depending on how the researchers have access to the potential respondents, different methods of postal mail, e-mail, phone calls, or even instant messaging, may be interchanged.

A common question, mentioned earlier in the chapter, is the question "How many survey responses are enough?" This is not easy to answer, as it has to do with a number of different issues: What is the goal of the survey? What type of survey? What sampling method has been used? What level of confidence and margin of error is considered acceptable? The reader is referred to Sections 5.4 and 5.5 for more information on an acceptable response.

5.12 Data analysis

There are several ways to analyze survey data. The analysis chosen will depend, in large part, on:

- whether it was a probabilistic or non-probabilistic survey;
- how many responses were received;
- whether a majority of questions were open-ended or closed-ended questions.

Generally, the quantitative and qualitative data is separated for analysis. The data is "cleaned," meaning that the researchers look through and make sure that each survey response is valid, and that none of the responses are either repeats (where the same person submitted more than one response), incomplete (where most questions weren't answered), or invalid (due to a respondent not meeting the qualifications). The quantitative data is ready to analyze, whereas the qualitative data must first be coded (see Chapter 11 for more information on content analysis).

Often, the goal of quantitative data analysis is simply to have a set of "descriptive statistics" that simply describe the data collected in a manageable way (Babbie, 1990). No one but the researchers will read through every survey response so the descriptive statistics are simply a short, high-level summary of the data. Most often, descriptive statistics involve percentages, ratios, or matrices. Inferential statistics involve a higher level of understanding of the data, by understanding the relationships between variables and how they impact each other. For more information on statistical analysis, read Chapter 4.

Summary

Surveys are a very powerful tool for collecting data from many individuals. However, for survey data to be valid, there must be a number of different steps that take place. Survey questions must be well-worded and the survey design should make it easy for respondents to understand and use. Appropriate sampling methods, even if they are non-probabilistic, must be used to ensure a representative response. There must be a sufficient number of responses for the data to be considered valid. The key is to use surveys when they are appropriate to the research questions. However, other methods can also be useful in conjunction with surveys, such as focus groups, interviews, or time diaries.

Discussion Questions

1. Is a survey the same thing as a questionnaire? If not, how are they different?
2. What is the difference between the target population and the population frame?
3. Why are censuses done rarely? What is often used instead when population estimates need to be made?
4. What is the defining characteristic of a probability sample?
5. What is a stratified random sample? How is it different from a traditional random sample?
6. What is one of the major reasons that non-probabilistic sampling is considered appropriate in human–computer interaction research but not in other research communities?
7. What is oversampling and why might it help improve validity of the research?
8. What is the difference between an open-ended and a closed-ended question?
9. Why might you want to use existing survey questions, when possible?
10. What is a double-barreled question and why is it not a good idea?
11. What is a contingent question and how might you deal with one in a survey layout?
12. What are two methods for testing a survey tool?