Survey Research in Technical Communication: Designing and Administering Questionnaires

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SUMMARY
Survey research can help inform technical communicators about the decisions they make in their professional or academic lives. This paper introduces the complex process of survey research to researchers and research consumers in technical communication, focusing specifically on the questionnaire method. Survey research includes several important steps:
• Defining research questions
• Sampling the population
• Administering the questionnaire
• Constructing questions
• Testing the questionnaire
• Measuring reliability and validity
• Analyzing the data
• Evaluating the survey.
This paper discusses these steps and reviews relevant literature relating to questionnaire design. From this review, readers will become better consumers of survey research and be on their way to conducting their own surveys with additional reading in sampling and statistics.

Survey research is a powerful tool that can help technical communicators identify and elaborate on the theories and practices that define technical communication as a profession. It can tell us more about the writing process, help us design hardcopy and online documents, enlighten us about the nature of collaborative work, and even help change the way we train people to become technical communicators. Whether the reader’s goal is to gain a beginning knowledge of how to conduct surveys, to critically read survey results, or to hire consultants to conduct surveys, this paper offers a starting point.

Specifically, this paper focuses on survey research that uses questionnaires to query people about what they know, what they do, what they like, or what they believe.

Researchers seeking to answer research questions may choose among different types of research methods; this special issue contains other articles about qualitative research (Sullivan) and about true experimental designs (Spyridakis). To make an informed decision about which method to use, researchers...
must know the advantages and disadvantages of each method.

Survey research has the advantage of ecological validity: It asks questions of real people in real situations. This advantage, however, gives rise to some inherent weaknesses: Respondents to surveys state what they think is true, which may or may not be what is true; they answer with how they believe they feel, which may or may not be how they truly feel. For survey results to be valid, respondents must know and remember how they thought or felt. While the self-report nature of survey research poses both advantages and disadvantages, it may be the best way to determine attitudes and beliefs.

When possible, the wise researcher uses a combination of research methods to obtain converging evidence. If an experimental study, an observational study, and a survey all point to the same answer to a question, the researcher has strong proof of the accuracy of the findings. Of course, not all research questions lend themselves to multiple methods of investigation, and not all researchers have the time and money to conduct three types of studies instead of one. Survey research, however, is often used along with either qualitative or experimental research: A study participant can be asked to complete a brief questionnaire or can be interviewed in addition to being observed or tested.

Researchers who choose to conduct surveys must decide on a method for collecting data. Printed questionnaires are probably the most common method of collecting information from a sample because they use the fewest resources and can access a large sample. Generally, questionnaires are mailed; however, they can be distributed to a specific sample in a specific location: for example, conference session evaluations, customer questionnaires packaged with software, library use surveys, or traffic surveys.

The main advantage to questionnaires is that they place minimal demands on personnel and budgets: Designing one questionnaire for 1,000 people is more efficient than asking 1,000 people the same questions in person or by phone. Another advantage is that questionnaires can be mailed anywhere; thus, the sample has no geographical constraints. They also can be totally anonymous, a desirable characteristic in some research.

The main disadvantages to questionnaires result from limitations in control. A common problem is self-selection of respondents. Because the researcher has no control over who responds to the questionnaire, respondents may in fact be a subset of the original population—a subset with its own characteristics. Researchers should consider whether those who choose to respond to a questionnaire have biased the results: Could respondents have (1) more free time or (2) a stronger interest in the results of the study?

Another type of response bias occurs in that researchers have no control over which individuals respond; they also have no proof that the respondents are actually the intended recipients of the survey, and thus members of the selected population. Another control-related disadvantage of the questionnaire is that researchers cannot seek clarification or elaboration on a response and generally have no way of verifying response accuracy.

Finally, researchers must limit how many questions a questionnaire asks because most people will allocate only a limited amount of time for filling out questionnaires. In fact, empirical evidence reveals that questionnaire length can negatively affect response rates [1].

This paper presents a process for conducting survey research with questionnaires, a process that includes the following steps:

- Determining research questions
- Identifying and sampling the population
- Administering printed questionnaires
- Constructing questions
- Testing the questionnaire
- Measuring reliability and validity
- Analyzing the data
- Evaluating the study

The process is not totally new for technical communicators, who are familiar with audience analysis. In fact, readers will encounter some familiar document design issues.

**Determining Goals and Defining Research Questions**

Most research is conducted because people want to learn more about their field in order to understand the application of current theories. Survey research can satisfy this curiosity by answering research questions produced by the researcher's overall goals. Because technical communication is interdisciplinary, the range of goals of researchers is broad. This section presents some examples of goals, accompanying research questions, and specific survey questions of interest to technical communicators.

Survey researchers must first consider a study's...
Goal of researcher 1: To determine what software can best aid writers

Research Question: Can collaborative writing be categorized?
Specific Questions: List the different types of documents you have worked on with a team.

Does the team process differ for different types of documents? If so, how?

Research Question: What kinds of teams do writers work with?
Specific Questions: Rank the numbers below to indicate how often you work with a team of this size.

Rank the job functions below to indicate which are most frequently included on a team. If the teams you work with never include a person who fits a job function category, leave it blank.

Goal of researcher 2: To design a collaborative writing seminar

Research Question: How do collaborative and individual writing differ?
Specific Questions: Place a check before all activities you engage in when working on an individual writing project.

Place a check before all activities you engage in when working on a collaborative writing project.

Research Question: What problems do collaborative writers have to solve?
Specific Questions: Did your training prepare you to work on a collaborative writing project? Please elaborate.

What are the three biggest obstacles to the success of a collaborative writing project? (List the obstacles in order of importance, with the most important first.)

Figure 1. The Relationship between Research Questions and Specific Questions

goal, which answers the question, "What am I going to do with the information I collect?" Many researchers want to know more about a current situation so they can describe it to someone else. For example, the survey of the Society for Technical Communication membership, conducted every four years, seeks to determine job, education, and salary levels in the field. The ostensible purpose of the survey is not to effect change, but to describe the status quo of employment in the profession.

Survey researchers can also collect information to support recommendations for change or a new course of action. A program evaluation survey, for example, can instigate changes in curriculum or in pedagogical methods. Or a questionnaire about the usability of software documentation can guide revisions in the documentation.

Another survey goal can be to discover design preferences to help information developers make design decisions. For new software packages, for example, a researcher can survey software users to determine whether screen designs are usable.

Researchers' goals affect the general research questions they ask. A relevant example illustrates the connection between goals and research questions, not to be confused with the specific questions asked of respondents. One researcher is interested in surveying writers in industry to see what kinds of collaborative writing occur, with the goal of determining what software can best aid the writers. Another researcher is interested in surveying the same group, but with the goal of designing an instructional unit on collaborative writing. Although the same respondents are surveyed on similar topics, the goals of the two researchers precipitate different research questions and thus different specific questions. Figure 1 reveals some of the goals, research questions, and specific questions for these two researchers.

IDENTIFYING AND SAMPLING THE POPULATION

Determining the research goals helps the researcher identify the population—all the people who,
because of certain shared characteristics or parameters, are of interest to the researcher. A population can be as broad as all professional writers or as narrow as technical writers in one department of a company. The population generally represents a group that is too large to survey in totality, thus creating the need for sampling.

The researcher must first identify the relevant population by deciding what characteristics of potential respondents are important to the research questions.

In some survey research, however, sampling is unnecessary because the researcher surveys the entire population. If the researcher is interested in the attitudes of only specific employees at one company using one computer program, he or she can survey the entire population and not worry about sampling procedures. In most cases, though, researchers are interested in generalizing the findings from a given sample to a larger population.

Identifying the Population

The researcher must first identify the relevant population by deciding what characteristics of potential respondents are important to the research questions. This process is similar to analyzing an audience for a technical document. Following are some sample questions that the researcher may need to ask when identifying the population.

Should the population—
- Have a certain level of education?
- Be involved in certain activities (for example, writing, editing, teaching)?
- Belong to a certain age group?
- Contain only males, only females, or both?
- Live in a specific geographical area?
- Possess a certain level of knowledge about a process or topic (for example, novices in computer graphics production)?
- Be experienced with a certain type of tool (for example, a computer platform or application)?
- Speak a certain language?
- Have a certain level of income?

Obviously, the criteria the researcher uses in identifying the relevant population must relate directly to the research goal(s). The researcher who wants to determine whether engineers who have had technical writing classes in college advance more quickly in their profession will identify the population as working engineers in management and non-management positions and then ask questions about the sample’s career history and college curriculum.

Sampling the Population

Ideally, after identifying the population, the researcher will secure a list of all its members. Their names can be entered into a computer or thrown into a hat and a random sample can be chosen, either by generating random numbers on the computer or by pulling names from the hat. With simple random sampling, the researcher is practicing probability sampling because each person in the population has an equal (and non-zero) chance of being chosen, assuming that the names selected are also returned to the pool. To survey 25 percent of the students registered for freshman composition classes at a university, one can obtain registration lists for the classes and mail a questionnaire to 25 percent of the names on the list, selected at random. Simple random sampling allows for the most generalizable results.

Two other types of probability sampling are also common: systematic sampling and stratified sampling. To draw a 25 percent systematic sample from Society of Technical Communication (STC) members, one chooses every fourth name from the STC membership directory. Stratified samples accurately represent the make-up of the population. Suppose that, of the STC members, 10 percent are managers. Unless the sample is very large, a simple 25 percent random sample will probably not contain 90 percent nonmanagers and 10 percent managers. With a stratified sample, one can ensure this ratio by randomly choosing managers for 10 percent of the sample and then completing the sample with randomly chosen nonmanagers.

Since most researchers cannot obtain a list of all population members, they may have to use nonprobability sampling methods. One method of nonprobability sampling is convenience sampling. For example, a researcher who wants to survey purchasers of spreadsheet computer applications can sit in a computer store and interview the first 20 people who purchase a spreadsheet program. This surveyor knows that these respondents are part of the population to be sampled but does not know whether they are a representative sample. The location of a particular computer store can easily bias the sample because of the customer base it serves.
Another type of nonprobability sampling is *purposive sampling*, where the researcher chooses a particular sample because it will be instructive. Frequently, election results are predicted by choosing certain electoral districts and interviewing the voters there because of the predictive value of those districts in past elections. In such cases, the pollsters have no assurance that such districts will be as predictive in the current election as in the past.

Researchers must also determine the ideal sample size. Those interested in conducting statistical analyses should realize that small sample sizes lack statistical power to identify significant differences among groups. Many research or survey design texts provide terms for calculating minimum sample sizes, but these formulas require knowledge of the population's variance on constructs of interest (2–3). Pilot studies are sometimes conducted to obtain the needed population parameters.

Sampling theory is crucial to good survey research, and reports of survey results should clearly state the sampling method used and the sample size. This section has discussed only a few of the most common sampling methods; a thorough discussion of the multitude of sampling techniques is beyond the scope of this paper.

**ADMINISTERING PRINTED QUESTIONNAIRES**

After selecting the sample to be surveyed, researchers need to develop, early in the project, an overall plan for the design of the questionnaire packet, the method of distribution, and the use of follow-ups and incentives. These administrative decisions may affect the design of individual questions, so they should be made early in the process, before the questions are constructed.

**Questionnaire Packet**

Printed questionnaires, whether mailed or distributed in person, should contain a stamped, self-addressed envelope (or be designed as a return mailable) and an introduction, often presented in a cover letter. If a cover letter is included, a short introduction should also be printed on the questionnaire so that the questionnaire is self-sufficient. The introduction should provide clear instructions for completing and returning the questionnaire by a stated deadline. In general, instructions should be brief and clear; pilot testing the questionnaire will help refine the instructions.

The cover letter is the researcher's chance to ask for cooperation; it should be brief since the researcher is asking respondents to take time not only to read the letter but also to complete the questionnaire. The cover letter is the only part of the questionnaire packet where researchers can be personal and persuasive, and thus is an important element in the survey. Some studies have shown that response rates are higher when cover letters are used to introduce questionnaires instead of less personal documents, such as brochures, that provide the same information (4–5); however, other studies have shown no differences between impersonal and personal approaches (1; 6). The cover letter should include the elements discussed in the following paragraphs (7).

The purpose of the study in general terms. Respondents want to know how the researchers are going to use the data and to what ends. Researchers can use this statement of purpose to persuade them of the importance of the research. For example, in surveying a group of technical experts about their attitudes toward technical communicators, a cover letter can explain that the data will help improve the working relationship between technical experts and technical communicators. To avoid threats to validity, the purpose statement should not hint at any expectations about responses and should not be too detailed.

An appeal for cooperation. This appeal can be stated in terms of the importance of each person's response to the success of the study.

A description of the anonymity procedures. Because the respondents’ names are not important in most mailed questionnaires, respondents should be told not to include their names on the questionnaire. If names are requested, researchers should explain the purpose and the procedure for ensuring confidentiality. Although counterintuitive, most research has shown that anonymity does not affect the response rate of questionnaires (8). In fact, one study revealed that 90 percent of the respondents to an anonymous questionnaire wrote their names and return addresses on the envelopes when they returned the questionnaires (9). Nonetheless, most survey designers still believe in the importance of assurances of anonymity.

A few words to introduce the researchers and establish credibility. The cover letter should state who the researchers are and what positions they hold.

An explanation of sponsorship of the study. If the research is supported by a university, a government
agency, or a private foundation, telling the respondents this may result in higher response rates. Research investigating the effects of sponsors on response rates has had mixed results, but, in general, studies have indicated that research sponsored by the government or by universities has higher response rates than research sponsored by market research firms [8, 10].

An explanation of any debriefing procedure. Finally, the cover letter should state whether and how respondents can obtain a summary of the results.

Figure 2 is an example of introductory information included at the top of a program evaluation survey. The mailed questionnaire also included a cover letter.

Follow-Ups

Follow-up contacts with nonrespondents can significantly improve a survey's response rate. One researcher suggests that follow-ups should be conducted if the response rate is less than 20% [7, 247]; another study found that each additional contact with nonrespondents increased the response rate by 7.4% [8]. The first follow-up should be made between two weeks and a month after the initial mailing [7, 247]. Telephone follow-ups are more effective than mailed follow-ups [7]; however, they are also more resource intensive.

Since follow-ups can improve the response rate, researchers should plan on including at least one follow-up in their survey design. The mailed follow-up should include a second letter emphasizing the importance of the response. Follow-ups can be mailed to the entire sample, thanking those who have responded and encouraging those who have not; or, if the researcher has linked names and addresses to the questionnaires, follow-ups can be sent only to nonrespondents. Sending a second copy of the questionnaire can further improve response rates [11].

Incentives

Research on the effects of monetary incentives ($0.25–$1.00) on response rates for mailed questionnaires has revealed that incentives do improve response rates without biasing the results [12–13]. Apparently, incentives are as effective if sent only with a second mailing [1], so the cost of monetary incentives can be reduced by including the incentive only in a follow-up.

The following questions have been designed to help the Technical Communication faculty in their ongoing evaluation of the graduate program. Please respond by circling the appropriate number or filling in an answer in the space provided. We appreciate your taking the time to respond and will read your answers carefully. Please return this questionnaire in the enclosed envelope by July 1. All responses to the questionnaires are anonymous.

Figure 2. Questionnaire Introduction

Constructing Questions

Researchers must carefully consider the format, wording, and order of the questions as well as the response formats, when creating a questionnaire. The ultimate design of the questions, of course, is guided by the purpose of the study and the characteristics of the respondents.

Question Format

Researchers must first decide whether to ask open or closed questions. Open questions allow respondents to answer in their own words and at any length; closed questions restrict respondents to selecting from the provided answers. Put another way, open questions elicit unstructured responses, and closed questions elicit structured responses. The choice between open and closed questions depends on the general research questions and the type of data researchers seek.

One important decision regarding open and closed questions is whether to phrase the items as questions or as statements. For example, one can ask respondents: “Did you find the function keys helpful while performing the search task?” On the other hand, one could ask them to respond to a statement: “The function keys were helpful while performing the search task.” With the question format, respondents can be further probed for information about why the function keys were or were not helpful.

With the statement format, responses are likely to be a check on a rating scale. The decision between question or statement format rests on the depth of information that the researchers want to collect, a factor sometimes affected by a project's budget. Both formats are equally effective at eliciting honest responses [7].

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Researchers who decide to use open questions and unstructured responses must then decide on the structure and scope of the questions. One consideration in the design of the items is the degree of specificity. For example, researchers can ask either of the following questions, depending on the type of answer desired:

How did you like the seminar on desktop publishing? (general)

Was Dr. Smith effective at answering participants' questions in the desktop publishing seminar? (specific)

One questionnaire may include both specific and general questions if the researcher wants both an overall view and responses about specific issues. While specific questions can be threatening in face-to-face or phone interviews, they are not as threatening in anonymous questionnaires.

Another consideration is whether questions should be direct or indirect. One can ask respondents to respond to the direct statement, "Comment on the usefulness of the online help provided with this application," or to the direct question, "Was the online help provided with this application useful?" The indirect approach is more open ended and less leading, and may result in more honest responses; however, it requires more probing to elicit the desired information, which can be difficult in printed questionnaires. Further, responses from indirect questions will vary considerably and be difficult to analyze, so researchers may need to also include some direct questions probing the same issue.

Researchers should include only questions that they are sure the population will be able to answer; including unanswerable questions indicates that the questionnaire is not a good match for the purpose and audience.

Finally, researchers must consider whether questions should elicit opinions or facts, and must be aware of the pitfall of interpreting an opinion as a factual response. To elicit a factual response, one might ask, for example, whether respondents use an outline when writing a paper for publication, or, to solicit an opinion, whether respondents think outlines are helpful when writing papers for publication. If respondents answer "yes" to the second question, the researchers cannot assume that respondents actually use an outline when writing papers for publication.

Researchers should remember that factual questions elicit respondents' beliefs about facts, not necessarily real facts, just as opinion questions do not necessarily elicit honest opinions.

Question Wording

The wording of questions is critical to the respondent's interpretation of questions. The wording should be guided by results from research in questionnaire design and should meet three practical standards [14].

Will the question mean the same thing to all respondents? Because researchers in technical communication are sensitive to language issues, they have an advantage over researchers in other fields in designing clearly phrased questions. As is true in most technical writing, simple, plain English is the goal for question wording; technical terms, acronyms, and abstract or ambiguous words should be avoided or defined.

One researcher found that questions addressing library use were interpreted differently by different people: 53 percent of his sample thought that the task of checking a name in a card catalog was indeed using the library, but 47 percent thought the same activity was not [15].

Technical communicators face similar problems when they ask respondents about their expertise on some issue or process. Usability tests of computer documentation and software often include questions measuring users' computer expertise, yet when asked to rate their computer expertise, users often rely on their own definitions. A better approach is for the researchers to determine expertise based on answers to more specific questions, such as "How many hours a day do you use a computer?" and "How many different computer platforms have you used?" Overall, differences in respondents' interpretations of questions argue for more specific questions or, at minimum, definitions of vague terms.

Will respondents be able to answer the question? Researchers should include only questions that they are sure the population will be able to answer; including unanswerable questions indicates that the questionnaire is not a good match for the purpose and audience. For example, a researcher surveying people in technical publications groups might need to design several different questionnaires: one for...
writers, one for editors, one for graphic-support people, and one for management. Writers probably do not know how many of a specific kind of document were produced in the department in one year, but managers do.

Another type of question respondents cannot accurately answer is the double-barreled question. When respondents are asked whether they used the online help and the hardcopy documentation when they performed a specific task, they do not know which part of the question to answer. If they used the hardcopy documentation, but not the online help, should they answer "yes" or "no" to the question? Double-barreled questions can frustrate respondents and should be avoided.

Other wording issues relate to the respondent’s ability to interpret the question. For example, some research indicates that younger or less literate respondents may have difficulty interpreting negatively worded questions [16–17]. One study found that negating a regular statement (I am happy/I am not happy) will produce higher internal consistency scores than using a polar opposite (I am happy/I am sad) or a negative polar opposite (I am happy/I am not sad) [18].

Checklists and scales offer the most potential for response bias whereas open questions offer the least.

Will respondents be willing to answer the questions? Researchers in technical communication will probably seldom have to elicit embarrassing or extremely personal information from respondents; however, they should be aware of the problems surrounding the reporting of personal information. Even in an anonymous questionnaire, respondents significantly underreport socially undesirable behavior. However, if the behavior is only moderately undesirable (drinking alcohol, for example), the respondent is more likely to report the behavior accurately in a questionnaire than in a personal interview [19].

Willingness to answer can be an issue in job-related surveys if respondents fear that their answers could affect their jobs or advancement. In such cases, assuring anonymity is the best solution.

Response Formats

Response formats can be categorized by the nature of the questions. Unstructured responses accompany open questions, and structured responses accompany closed questions. With unstructured responses, respondents fill in a blank or write extended text. With structured responses, respondents pick an answer from a list, mark a rating scale, or rank items in a list.

The advantage of unstructured responses is that the researcher may elicit unexpected or unplanned-for answers. Also, unstructured responses are useful when the list of possible answers is too long to include on the questionnaire. To reduce the variation across unstructured responses, researchers often use rather specific questions to solicit concrete unstructured responses.

Structured responses, however, are often used because respondents can more reliably and quickly answer the questions, and researchers can more reliably and quickly interpret and analyze the answers [14]. An excellent strategy is to pilot-test the questionnaire with unstructured responses to obtain the categories needed for structured responses on the final instrument [20].

Response format is important because it determines the type of data researchers analyze. Response format is also a factor in the amount of response bias that a questionnaire may elicit. Checklists and scales offer the most potential for response bias [71], whereas open questions offer the least. Following are some of the issues involved in the design of three
common response formats: unstructured responses, checklists, and scaled responses.

**Unstructured responses.** The format of unstructured responses is the easiest to design, simply because respondents supply all the information. Researchers should remember, as mentioned earlier, that respondents are unlikely to write more than a few lines. The space provided for the response to open questions should be considered carefully: If the space is too large, respondents may think too much writing is required; on the other hand, if the space is too small, respondents may be frustrated by their inability to fit their answer into it. Pilot-testing the questionnaire helps determine the appropriate amount of space.

**Checklists.** Simple checklists ask respondents to check one of two possible responses (a *nominal dichotomous item*)—for example, whether they are female or male. Expanded checklists ask respondents to check only one of several possible replies—for example, one of five levels of education. More complex checklists ask respondents to check more than one item in the list, as shown in Figure 3.

To ensure that all respondents interpret the question similarly, the question instructs respondents to “Check all that apply.” The “Other” response option is provided in case the researcher has not considered all possible writing activities one could engage in at work. The advantage of a checklist over an unstructured response, in this case, is that the list prompts respondents to think about the process in the researcher’s terms; consequently, the resulting data are more easily analyzed and interpreted.

Researchers should consider, though, the possible response bias resulting from the order of the checklist items. In Figure 3, the items follow a sequential process; in many cases, however, there is no logical order for the items. One study showed that people choose items at the beginning of lists more often than items at the end of lists, resulting in a *primacy effect*, which indicates that respondents do not evaluate all items in a list equally [21].

This primacy effect was particularly pronounced for respondents with lower levels of cognitive sophistication, measured by years of formal education and scores on vocabulary tests. To prevent this bias, these researchers recommended that questionnaire designers (1) randomly order the items for each respondent, (2) increase the motivation of the respondent, perhaps with special instructions, and (3) shorten the checklist.

**Scaled responses.** There are a variety of designs for scaled responses and hence several design issues to consider. One of the most common scaled-response formats is the Likert scale, typically a five-point scale, as shown in Figure 4.

Studies have shown that fewer than three or more than 11 response choices on the scale negatively affect reliability [22–26]; five choices offer the advantage of a neutral position.

Another design decision is whether to place the positive or negative end of the scale on the left, although the positive end is usually placed on the left. A *primacy effect* can occur in response scales, leading people to choose the first acceptable response, beginning from the left [27]. Researchers should realize that varying the scale (positive on the left, then negative on the left) from one question to another or from one section of the questionnaire to another may threaten the validity of the questionnaire.

Another type of scale, a simple rating scale, asks respondents to rate some item or quality on a specific scale; for example: “On a scale of 1–10, how do you rate the tutorial for this software?” A more formal rating scale asks respondents to rate an activity or a person on several different dimensions. Figure 5 shows a rating scale that might be used to evaluate the collaborative writing process after completion of a project.

Another form of response bias that can occur
with rating scales is the halo effect, where respondents rate people whom they like or respect high on all scales, regardless of the person’s actual performance. For example, corporate trainers realize that they will get better evaluations from clients who appreciate them as people. Certainly, there is no reason why professionals should avoid developing working relationships with those who are evaluating them; however, if evaluations are compared, one should watch for the halo effect when accounting for differences among evaluations—these differences may have nothing to do with performance.

The semantic differential scale is another type of scale used for measuring attitudes [28]. A semantic differential asks respondents to rate concepts on three different factors: evaluation, activity, and potency. Figure 6 contains such a scale using two sets of bipolar adjectives for each factor, first soliciting evaluation responses, then activity responses, then potency responses. Although the semantic differential scale is particularly useful for the measurement of attitudes, it is susceptible to the same response biases as other scales.

### Question Order

Once the questions have been designed, researchers must determine the order of the questions. In some cases, a logical order presents itself. For example, to query college students about their writing experience in college classes, one could use chronological order. In many cases, however, no logical order is apparent. An academic department’s questionnaire to evaluate current programs provides a relevant example. Questions may address the program overall, individual courses, facilities, and labs.

One decision is whether global questions should be placed first or last. In general, research has shown that global or summary questions are more sensitive to order effects than specific questions [20]. In one study of the effect of placement of global course ratings, people rated the course (but not the instructor) lower when the global items were placed at the end [29]. This result is intuitive, since, when global evaluations come last, respondents have made many specific evaluations first, and would feel that the global evaluation should reflect the specific evaluations. This tendency toward consistency between early responses and later ones is called self-generated validity [30]. Researchers should be aware of this order effect when interpreting the results of surveys.

A decision must also be made about where to place questions about facilities and labs. These questions will be easier for respondents to answer because they do not ask respondents to evaluate faculty’s performance in courses. As these questions are deemed less threatening for the respondents, they should be placed before the course evaluation questions. Asking nonthreatening questions first helps put the respondents at ease [31].

### Testing the Questionnaire

Unforeseen problems can be avoided by pilot-testing the questionnaire, ideally with a random sample of a small subset from the survey population. The pilot test should assess the clarity of the instructions, the overall time required to participate, the clarity and order of the questions, the need for “other” response categories, and, overall, the ability and willingness of respondents to answer honestly and completely.
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For example, if all respondents give the same answer on a question, the question may not be sufficiently discriminating; on the other hand, if answers vary too widely on one question, the question may be ambiguous.

While printed questionnaires can be mailed to the test sample, an excellent strategy is to use an in-person interview for at least some of the test sample so that respondents can provide more feedback about unclear questions. Focus groups similar to the target population can also supply such feedback. Pilot tests can significantly improve the reliability and the validity of questionnaires.

MEASURING RELIABILITY AND VALIDITY

Depending on the type of information solicited, the researcher may want to quantitatively measure reliability and validity. Reliability refers to the extent that the questionnaire elicits the same answers from the same people at different times. One way to measure reliability is to ask respondents a few questions twice in the questionnaire. The chosen questions should be reworded, of course, but the goal of the original and its iteration should be to elicit the same responses. Alternatively, the same questionnaire can be readministered to a pilot group a few weeks after the initial questionnaire. The answers to the original questions and the subsequent questions can be correlated.

Validity refers to the degree to which the survey actually measures what it is designed to measure (internal validity), and also determines the extent to which the results from the survey are generalizable to the population sampled (external validity). Self-selection is a threat to validity, as are dishonest or incomplete answers.

One possible way to determine validity is to check respondents’ answers to certain questions against factual data gathered from other sources and calculate the percentage of agreement between the two data sets. For example, writers’ descriptions of the document-review process at their company could be compared with the company’s formal procedure; or students’ responses about the number of writing classes they have taken could be compared to transcripts. More thorough discussions of reliability and validity can be found in survey research books (see bibliography).

ANALYZING THE DATA

Survey data can be analyzed with descriptive or inferential statistics. Descriptive statistics describe trends and distributions in the data; inferential statistics allow the researcher to infer the causes of the trends and distributions. Many surveys are analyzed with descriptive statistics because they are easy to use and are commonly understood by researchers and readers. Discussed here are four types of data that frequently result from questionnaires and some common statistical routines relevant to each type.

Nominal or categorical data. Nominal data represent named qualities; they are not ranked and do not represent a scale with equal intervals. For example, asking respondents to check an option that represents their job title (writer, editor, programmer) produces nominal data. The researcher who asks this question is probably interested in finding out not only how many respondents are in each category, but also whether respondents marked one category more frequently than any of the others.

Numerical codes are assigned to these categories for data analysis. The most common statistical method for analyzing nominal data is the Chi square, which determines how different the ob-
served frequency of answers is from the theoretical or expected frequency of answers.

**Ordinal data.** Ordinal data have order but not equal intervals. For example, if respondents rank their frequency of use of three different desktop-publishing software applications, their answers will consist of rankings of first, second, and third. Then the researcher can determine which application was ranked high, middle, and low most frequently and how the response frequencies in the three categories differ. The Friedman analysis of variance is commonly used for analyzing ordinal data.

**Interval data.** Interval data possess not only order, but also equal intervals between points on the scale. If respondents report how many hours per week they spend in team meetings, the resulting data will be interval data and would be entered into a statistics program as raw data. Generally, data from rating scales can be treated as interval data [7]. Several descriptive and inferential statistical techniques are used to analyze interval data, as discussed in the following paragraphs.

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**Survey researchers should carefully define their goals and identify and sample the survey population. Then they must plan and monitor the administration of the questionnaire, designing questions that will elicit honest, unbiased responses.**

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**Means, medians, and modes** all measure central tendency. In other words, all describe many numbers with one single number that captures the tendency of the respondents in relation to a particular question. Strictly speaking, measures of central tendency do not apply to nominal or ordinal data: It makes no sense to describe data in the terms of a central tendency if the data simply represent different categories of, say, job titles.

The **mean** represents the average response. If a researcher asks how many hours a week respondents spend editing, the mean would be calculated by adding up all responses and dividing by the number of responses. The mean is the most commonly used descriptive statistic and can tell the researcher a great deal about the data since it is calculated using all data points. However, means are appropriate statistics only with normal curves, where the data set has few extreme responses on either end of the scale. In other situations, it is better to use the median or the mode.

The **median** is literally the middle score. If one took all the scores, lined them up sequentially, then counted in to the middle, that middle score would be the median; it is not distorted by a few extreme scores.

The **mode** is simply the most common score or response.

**Correlations** measure the relationship between two data sets. For example, a researcher might be interested in the relationship between number of years of formal training in technical communication and job salary. A correlation would show to what extent these two variables varied in the same direction (as training goes up, salary goes up), or in the opposite direction (as training goes up, salary goes down). The **Pearson r**, also called a **correlation coefficient**, is the most commonly used correlation statistic for interval data.

Readers interested in other inferential statistical methods used for interval data, such as t-tests, analyses of variance, and analyses of covariance should consult Spyridakis (this issue), Paul Anderson’s excellent summary of survey research [32], or statistics textbooks.

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**EVALUATING THE SURVEY**

After the questionnaire data have been analyzed, a post mortem should be held in which the researcher evaluates the success of the methods used. No survey is perfect, and taking stock of what did and did not work will improve the quality of future research. Part of the evaluation is determining reliability and validity, as discussed earlier; however, other evaluation activities should also be conducted.

The follow-up procedure should be evaluated to determine whether it improved response rates and whether it was worth its expense. The questionnaire itself also needs to be evaluated. Even with pilot testing, problems can arise with question ambiguity, questionnaire length, unanswered questions, and misread instructions. Documenting these problems immediately at the end of the study aids in revising the questionnaire if it is to be used again.

In addition, the researcher should note any data-entry problems caused by the format of the questionnaire. If the questionnaire is designed to facilitate data entry, the process is less resource intensive.

The adequacy of the budget should be evaluated to determine which tasks required more or less time.
and money than anticipated; these budget evaluations will be helpful for future research.

**CONCLUSION**

This paper has attempted to provide a beginning point for those who plan to design questionnaires and an interpretation guide for those who read the results of surveys. Our emphasis has been on designing and administering the questionnaire because, as technical communicators, those issues are important to us and our readers. Furthermore, questionnaire design has not been emphasized in many summary articles about survey research.

Survey researchers should carefully define their goals and identify and sample the survey population. Then they must plan and monitor the administration of the questionnaire, designing questions that will elicit honest, unbiased responses. Researchers must also realize the importance of pilot-testing instruments as they attempt to ensure reliability and validity. With these careful steps, researchers can gather useful, analyzable data.

We hope that we have communicated the complexity of survey research; at the same time, we hope our article encourages the development of valid survey research in the field of technical communication.

**REFERENCES**