BASIC RESEARCH METHODS FOR LIBRARIANS

Lynn Silipigni Connaway
and Ronald R. Powell

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Lynn Silipigni Connaway and Ronald R. Powell

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Preface

This text is addressed to the practicing librarian and other information professionals who need to conduct research and publish. It is intended to provide guidance for any librarian who must be able to read and evaluate research reports critically and assist others with their research. It also is designed to be of benefit to the graduate library and information science student.

Although applied and action research methods are included, the book almost exclusively considers basic research methods. Its primary purpose is to help teach the skills necessary for a librarian to conduct rigorous, basic research. Yet many of the methods, techniques, and tenets of basic research are relevant for applied research, and a person conducting applied research should benefit from a solid understanding of basic research methods. The librarian wishing to carry out a cost study, evaluate the performance of his or her library, or survey the library's users will need to be able to apply many of the principles and techniques treated in this book to his or her specific project. The more rigorous the research, the more useful its results, whether it be basic or applied in nature.

The perspective of this work is that library-related research should be as sound as any scientific research, and basic concepts are presented accordingly. A second viewpoint is that the conceptual development of a study is as crucial to its success as are the specific techniques employed in its conduct. That too is reflected in the contents of the text. The methods presented are applicable to most social science research, but the illustrations and applications presented throughout the text are specific to library settings. With the exception of the seventh chapter, quantitative, rather than qualitative, methods are generally emphasized; but a number of the techniques covered are noted as having applications to qualitative research.

The book first addresses the role of research in librarianship and then considers the major steps in the development of a research study. Following that, it focuses on four major research methodologies—survey, experimental, qualitative, and historical—with extra attention given to sampling procedures. Chapters on data analysis, research proposals, and research reports conclude the text.

This text is not intended to be a cookbook for conducting basic research in library and information science, but it does attempt to introduce the researcher to the major issues involved in conducting original research and to present the basic information needed to design effective research. Neither is the text meant to stand alone. There are a variety of textbooks and other resources which the reader should consult, and referral to standard texts on statistical analysis is recommended. This book is an introductory presentation of basic research methods, and the reader wishing to become an accomplished researcher should not stop here.

The fifth edition of *Basic Research Methods for Librarians* represents a general revision and some reorganization of the fourth edition. References to other sources were updated and additional works cited where appropriate. (A number of Web site URLs were added, but their inherent instability should be kept in mind.) Additions to the text include: expanded sections on electronic and Web questionnaires, evaluation research, statistical analysis, and inferential statistics; sections on task-based, evidence-based, and social media research; usability testing; oral presentations of research; and more consideration of research into the nature and uses of electronic technology.

The authors would like to thank the many students who have made helpful comments over the years as well as Lynn Westbrook, Jack Glazier, and Sebastian Mundt for their contributions to the text. They also are indebted to Catherine Dishman of Wayne State University and Timothy J. Dickey, Erin Hood, and Larry Olszewski of OCLC Online Computer Library Center, Inc. for their assistance in the preparation of the fifth edition.

It is not a simple matter to conduct rigorous research, but it can be interesting, enlightening, and rewarding. Hopefully, this book will help and encourage librarians and others to become more active, productive researchers.

Chapter 1

Research and Librarianship

RESEARCH RECORD

The consensus of a number of those individuals who have assessed the previous research of librarians is that the quantity and quality have left something to be desired. For example, "Ennis described library research as 'noncumulative, fragmentary, generally weak and relentlessly oriented to immediate practice.' "[1] Neal stated, "Librarianship is an 'information poor' information profession. Decisions are routinely not supported by the evidence of well-designed investigations. Research in the field is poorly communicated, understood, and applied."[2] But that is not to say that there has not been a substantial amount of good library-related research. In addition, most observers seem to be of the opinion that library-related research of late has shown improvement with regard to its rigorousness, sophistication, and incorporation of multiple methods and statistical analysis. Yet they also seem to agree that there continues to be room for improvement.

This chapter will concern itself only with the relatively recent record of library research. Readers wishing to learn more about the history of library science research may wish to consult Jackson's brief history of research in librarianship in the United States and Canada, or Busha's review of the past status of library science research.[3]

Definition of Research

There is no one definition of research, in part because there is more than one kind. Considering research in the general sense, *Merriam-Webster Online Dictionary* defined it as "studious inquiry or examination; especially: investigation or experimentation aimed at the discovery and interpretation of facts, revision of accepted theories or laws in the light of new facts, or practical applications of such new or revised theories or laws."[4] Hillway, in his introductory text on research methods, defined research as "a method of study by which, through the careful and exhaustive investigation of all the ascertainable evidence bearing upon a definable problem, we reach a solution to that problem."[5] Mouly stated that "Research is best conceived as the process of arriving at dependable solutions to problems through the planned and systematic collection, analysis, and interpretation of data."[6]

These general definitions suggest that there are at least two major types of research, one of which is *basic research*. Basic research, also referred to as pure, theoretical, or scientific research, is primarily interested in deriving new knowledge and is, at most, only indirectly involved with how that knowledge will be applied to specific, practical, or real problems. Or, as Vickery stated, "Scientific research . . . is concerned with elucidating concepts and their relations, hypotheses and theories, and is not necessarily and certainly not directly related to technical and practical problems."[7] It is sometimes labeled as research conducted in order to acquire knowledge for its own sake, but, as will be argued later, that probably is a simplistic viewpoint. Basic research, particularly if quantitative in nature, is usually designed so as to produce new knowledge that is generalizable.

The second major type of research is usually known as *applied research*, and it encompasses a variety of specific research techniques such as systems analysis and operations research. In contrast to pure or basic research, applied research emphasizes the solving of specific problems in real situations. Much of the library-related research has been applied research dealing with everything from evaluating book collections to analyzing automated circulation systems. (See Chapter 3 for additional information on applied and action research.)

But in spite of the fact that basic and applied research have tended to be conducted in isolation from one another, they are not necessarily dichotomous. As Shera noted, "Research is no less 'pure' for leading to useful results, though it most certainly does not have to possess immediate applicability to qualify as research."[8] In other words, basic research often leads to practical applications, while applied research frequently acts as a foundation for subsequent theoretical or basic research. Stokes also dismissed this dichotomous notion of the relationship between basic and applied research. When discussing Pasteur's philosophy of research, Stokes described it as the integration of both basic research in his search for knowledge and applied research in his quest to solve practical problems.[9] According to Mouly, "the distinction between pure and applied research is not very clear. All research findings will be useful and practical—sooner or later—no matter how disinterested in immediate utilitarian goals the pure researcher might be. Both pure and applied research are oriented toward the discovery of scientific truth, and both are practical in the sense that they lead to the solution of man's problems."[10] Perhaps, as Muller argued, the crucial factor is not whether the research is pure or applied but whether it is relevant.[11]

Research also can be dichotomized as quantitative and qualitative. "*Quantitative research* methods involve a problem-solving approach that is highly structured in nature and that relies on the quantification of concepts, where possible, for purposes of measurement and evaluation."[12] *Qualitative research* methods focus on observing events from the perspective of those involved and attempt to understand why individuals behave as they do. They take a more natural approach to the resolution of research problems. Some research projects utilize both quantitative and qualitative research methods to study and report behaviors and events. This book emphasizes quantitative methods; however, Chapter 7 is devoted to qualitative methods, and a number of the procedures covered elsewhere have qualitative applications.

Types of Previous Library Research

According to Shera, Ralph Beals once categorized library literature into the tripartite classification of Glad Tidings, Testimony, and Research, and noted that there was little of the last.[13] Goldhor, in his text on library research, categorized library literature with regard to research as including: one, a relatively small body of published research as defined in the narrow sense; two, a larger amount of published and unpublished services studies, or applied research; three, an even larger number of reports or descriptions of specific situations, or simply opinions; and four, original data.[14] Losee and Worley stated: "There is a tendency among information professionals to write and publish in the 'How I done it good' genre, a genre that is very situation-specific."[15] In short, as was noted earlier, and as Busha and Harter indicated in their textbook, the preponderance of library-related research has been applied in nature.[16]

A 1984 issue of *Library Trends* was devoted to research in librarianship, and it reviewed research as related to the history of library and information science, economics of libraries, political science, sociology, psychology of information use, organization theory, public administration, and operations research. This work thus provided a categorization of library research in terms of both methodology and subject. In the first chapter of this issue of *Library Trends*, Mary Jo Lynch identified her own general categories for describing different research activities as practical research, bibliographical research, scholarly research, and scientific research.[17] She characterized practical research as problem solving with information; bibliographical research as reordering the thoughts of others; scholarly research as systematic collecting, organizing, and analyzing of data; and scientific research as discovering new knowledge.

Mathews described research performed by the U.S. Department of Education from 1977 to 1988.[18] Along with analyzing the products of the research, she also discussed recent research agenda efforts of the Department and implications for future research. McClure and Bishop provided a useful summary of reports published from 1976 to 1988 related to the status of research in librarianship.[19] Several of the reports contained analyses of the types of research methods utilized during various time periods. Powell summarized some methodological studies ranging from an analysis of dissertations dating back to 1925 to an examination of research articles published in 1984.[20] He also characterized more recent trends including qualitative, interdisciplinary, and technology-based research. Buttlar analyzed library and information science (LIS) dissertations to identify the authors' gender, the nature of the most highly cited materials, the most highly cited journals, the literature cited in disciplines other than LIS, the countries of origin of publications cited, and the currency of the cited literature.[21] She did not identify the type of methodologies used, but did report that the literature from the LIS field is cited about 50 percent of the time and identified education, computer science, health and medicine, psychology, communications, and business as disciplines that impact LIS research.

Bao analyzed the articles published in *College & Research Libraries* (*C&RL*) and the *Journal of Academic Librarianship* (*JAL*) between 1990 and 1999.[22] The majority of the refereed articles addressed collections, services, staffing, and the Internet, indicating that some of the research areas identified by the College Library Section of the Association of College & Research Libraries (ACRL) had not been studied by the authors included in the sample. Bao could not identify any research patterns or trends for the journals, except that Internet technology had been a popular research topic since 1994.[23]

Crawford reported research patterns represented by the articles published in *C&RL* and *JAL* for 1996 and 1997.[24] He identified more than 65 percent of the articles published in *C&RL* as quantitative empirical studies while less than 25 percent of the articles published in *JAL* during this same time period were categorized as quantitative empirical studies. How-to, model and issue discussions, project reports, and other nonempirical papers represented 29.6 percent of the articles published in *JAL*, while 14.3 percent of the articles published in *C&RL* were categorized as nonempirical.

Hildreth and Aytac analyzed 206 randomly selected articles in 23 LIS journals published between 2003 and 2005 using 35 factors, such as authorship, topic, type of research, data collection methods, etc. They concluded that "there is little difference in the quality and organization" between the published reports of practitioner and academic research. Not surprisingly, "practitioners conduct more library-specific studies and academics conduct more use and user studies." The authors confirmed that qualitative research methods are being used but have "leveled off" and expressed concern about library practitioners' limited use of qualitative research methods.[25]

In another study focusing on librarians' research productivity, Fennewald identified the factors associated with Penn State librarians' research publication output. The most critical factor was the expectation of the institution. Personal motivation, intellectual curiosity, and education also were identified as important factors influencing the librarians' research productivity.[26]

Hider and Pymm examined librarianship and nonlibrarianship journals published in 2005 to identify the strategies and data collection techniques used in the studies. The survey was the most used strategy (30.5%) for all journals examined, and "the leading technique was questionnaire/interview" (32.5%). Experimental design (20.8%) was the second most used technique, and content analysis was "the only other specific technique with more than 10 percent."[27] Historical research was very low (1.2%) and showed a "marked decline" when compared with the results reported for 1975 and 1985 by Jarvelin and Vakkari and Kumpulainen.[28] Thirty-two percent of all the journals reported no empirical research (these were discussion and theoretical papers), and there was no significant difference between the librarianship and nonlibrarianship journals. In the 1985 analysis 55.9 percent of the articles reported no empirical research, which may indicate that discussion and theoretical papers were less likely to be published in 2005. Hider and Pymm reported that "qualitative approaches including case studies and ethnography are now well established." Bibliometrics are still "valuable tools of investigation" and "the largely quantitative technique of transaction log analysis has grown rapidly to become a major instrument." Approximately 26 percent of the articles in the librarianship journals used both quantitative and qualitative analyses, while 12.2 percent of the articles in the nonlibrarianship journals used both analyses.[29]

Fidel analyzed 465 articles published in four LIS research journals. Five percent (22 articles) used the mixed methods research (MMR) approach, "which integrates qualitative and quantitative methods in one study." Fidel also reported that the use of the MMR name or recognition of MMR "was absent from these articles and from the methodological literature in LIS."[30]

Limitations of Previous Library Research

Unfortunately, the past research record for library and information science is not exemplary. It has been easier to find criticism of library research than praise. Zweizig called for improvements in research methodologies, especially as they related to users of library services.[31] Busha and Harter stated: "a large proportion of librarianship's research has been uneven in quality and demonstrably weak methodologically . . . "[32] Shaughnessy was even more critical in contending that traditionally the field has permitted much of what is not actually research to be called research.[33] Cuadra identified shortcomings in library and information science research so far as purpose is concerned.[34] He noted "a failure to ask the right questions and to establish a proper theoretical foundation for later research or application."

On what else do these writers and others base their rather negative evaluations of much of the previous library research? Martyn and Lancaster pointed out that much of the earlier literature of library science was too heavily based on opinion, as opposed to investigation, to be considered research.[35] Shera noted that because of library research's "excessive dependence upon local observations and limited data, more frequently than not it is provincial and parochial rather than general in applicability."[36] Van House observed that "much of the research in LIS is episodic. Rarely do researchers build a continuing series of projects so that their own work is a coherent whole. Nor do they often build on one another's work."[37]

Garrison, while acknowledging that considerable advances had been made in public library research in the previous decade, went on to itemize several shortcomings of research, including the following:[38]

1. Researchers have not disseminated their results adequately.
2. Practitioners have not kept up with research results that have been reported.
3. The profession has been too content with nonresearch reports.
4. The audiences for research journals have been too limited.
5. Dissertations have seldom had any relationship to previous or subsequent research.
6. The impact of reported research has been weakened due to poor bibliographic control and inadequate availability of copies.

Goodall reported that a variety of topics were being investigated by public librarians in England, yet the methodologies used for the studies were limited.[39]

Survey methodology was employed for the majority of the studies. Although new and varied methodologies are being demonstrated in the library and information science literature, survey methodology continues to dominate.[40]

Gatten criticized library science research for failing to draw upon the research literature and methods of other disciplines and for too often utilizing unsophisticated analytical techniques and limited theoretical frameworks.[41] Trahan stated that library research "is at a relatively primitive stage in its development when compared to the research literature of other disciplines" and that "there has been little, if any, increase in research activity in librarianship."[42] In an editorial, Hernon expressed his concern for the poor quality of research published in library and information science journals.[43] Although Fisher concluded that the professional literature represented in six LIS journals in 1993 validates the results of prior studies in regard to author demographics, he recommended the continued publication of both applied and "rigorous empirical/theoretical research" to meet our professional needs.[44] Dillon was critical of LIS research but stated, "I actually do not share the belief of others that this is a field in crisis . . . I believe this is a wonderful moment of opportunity for us all, but to grasp it, we must be prepared to address the shortcomings in our research operations."[45]

In short, in spite of some progress, there continues to be a need for more and better library-related research. But the limitations of earlier research are not the only reasons for calling for better-conducted research. There are a number of positive justifications that can be made for more rigorous research and, in particular, basic research.

RATIONALE FOR BASIC RESEARCH IN LIBRARY AND INFORMATION SCIENCE

Growth of the Profession

As indicated earlier, one of the major purposes of basic research is to create new knowledge. Or, as stated by Mouly, "it is the purpose of science [scientific research] to go beyond experience and common sense, which frequently are quite limited and inadequate—and often quite incorrect, . . . for advancing knowledge, for promoting progress, and for enabling man to relate more effectively to his environment, to accomplish his purposes, and to resolve his conflicts."[46] "And as Kunge has written: 'Learning to master theoretically and in practical application, the ground rules of research creates the best foundation for continuing growth in a profession.' "[47]

But perhaps even more basic to the advancement of the profession "is the need for the field to test the various myths, assumptions, rules-of-thumb, and other conventions by which it has operated for so long a time, to link concepts which have been proven through testing to be valid, and thereby establish theories indigenous to the field itself."[48] In addition, the profession needs to advance beyond its heavy dependence on descriptive data and establish principles and theories on which libraries and information systems and services can be based.[49] "One of the hallmarks of a profession is the ability of its members to give advice to clientele derived from a body of generalized and systematic knowledge that comprises its theoretical core."[50]

Those concerned about the status of the LIS profession have commented on the need for more and better basic research. Shaughnessy noted: "Of the two primary marks of a profession—a service ideal and a body of theoretical knowledge—it has been suggested that librarianship possesses the first, but not the second. Theoretical knowledge, as distinguished from knowledge based on practice, is generally developed or discovered through the process of research; a process in which librarianship has not had much of a tradition."[51] Busha and Harter argued that "if librarianship is to merit the coveted designation 'science,' a significant number of scholars and research workers must regularly apply scientific method to analyze relationships among the problems which librarians are obligated to explore and which they are qualified to serve."[52] In other words, "A profession that would know itself—that would anticipate or, to use Gabor's phrase, 'invent the future'—must support and engage in productive research."[53]

In 2001, the Special Library Association (SLA) published a research statement, "Putting OUR Knowledge to Work: The Role of Research in Special Libraries," defining library and information science research as not well developed, with fewer peer-reviewed journals and grant-funded research in comparison to other disciplines.[54] The statement identifies ways that special librarians, researchers, and SLA can work together to contribute to the library and information profession and to build a foundation for evidence-based practice.

In short, basic research is crucial if the field of library and information science is "to solve professional problems, develop tools and methods for analysis of organization, services, and behavior, to determine costs and benefits of our services, and most importantly, to establish or develop a body of theory on which to base our practice."[55] It is imperative that academic librarians and higher education libraries (among others) develop and carry out systematic research and development programs. LIS students and professionals must not only be able to " . . . read, understand, and value the LIS research literature," but "they must also be able to locate it within its cultural context . . . " A commitment to understanding and applying research is also essential if the field is to continue to advance."[56] Unfortunately, as Busha and others have noted, the development of new knowledge within the library and information science profession has traditionally received a relatively low priority.[57] In 1994, Riggs argued that the profession seems, in fact, to be reducing the attention that it gives to research.[58]

Management

As has been indicated earlier, basic research has more to offer than the expansion and refinement of the profession's theoretical underpinnings. Much of the knowledge created as the result of basic research is likely to have practical applications for the improvement of practices in actual library operations.[59] Swisher argued that "there is no more important activity than acquiring new information that may now or someday assist in the goal of improving our professional decision making. Assuming the responsibility of practical research is probably the most important role a librarian can accept."[60] The application of research findings should result in "improved decision making, more knowledgeable insights into a wealth of library issues, better and more accountable services and programs, and the continued maturation of LIS as a discipline/profession."[61] "Thus, there is the need for academic librarians to possess an understanding of data-gathering techniques, which are informed by an understanding of the nature of the research methodologies available and an understanding of the nature of the statistical analysis techniques available."[62] Recently there has been much discussion about evidence-based decision making, which requires collecting and analyzing relevant data to make informed decisions for services, policies, etc.[63] Hernon and Schwartz proposed a managerial leadership research agenda that includes evidence-based decision making for assessing, evaluating, and managing.[64] A new open access journal, *Evidence Based Library and Information Science Practice* (http://ejournals.library.ualberta.ca/index.php/EBLIP/index), began publication in 2006. The purpose of the journal is "to provide a forum for librarians and other information professionals to discover research that may contribute to decision making in professional practice" (http://ejournals.library.ualberta.ca/index.php/EBLIP/about/editorialPolicies#focusAndScope).[65]

The American Library Association (ALA) promotes the need for the dissemination of research findings for support of professional practice and has published "recommendations related to the effective dissemination of research."[66] In addition, ALA initiated the *ALA Research Series* in 2009 "to expand the knowledge base of library research by publishing quantitative and/or qualitative research and analysis that addresses topics important to libraries, librarians, and education in the profession"—"accessible, useful, practical, sustainable research" (http://www.ala.org/ala/professionalresources/publications/alaresearchseries/alaresearchseries.cfm).[67]

While most research for decision making takes the form of applied research, it typically draws upon the tenets of basic research. McClure observed that "applied research takes the theory and concepts from basic research and by formal methods of inquiry, investigates 'real world' phenomena."[68] In other words, a solid understanding of the basic research process should better enable one to conduct sound applied research. As Goldhor pointed out, "Once one has learned this method [scientific research] he can understand and use any of the less rigorous methods, but learning the latter will not prepare one really to use the former."[69]

ACRL established the Focus on the Future Task Force in the fall of 2001 to identify the issues facing academic librarians, and to assist with developing " . . . services to further improve learning and research."[70] After extensive interviews and open forum discussions, seven top issues were identified. These issues provide a research agenda that can guide and direct research projects that enable library managers to make intelligent decisions.

Reading Research Reports

Another benefit of having a reasonable mastery of basic research methods is that it should allow one to understand and critically evaluate the research reports of others. According to Swisher "the reader who understands the process of research will question much more about the literature in general, and correctly identify the working limitations of the literature."[71] Some librarians, particularly special librarians, are expected to evaluate or screen research reports (i.e., serve as research intermediaries) for their clientele. Unfortunately, as Sullivan has contended, not only do librarians who are practitioners tend to be too busy and unskilled to conduct their own research, but more seriously, "they are also either uninformed or unwilling to accept or unable to judge critically the research of others in the field of librarianship."[72] Until a majority of the field's practitioners can understand and apply the research results of others, the profession is not likely to realize much benefit from its research efforts. Numerous writers, including Busha and Harter and Grazier have argued for the need to evaluate and apply published research.[73] As Williams and Winston stated, "the research literature in any discipline can serve to further the scholarly discussion, advance the theoretical base of the profession, and inform practice."[74]

A study by Powell, Baker, and Mika provides a more hopeful perspective on the profession's use of research.[75] Members of the American Library Association, the American Society for Information Science and Technology, the Medical Library Association, and the Special Libraries Association were surveyed to identify their involvement in reading, applying, and conducting research. The findings revealed that "almost 90 percent of LIS practitioners in the United States and Canada regularly read at least one research journal, nearly 62 percent regularly read research-based articles, approximately 50 percent occasionally apply research results to professional practices, and 42 percent occasionally or frequently perform research related to their job or to the LIS profession."[76] Only 15 percent of those surveyed indicated that they read more than four research journals, and research activity varied by membership in the professional associations represented in the study. Master's degree courses in research methods were found "to be significantly related to conducting, as well as reading research."[77] A survey of British librarians in academic, health, public, school, and special libraries found that half of the respondents reported that they had been involved in some form of research in the past two years.[78]

Improved Service to Researchers

Yet another advantage to having a basic knowledge of research methods, at least for those librarians who serve researchers, is the greater understanding of the needs of researchers provided by this awareness. Only when the librarian knows the basic process which a researcher utilizes, can the researcher's needs be fully anticipated and met. Or as Engle stated, "A thorough and continuing personal grounding in the experience of learning and research in an academic setting prepares us to join students and faculty in the creative act which bibliographic research can be."[79] In addition, the librarian's status is likely to benefit from being knowledgeable about the researchers' techniques and from being able to discuss them intelligently with his or her clientele. Grover and Hale argued that librarians should assume a proactive role in faculty research and be viewed as key players in the process.[80] Librarians are often recruited to help conduct the literature review for a research proposal and may even help write the proposal and conduct the research.

Personal Benefits

Perhaps most important among the benefits one could expect to realize from a study of research methods is the ability to conduct research. For many librarians, especially in academic settings, research activities are not only desirable but a necessity. A number of academic institutions expect their professional librarians to meet the same requirements for promotion and tenure as do their regular teaching faculty, and these usually include research and publishing. If these librarians, and others, are to conduct the kind of rigorous research that they and their profession need, a thorough understanding of basic research methods is absolutely essential.

An awareness of research methods and design also should prove helpful for those preparing research proposals in order to obtain financial support for their research activities. In addition, it has been pointed out that the study of research methods can improve one's ability to think critically and analytically—competencies associated with leadership. A library's involvement in research can even improve staff morale and enhance the library's status in its community.

THE FUTURE OF LIBRARY RESEARCH

As Busha noted, past weaknesses of library-related research can at least partially be explained by the fact "that research in librarianship is still relatively young. Clear conceptions of the goals, objectives, and methodologies of library science research are only now beginning to be solidly formulated."[81] It does appear clear, however, that it will become more and more "necessary to use the methodology of other disciplines—in particular, those of sociology, psychology, economics, linguistics, history—and to employ more generally applicable methodologies" in order to study the many problems facing librarianship today.[82]

But who is going to be qualified to conduct the kinds of research needed, how will they be trained, and how will practitioners be equipped to read and utilize this research? Shera provided at least one answer to these questions when he wrote: "Research is too important to be left to dilettantes and amateurs, and its pursuit should be reserved for those who are qualified for it by aptitude, education, and motivation."[83] In short, education appears to be one key to solving the problem. Not only can education provide the basic skills needed for conducting research, but it can help to shape attitudes and supply motivations.

Logically, the major responsibility for imparting research skills to librarians must belong to the LIS education programs. As Shera stated, "A specific part of the course of study for a graduate student in librarianship should be the acquiring of a knowledge of the principles and methods of research as applied to the investigation of library problems, together with the ability to evaluate research results, especially research in librarianship . . . "[84] As Muller wrote: "Students should learn to appreciate the contribution of research and be urged to rid themselves of the notion that research is something esoteric, remote, or impractical."[85] Yet most students view LIS programs as primarily concerned with providing professional, not academic, training[86] and "too few practitioners have education in the research or knowledge creating process . . . "[87] Only

47 percent of the practitioners responding to a survey conducted in 2000 reported that they had taken a course on research methods at the master's degree level, and 59 percent of them reported that their master's degree programs had not adequately prepared them to conduct research.[88]

In other words, the track record of LIS programs regarding the teaching of research skills is not outstanding.[89] O'Connor and Park reported that a research methods course was not required in 38.5 percent of the American Library Association accredited LIS programs and that "only half of the twenty-four top-rated programs required Master of Library Science (MLS) students to take research methods."[90] In 2003, Hernon and Schwartz referred to this as a crisis that should not be allowed to continue,[91] but four years later they still had to conclude that graduates of LIS programs "might emerge with little or no understanding of the research process and how to gather and interpret evidence related to accountability, effectiveness, efficiency, or continuous quality improvement in programs and services."[92] In a study conducted by Dimitroff, she reported that special librarians identified the following as the top barriers to their involvement in research activities: the lack of management support of research, the lack of money/funding for research, the lack of personal interest in research, an insecurity of research skills, and a lack of research ideas.[93]

However, LIS programs do not have the entire responsibility for training competent researchers. It is also the responsibility of professional associations and, in some cases, research organizations, to provide appropriate continuing education opportunities. If libraries and other employers are going to expect librarians to equip themselves to do research, then they must be prepared to provide appropriate incentives, support, and rewards. For example, released time, special leaves, and sabbaticals can be arranged to allow more time for research. Administrative support can be provided through salary raises, in-house training, and financial and clerical support for research projects. Relevant courses such as those in statistical analysis can be taken in departments outside the LIS program when desirable or necessary. And ultimately, of course, it is the responsibility of the would-be researcher to take advantage of continuing education and staff development programs and to commit himself or herself to a substantial program of self-study.

Goldhor's statement made almost four decades ago still rings true: "Librarianship today is particularly in need of the generalized truths which scientific research is designed to uncover."[94] And the research problems will ultimately direct the methodologies employed, which justifies the sustained development of research theories and models as described by Glazier and Grover in their multidisciplinary framework for theory building.[95] In other words, if we are to realize the professional growth needed by the field of library and information science, "Our attention must increasingly be devoted to research which is more basic and less applied . . ."[96] "We must all raise our expectations and challenge the profession to value and use research."[97]

Fortunately, there are promising signs. In an editorial in *Research Strategies*, the authors stated that "a new strain of thought has sprung up in the field of librarianship . . . an interest on the part of practicing librarians in conducting serious research."[98] The professional associations continue to establish more and more units concerned with research. As of 2009–2010, ALA's Research and Statistics Assembly had 23 member units. At the annual conferences of the American Library Association, a considerable number of programs and committee meetings directly deal with research and statistics. ACRL established a Research Mentoring Program to help members with various aspects of the research process. ALA's Committee on Research and Statistics is charged with promoting research to answer questions regarding library services.

SLA's "Research Statement" calls for evidence-based practice, which is decision making " . . . based on the strongest evidence" of what will work best for the libraries' clients.[99] With the expanding role of library and information professionals and the widespread accessibility of information, SLA advocates for the selection, acquisition, organization, and management of information resources to be based on research findings.

The creation and dissemination of research is central to the Vision Statement of the American Society for Information Science & Technology (ASIS&T). The vision of the society includes: " . . . advancing knowledge about information, its creation, properties, and use; providing analysis of ideas, practices, and technologies; valuing theory, research, applications, and service; nurturing new perspectives, interests, and ideas; and increasing public awareness of the information sciences and technologies and their benefits to society."[100]

McClure and Bishop asked 23 leading researchers in library and information science about the status of research in the field.[101] They concluded that it had improved somewhat in the 1980s and expressed "guarded optimism" about the future status of research in library and information science. At least two studies indicated that the number of published research articles is increasing (though there is some evidence that the proportion of research articles in the core journals has declined since 1975).[102] A 1991 book edited by McClure and Hernon was dedicated to the improvement of library and information science research. It provided an overview of LIS research, considered its practical context, and discussed issues and concerns related to research in library and information science.[103]

The annual reports of ALA's Office for Research and Statistics continue to show considerable activity in the research arena. Eisenberg wrote in 1993 that we can take pride in the research that has been conducted in the area of school library media programs.[104] In three editorials, Hernon and Hernon and Schwartz argued that some of the indictments of library research are supported by few references to the LIS literature, LIS researchers have drawn on procedures developed in other disciplines, and LIS researchers have contributed to the development of innovative methods.[105] There have been four national Library Research Seminars since 1996, with a fifth one in the planning stages, and each received numerous proposals for papers representing a wide range of methodologies, including content analysis, historiography, path analysis, discourse analysis, transaction log analysis, protocol analysis, survey, modeling, and meta-analysis. The research topics were equally diverse and often interdisciplinary. These research seminars provided effective forums solely devoted to research ideas and methodologies.

It is always difficult to predict the future, but research in LIS will probably continue to incorporate more multidisciplinary and qualitative methods.[106] Studies addressing the impacts and use of digital resources and technology are currently represented in the literature and will likely continue to pique interest in researchers and practitioners as the resources and technologies evolve and library users become more sophisticated in their demands for and use of these resources. Hernon and Schwartz support this assessment and add, "the problems, research designs, the tool chest of methodologies, and data analysis techniques and software are richer today than ever before."[107]

In conclusion, there is mounting evidence that the quality, if not the quantity, of LIS research is improving. And, hopefully, there is increasing recognition "that the results of research in a broad spectrum of effort extending well beyond librarianship will, in large measure, determine the future directions of library services and the nature of the profession itself" (American Library Association, 1970)—a statement that still resonates after 40 years.[108]

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Chapter 2

Developing the Research Study

More research effort is wasted by going off half prepared, with only a vague set of ideas and procedures, than in any other way.[1]

PLANNING FOR RESEARCH

The first question that a researcher may well ask is, "Where do I begin?" In other words, where does the planning begin? Leedy and Ormrod state, ". . . by asking questions, we strike the first spark igniting a chain reaction that leads to the research process. An inquisitive mind is the beginning of research."[2] After all, as we learned earlier, the major purpose of basic research is to discover new knowledge.

Historically, new knowledge has been sought either by means of deductive logic or through the use of inductive reasoning. Deductive or systematic logic, which was developed by Aristotle, is characterized by use of the syllogism. A syllogism starts with a basic premise, which is then logically applied to a particular case; for example: "All men are mortal; John Doe is a man; therefore John Doe is mortal." The truth of the conclusion obviously depends upon the truth of the basic premise, which in this example was "All men are mortal."

In contrast to the deductive method, inductive reasoning proceeds from particular instances to general principles, or from facts to theories. Using inductive logic, one might note that John Doe is mortal and then observe a number of other men as well. One might next decide that all of the *observed* men were mortals and arrive at the conclusion that *all* men are mortal. The obvious limitation to this method is that it is virtually impossible to observe all of the instances supporting the inductive generalization.

Let us consider one more example which may help to illustrate the distinction between deductive and inductive logic. Suppose we are interested in the possible relationship between the amount of library instruction received by certain college students and their subsequent academic performance. Using the deductive method, we could hypothesize that library instruction improves academic performance. We could then specify that library instruction would be represented by the number of hours spent receiving library instruction in an English literature course, and that academic performance would be represented by the final grade for the course. If we were to observe that, as the hours of instruction increase, grades improve, we could then conclude that our hypothesis describes the relationship that exists.

Using inductive reasoning, we could start with an observation that the students in a particular English literature class who had received library instruction seemed to do quite well in the course. We might then wonder if most library instruction methods have a positive effect on the academic performance of college students. We could proceed to make a variety of observations related to both library instruction and academic performance. Next, we would look for a pattern that best represents or summarizes our observations. In other words, we would attempt to generalize that, based on our observations, library instruction of all types tends to improve academic performance. As Babbie has pointed out, with the deductive method we would have reasoned *toward* observations; with the inductive method we would have reasoned *from* observations.[3]

THE SCIENTIFIC METHOD OF INQUIRY

Inductive reasoning contributed to the development of what is known as the scientific method or the scientific method of inquiry (SMI). This approach to the discovery of knowledge, which arose during the Renaissance, gained major support in the sixteenth century. Many scholars still consider the scientific method of inquiry to be the most valid method for resolving unanswered questions and solving problems. There are other viewpoints, however. Budd, for example, argues that the SMI is too positivist in nature, and that LIS needs more research that is based on a different epistemological foundation—one that is less concerned with universal laws and invariant relationships.[4]

There is a general consensus among researchers regarding the basic pattern of the scientific method of inquiry, but specific elements do sometimes vary. Leedy describes the scientific method of inquiry as a means by which insight into an undiscovered truth is sought by (a) identifying the problem that will provide the goal of the research, (b) gathering the data needed to resolve the problem, (c) developing a tentative hypothesis, and (d) empirically testing the hypothesis by analyzing the data.[5]

Babbie, who sees the scientific method of inquiry as a combination of the inductive and deductive methods, depending upon the research phase, summarizes the basic steps of the scientific method as (a) identification of an idea or interest, (b) theory construction, (c) derivation of theoretical hypotheses/expectations, (d) operationalization of concepts, and (e) testing of hypotheses.[6] Frankfort-Nachmias and Nachmias state that the research process consists of seven principal stages: problem, hypothesis, research design, measurement, data collection, data analysis, and generalization. They point out that "Each stage influences the development of *theory* and is influenced by it in turn."[7]

Some believe that LIS has little formal theory of its own;[8] others call for more LIS research to advance practice and theory.[9] Budd reminds us that "general progress only occurs when there has been deep critical investigation into the workings of our field."[10] This means that we must study the intellectual foundations of the LIS field. This type of reflection will influence not only our research but also the development of systems and services for the practice of LIS. Glazier (see his section below) argues that, before we begin the research process, we should consider our basic epistemological and ontological assumptions and presuppositions. They influence how we approach and carry out research in the social and behavioral sciences.

A General Outline for Research

Given differences in subject disciplines and/or the types of data to be collected, researchers find it necessary to employ a variety of specific methodologies, but most true research does follow the same general outline and exhibits similar characteristics. In developing a research study, the investigator typically begins with a question about something of interest. For example, a college librarian may wonder why the use of his or her library seems to be declining or, better yet, increasing. As early as this point, and throughout the development of the research study, the investigator is likely to benefit from a thorough review of the literature (see Chapter 10 for tips on reviewing the related research).

The next important, logical step would be for the librarian to identify the problem that this question represents. He or she may have a hunch that library use is low because the majority of the students do not have adequate library skills. In other words, the actual problem facing the librarian may be poor library skills, which ultimately tend to be evidenced by low library use. The librarian may also conclude that he or she is actually confronted with several problems, or at least subproblems of the main problem. For example, the librarian turned researcher may need to consider specific types of library skills or different class levels.

Having identified the specific research problem, the researcher should then attempt to place the problem in its broader theoretical framework. An adequate theory might have been articulated already, or it may be necessary to develop one.

Keeping in mind the main problem, subproblems if any, and the relevant theory, the librarian should consider developing one or more hypotheses to guide the future investigation or study. In this case, the librarian may wish to hypothesize that library skills have a positive effect on library use. This hypothesis may be based on obvious assumptions, such as "library instruction will in fact be reasonably effective at teaching certain library skills," or "students will be able to transfer skills learned as a result of an instructional program to actual use of a library."

Throughout this process, but perhaps particularly at this point, the librarian will need to develop a plan for attempting to resolve the problem. In other words, it will be necessary to decide what methodology and data collection techniques, among other procedures, to utilize in the investigation. The librarian could elect to conduct an experiment during which a particular type of library instruction would be given, and after which the students' library skills would be posttested. Or a survey could be conducted in which students would, for example, be asked about their library use and/or skills.

Another characteristic of research inherent to most of the process is the necessity to deal with facts and their meanings. This activity is particularly crucial during the data collection and analysis stages. It is here that the researcher must attempt to gather information needed to solve the problem, organize it in meaningful categories, and analyze its significance. Data collected during the library instruction study could include scores on tests, attitudes toward the library, and self-perceptions of library skills.

And last, but not least, the librarian should keep in mind that this process is almost always circular in nature. The researcher's analysis and interpretation of the results of his or her study may well lead to new questions, or fail to answer the original question, thereby starting the research process again. Leedy and Ormrod developed a diagram, reproduced below as Figure 2.1, which helps to illustrate the circular nature of research.[11] As they state, "Every researcher soon learns that genuine research yields as many problems as it resolves. Such is the nature of the discovery of knowledge."[12]

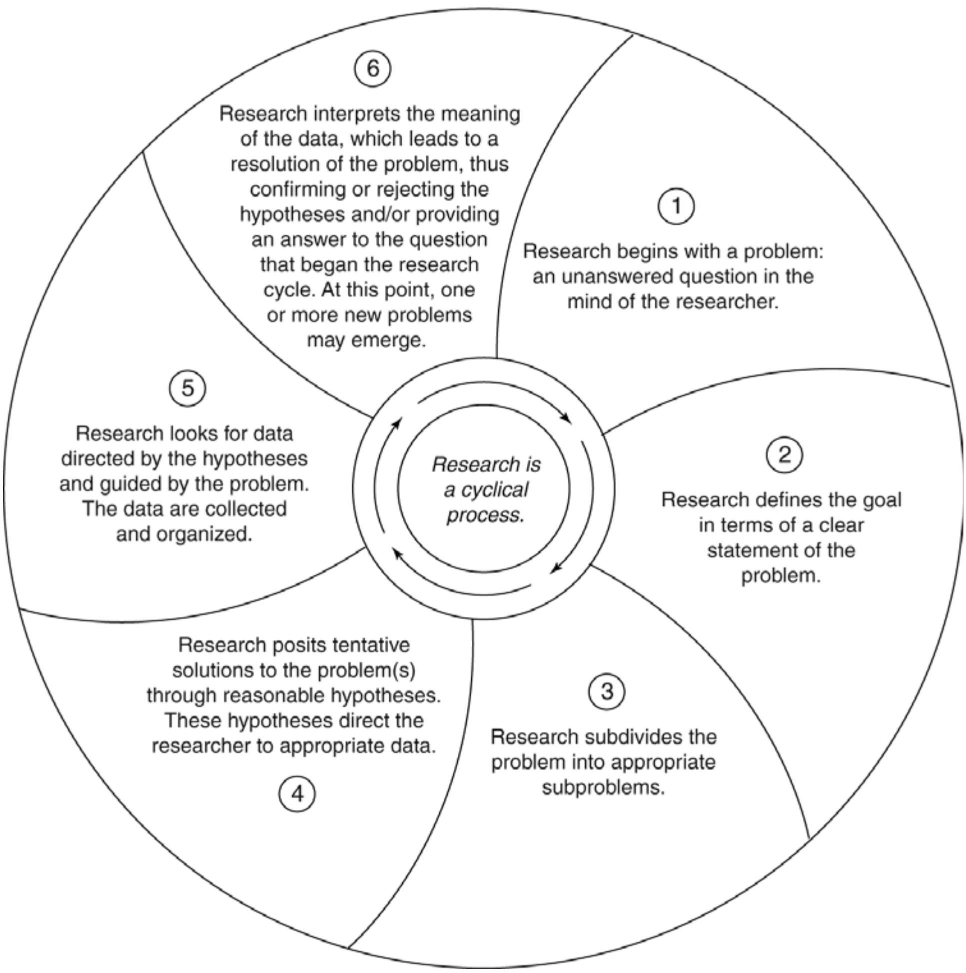

Figure 2.1 The Research Process Is Cyclical. From Leedy, Paul D. & Jeanne E. Ormrod, *Practical Research; Planning and Design*, 8th edition. Published by Allyn and Bacon/Merrill Education, Boston, MA. Copyright © 2005 by Pearson Education. Reprinted by permission of the publisher.

General Criteria for Basic Research

In addition to adhering to a general outline, basic research studies generally should meet certain criteria to qualify as basic or pure research:

1. Universality, which means that the study should be researchable by any other qualified investigator. In other words, another researcher should be able to conduct the study as designed and get essentially the same results as the original researcher would have obtained and also to generalize the results to a comparable situation.
2. Replication, which is related to the criterion of universality. It means that the research study is repeatable. Not only should another competent researcher be able to conduct the study and get essentially the same results, but also should be able to do so time and time again.
3. Control, which relates to the parameters of the research study. This criterion is important for isolating the critical factors and for facilitating replication. As will be emphasized later, control is relatively easy to realize in experimental research and much more difficult, if not impossible, to realize in survey and historical research.
4. Measurement, which constitutes the observation and recording of phenomena. This activity requires, of course, that the data be susceptible to measurement. Measurement (and control) generally is easier to accomplish in physical science research than in the humanities and social science research. The latter typically require more comparative and subjective judgments. Consequently, measurement in the humanities and social sciences is seldom as precise as in the physical and natural sciences.

Hernon categorizes the criteria for basic research into the following five components:

1. Reflective inquiry, which includes a problem statement, a literature review, a theoretical framework, a logical structure, objectives, research questions, and hypotheses (if appropriate);
2. Procedures or research design and data collection methods;
3. Data gathering, processing, and analysis;
4. Reliability and validity, for quantitative studies, and credibility, trustworthiness, transferability, dependability, and confirmability for qualitative studies;
5. Presentation of the research findings.[13]

More specific criteria for basic research are contained in the checklist reproduced on p. 24 as Table 2.1. This checklist refers specifically to research in educational psychology, but most of the criteria can be applied to any basic research in the social sciences. As can be seen, some of the criteria presented here also relate to the feasibility of a research study. For example, the third question asks, "Have you sufficiently limited your problem?" Leedy and Ormrod, in their textbook on research, provide the reader with an Estimation Sheet to

TABLE 2.1 A Checklist for Planning a Research Study*

A. Scope and Definition of Study

1. Is your study related to an educational problem?
2. Is your problem being considered broadly enough?
3. Have you sufficiently limited your problem?
4. Have you made the educational implications of the study clear?
5. Have your decisions benefited by the experiences of investigators who have preceded you?
6. Have you consulted the *Encyclopedia of Educational Research*, the *Handbook of Research on Teaching*, the *Review of Educational Research*, and other background sources?

B. Hypotheses or Questions to Be Answered

1. Are the hypotheses clearly and precisely stated?
2. Are the hypotheses stated in a form that permits them to be tested?

C. Definitions

1. Are concepts adequately and accurately defined?
2. Are your sample and experimental procedures sufficiently described so that another investigator would be able to replicate the study?
3. Do the measurements of variables in the study have validity and reliability?

D. Method of Study

1. Is there a direct relation between the question which the study is trying to answer and the data to be collected?
2. Do you have a plan for securing the data necessary for your study?
3. When more than one investigational approach is available, is it worthwhile to compare the results using different criteria?
4. Can you draw conclusions as to cause and effect from evidence as to relationships from the design employed?
5. How do you propose to select your subjects for study?

E. Design

1. Have you conferred with the persons and/or agencies involved?
2. Is the design of your study clearly formulated?
3. Do you have a PERT chart or a systematic schedule of procedures for the study?
4. Is it feasible to assign subjects randomly to treatment groups?
5. Have you considered the possibility of statistically equating groups on relevant factors?
6. Have you included the most relevant variables in a factorial design so that you can detect interaction among variables?
7. Is your choice of statistical methods the most efficient for the intended purposes?
8. Have you consulted statistics, measurements, and research specialists in the design and analysis of your study?

TABLE 2.1 (Continued)

9. Are there standard library computer programs available for your purposes?
10. Have you determined limitations of time, cost, materials, manpower, instrumentation, and other facilities and extraneous conditions?
11. Have you given consideration to the human and personal relations "side effects?"

F. Sampling

1. Is your sample representative of the group to which you wish to generalize your findings?
2. What factors may be biasing the selection of subjects?
3. Are you taking into account the subgroups in your total sample?

G. Criteria Factors

1. How do you propose to measure achievement, intelligence, attitudes, and interests you plan to investigate?
2. Have you purchased or developed the tests, instruments, and materials needed?
3. Are you going to attempt to ensure that your subjects or judges express their true feelings and attitudes?
4. Have you given sufficient study to determine the best criteria for your study?
5. Have you taken into account the difficulty level and readability of your test for your subjects?
6. If you are using a nonstandardized test, how are you determining its reliability and validity?
7. Have you consulted Buros's *Mental Measurements Yearbook* for critical reviews of standardized measures to be employed in your study?
8. If you plan to use judgments, have you specified the basis on which your judgments would be made?
9. If you plan to use judgments, are you sure your judges have the necessary intelligence, information, background, and other qualifications to permit them to make the judgments?
10. To what extent will bias enter into judgments that you propose to make (or use), and how can these be avoided?

H. Interpretation of Results

1. Have you confined your conclusions to the evidence at hand?
2. Have you tempered your conclusions with the practical meaning of the results as well as with their statistical significance?
3. Have you pointed out implications of the findings for application and for further study?
4. Have you accounted for any inconsistencies and limitations imposed by the methods used?
5. Have you interpreted findings in light of *operational* definitions of variables investigated?

(*continued*)

TABLE 2.1 (Continued)

I. Preparing the Report

1. Have you described your work clearly in order that, if necessary, it could be replicated by a later investigator?
2. Have you used tabular and graphic methods for presenting the results where possible?
3. Have you supplied sufficient information to permit the reader to verify results and draw his or her own conclusions?
4. Have you plans for publishing your study?

*Adapted from P. M. Symonds, "A Research Checklist in Educational Psychology," *Journal of Educational Psychology* 47 (1959): 101–09; Charles A. Bieking, "Some Uses of Statistics in the Planning of Experiments," *Industrial Quantity Control,* 10 (1954): 23.

Determine the Feasibility of the Research Project (see Figure 2.2 on p. 27).[14] Feasibility is one of the most important questions that the researcher can raise before initiating a study. Consequently, the estimation sheet is reproduced below.

This estimation inventory represents a useful exercise, and it is highly recommended that the would-be researcher work through this, or a similar exercise, before undertaking a research study of any magnitude. Some particularly important practical concerns raised by the feasibility exercise are represented by the questions asking about the aptitudes of the researcher, the availability of data, and the data collection techniques to be used. No matter how potentially worthwhile a research study is, if it cannot be managed, it is not likely to be of any value.

IDENTIFICATION OF THE PROBLEM

The research problem is essentially the topic to be investigated or what needs to be known. It is assumed that one plans a research study because he or she has identified some problem worthy of investigation. In fact, Einstein and Infield have been quoted as saying, "The formulation of a problem is often more essential than its solution."[15] Or as Leedy and Ormrod stated, "The heart of every research project is the problem. It is paramount in importance to the success of the research effort. To see the problem with unwavering clarity and to state it in precise and unmistakable terms is the first requirement in the research process."[16]

But given the primary importance of identifying a problem before conducting research, where and how are problems found? The answer to the first part of this question is that problems are all around us. In response to the second part of the question, we can take a variety of approaches. For example, one important, if not essential, approach toward identifying problems for research in a given field is to develop a thorough knowledge and understanding of that field. More specifically, the would-be researcher should be fully familiar with the known facts and accepted ideas in the field, be knowledgeable of previous, related research in the area, and be aware of gaps in knowledge in the field or unresearched areas.

Figure 2.2. Estimation Sheet to Determine the Feasibility of the Research Project*

The Problem

1. With what area(s) will the problem deal?

   ____ People ____ Things____ Records ____ Thoughts and ideas ____ Dynamics and Energy

2. Are data that relate directly to the problem available for each of the categories you have just checked?

   Yes ____ No ____.

3. What academic discipline is primarily concerned with the problem?
   ____

4. What other academic disciplines are possibly also related to the problem?
   ____

5. What special aptitude do you have as a researcher for this problem? ____ Interest in the problem ____ Education and/or training ____ Experience in the problem area ____ Other: Specify _____________

The Data

6. How available are the data to you?____ Readily available ____ Available, with permission ____ Available with great difficulty or rarely available ____ Unavailable

7. How often are you personally in contact with the source of the data?____ Once a day ____ Once a week ____ Once a month ____ Once a year ____ Never

8. Will the data arise directly out of the problem situation? Yes ____ No ____ If your answer is no, where or how will you secure the data?

9. How do you plan to gather the data?____ Observation ____ Questionnaire ____ Tests or inventories ____ Photocopying of records ____ Interview and tape recording ____ Other (Please Explain):___________________

10. Is special equipment or are special conditions necessary for gathering or processing the data? Yes ____ No ____ If your answer is "yes" specify:
    ____

11. If you will need special equipment, do you have access to such equipment and the skill to use it? Yes ____ No ____ If the answer is "no" how do you intend to overcome this difficulty? ________________________

12. What is the estimated cost in time and money to gather the data?
    ____

13. What evidence do you have that the data you gather will be valid and reliable indicators of the phenomena you wish to study? ___________________________

Criterion-Based Evaluation

14. Does your research project meet the four criteria applicable to all research?

    Universality ___ Yes___No

    Replication ___ Yes___No

    Control ___ Yes___No

    Measurement ___ Yes___No

15. As you review your responses to this checklist, might any of the factors you have just considered, or perhaps any other factors, hinder a successful completion of your research project? Yes ____ No ____

    If your answer is "yes," list those factors. ____________________________

*From Leedy, Paul D. & Jeanne E. Ormrod, *Practical Research; Planning and Design*, 8th edition. Published by Allyn and Bacon/Merrill Education, Boston, MA. Copyright ©2005 by Pearson Education. Reprinted by permission of the publisher.

These objectives can be met, at least in part, by reading published research, which often identifies needed research in the field. Doctoral dissertations are particularly good sources of suggestions for further research. Another potentially useful activity can be the checking of new bibliographies and other lists of related materials. Specific titles can suggest new topics for research.

Domain Assumptions of Research

By Jack D. Glazier

BASIC DOMAIN QUESTIONS

While there are many elements and aspects of the research process that are important to the production of valid and reliable research results, there is one general aspect that tends to be overlooked. That aspect has to do with the domain assumptions that individuals carry into any research project. Domain assumptions are those assumptions that are the most basic and serve to structure individuals' belief systems as well as their lives in general. In structuring belief systems and lives, domain assumptions and the modern concept of research intersect.

Research is a complex undertaking because, whether basic or applied, it is the pursuit of knowledge. The ancient Greeks classified knowledge in two forms—"doxa" or opinion and "episteme" or knowledge or truth. The early Greek philosophers and historians, for the most part, generated "doxa" or opinion. They did so because they relied on speculation and myth as opposed to sensation or experience for their knowledge. This did not mean that they accepted "doxa" as the only legitimate means for knowing the world around them as evidenced by the fact that the Greeks had a separate word, "episteme," that they used for "knowledge or truth." This means that two problems that existed for the ancient Greeks are still relevant for modern researchers. The first problem has to do with the epistemological and ontological assumptions that all researchers carry into their work. The second one is concerned with the meta-theoretical organization, dynamics, and linkages among theories, paradigms, and disciplines.

Before researchers can begin designing research projects, deciding on the methods and methodologies to be employed, and making decisions relative to sample size or strategies, they must first reflect upon their basic epistemological and ontological assumptions. These are the personal assumptions that all researchers and most individuals encounter in the process of figuring out who one really is, what is accepted as knowledge or "episteme," what is opinion or "doxa," and how persons come to know what they think they know. What one believes comprises both how reality is ascertained and the content of such a reality.

These philosophical questions are fundamental to learning and discovery. They are as old as learning itself. But they are also questions to which mankind has been unable to find a single correct answer. They are part of each individual's worldview ("weltanschauung") or belief system that is taken for granted as one goes about his or her daily activities.

However, when it comes to research, one's belief system takes on greater significance because it provides the domain assumptions upon which the work and knowledge of research are based.

Before one examines the nature of epistemology and ontology, consideration must be given to how individuals acquire their belief systems and knowledge. This has implications for researchers in terms of what Camic refers to as the predecessor-selection processes.[1] It also has implications for the formulation of what Mullins calls theory groups and the ultimate emergence of new disciplines.[2]

Individuals acquire knowledge and belief systems from parents, teachers, experiences, and other sources too numerous to list here. Some of this knowledge and the basis for one's value and belief system appear early in life as a result of conditioning and role imitation of parents and siblings and link all phases of one's upbringing.[3] Most of this early knowledge and training is formative and not gained by the choice of the receiver. However, as people grow older they are able to select, within limits, what to learn and from whom.

This selection process is a topic considered in the works of Mullins[4] and Camic.[5] Mullins documents how individuals choose the theories they adopt and how they carry and transmit these to others who in turn carry on the traditions of their predecessors.[6] Camic articulates with more specificity the processes by which scholarly knowledge is transmitted.[7] This transmission, he argues, is driven by rational linkages between concepts and cumulative growth. It is contingent on a "content-fit" that brings together, according to Maines, Bridger, and Ulmer, "scholars [who] purposely select predecessors whose work fits their own intellectual purposes."[8] This relates directly to the development and transmission of theories, paradigms, and disciplines discussed later in this section.

UNDERSTANDING THEORIES OF KNOWLEDGE

Etymology, Nature, and Role of Epistemology and Ontology

The study of knowledge has been referred to since the time of the ancient Greeks as epistemology. The Greek root word for this term is, "episteme," the word used earlier, meaning "knowledge or truth." The suffix "ology" comes from the Greek "logos" meaning "the principle of reason or theory." These elements come together to form the concept of epistemology as "theory of knowledge." Runes formally defines epistemology as, "[t]he origin, structure, methods, and validity of knowledge."[9] However, understanding the etymology and formal definition of the term conveys only limited information about the role of epistemology, the historical and modern range of theories of knowledge, and their impact on research.

Grounding our epistemological perspective is our ontological perspective. The term ontology comes from the Greek words "ontos" meaning "being" and "logos" meaning "theory." "Being" is the extended term with the concept of existence subsumed under it. Together, the word ontology is formed to mean "theory of being or existence." Aristotle argued that this was the First Philosophy—the study of the nature of things. Runes defines ontology as "The science of fundamental principles."[10]

The role of ontology is to serve as the basis for all things including the nature of knowledge. The role of epistemology is to serve as the foundation upon which to build one's knowledge of the world. An individual's ontological perspective must come first, followed by her or his epistemological position. However, as is frequently the case, articulating one requires simultaneously considering the other. In this case, as epistemology is discussed, by necessity so is ontology. This is especially true when the subjective/objective continuum is examined. Ontology not only encompasses the fundamentals of knowledge but also has implications for our understanding of being.

However, it is epistemology that is the foundation of the assumptions that ground the research methodologies that we employ to gather data and that supplies the basis for the means of analysis from which we interpret our data and draw our conclusions. These assumptions are not universals. They can and frequently do differ from individual to individual. As a result, there may be as many interpretations of the meaning of data as there are individuals doing the analysis and interpretation. As sociologist Scott McNall observes, "Just because someone has grown up in society, he is not a qualified interpreter of human experience."[11] And so it is in libraries and library and information science. The very fact that one has been socialized in, or is intimately familiar with, libraries and their ways brings with it certain assumptions and biases that can impede rather than facilitate research related to libraries and matters associated with them.

Subjective/Objective Continuum

The subjective/objective continuum encompasses a broad range of ontological perspectives on knowledge. At one end of the continuum there is pure or radical subjectivism. A radical subjectivist, if there is such a person, believes in a world that is entirely phenomenal (see Figure 1 on page 30). That is, a person understands that a world of objects is a mere projection of the mind and there is no truly external or objective world. The world of reality exists in the mind of the individual. This position is often referred to as "idealism." It is the position of radical subjectivists who pose problems in terms of empirical data gathering for several reasons. First, in an entirely subjective world, how do minds communicate since there is no independent existence? If all a person can know is what is in her or his own mind and everything else is an extension of individual minds, are individuals not truly "islands unto [ourselves]?" Such isolation, according to Runes, is solipsistic to the extent that the individual self is viewed as the whole of reality while others and the external world are only representations of the self with no independent existence.[12] What this implies is that there can be no independent, external sense data to gather and analyze. This is a problem with which philosophers historically have

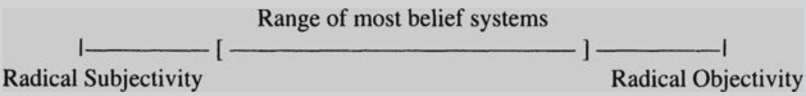

Figure 1. The Subjective/Objective Continuum.

struggled—the question of a mind/matter duality. In fact, the question becomes, how do we even know that we as individuals exist? This was the question that provoked the famous aphorism by the seventeenth-century philosopher Rene Descartes: "Cogito ergo sum," (I think, therefore I am).

Second, at the other end of the spectrum, is the view of pure or radical objectivism. An individual who would be labeled a radical objectivist believes in a world that is entirely nominal and empirically accessible. This position is often referred to as "materialism." This is a world in which individuals are able to perceive sense data directly and objectively without the interference of personal values or opinions.

However, most modern researchers fall somewhere between the two poles of radical subjectivism and radical objectivism. Most individuals recognize the existence of an external world that can be perceived in the form of sense data. Sense data are data that can be empirically gathered and analyzed, and from which conclusions can be drawn. Still, most also recognize that when a researcher gathers data and begins the process of analysis, that researcher must be aware that he or she carries within himself or herself sets of values and beliefs that influence perception. In other words, what we perceive is filtered through our systems of values and beliefs and to that extent loses some degree of objectivity.

It is this filtering system of which the researcher must first be aware. By understanding personal dynamics and being reflexive (aware of one's self and what is going on in the general proximity and broader contexts which might influence perception), the researcher attempts to limit the extent to which sense data are colored by these personal and proximal influences. Hence, the degree of objectivity that the researcher is able to achieve depends largely on his/her skill at recognizing and limiting subjective or outside influences. As the renowned social psychologist/philosopher Campbell notes, "... the goal of objectivity in science is a noble one, and dearly to be cherished. It is in true worship of this goal that we remind our selves that our current views of reality are partial and imperfect."[13]

The second point that must concern the researcher is the transition from sense data to words and concepts. This has to do with what Maines and Chen call "human symbolization."[14] In essence the process begins with the assignment of a symbol or set of symbols to perceived sense data.[15] The symbols become a representation in communication of the elements in sense data. Representations are interpretations by the observer calling for, once again, care in their application. Such representations are a form of communicative action within the context of the social process in what has been described as "structuration."[16] These are first-order symbols that later are translated into second-order symbols in the form of printed or electronic words and concepts; thereby they become critical elements in Habermas's "theory of communicative action."[17] In other words, the assignment of symbols (first-order) to sense data and the late transfer of those symbols to word and concepts (second-order symbols) becomes an important link in the process of social action, an important end for research and society.

However, research by itself is of little value until it is communicated by means of print or other media. Understanding the communication processes is, therefore, an important part of understanding the research process. The application of symbols to sense data supports Maines and Chen's contention that consciousness is a result of social interaction.[18] The assignment of symbols is an important part of the communication process, for without symbols mankind has nothing with which to communicate. Accordingly, Couch argues that "referential symbols designate objects, events, qualities, and sequences."[19] While not limited to vocalizations, referential symbols begin at that point but are further extended to print and other forms of communication relative to research results and processes. It is the pursuit of this goal that is the point of our meticulous efforts to design good research and select appropriate methods and methodologies. It is to this end that the sciences, natural and social, must be committed.

METHODS AND METHODOLOGIES

Etymology and Role of Methods and Methodologies

Understanding what is meant by methods and methodology and the difference between the two is found again in the examination of each term. Method comes from the Greek words "meta" meaning "from or after" and "hodos" meaning "journey." These terms can be understood to mean the "journey or pursuit after or of" some end. Runes defines method as, "Any procedure employed to attain a certain end."[20] In this case, the end is the data to be gathered and the method is the means. However, the habit of referring to research methods and methodologies as interchangeable is misleading.

The term methodology originates with the same Greek terms as the word method. This enables individuals to use the term method as the root word in understanding the intricacies of the broader term methodology. Adding the now familiar Greek suffix "logos" meaning "study, theory, or principle of reason" to the root word "method" leaves the word methodology meaning "a study of the plans which are used to obtain knowledge" as defined by Polkinghorne.[21] Thus, while the term method refers to specific means of collecting data, methodology refers to the strategies surrounding the use of multiple methods of data collection as required by different types of data attempts to achieve higher degrees of reliability and validity. The topics of triangulation and the various types of validity and reliability are covered in more detail elsewhere in this book.

Methods, Methodologies and Theories of Knowledge

The methodological selection of particular data collection methods relies on various criteria. At this juncture, the concern is with the epistemological bases for selection. Earlier, the discussion centered around the extremes of the subjective/objective continuum. However, these only represent theoretical polar extremes and have few operational implications for day-to-day research design and implementation. Now consideration will be extended to both the actual role, historical and present, of epistemological perspectives and the research process.

Historically, arguments concerning what constituted acceptable research centered around the degree of empiricism required. Some ancient Greeks chose to speculate hypothetically on objects of interest to scholars of the time. The subjective aspect of the speculative arts became suspect, tainted by an individual's values and beliefs. Others, particularly Aristotle, attempted to forge links between the more objective empiricism of science and the more subjective speculation of philosophy through the process of systematizing the knowledge of their predecessors. Aristotle accomplished this by utilizing empirical observation, conceptual categorization, and analysis through the development and use of categorical logic.

Many philosophers relied upon what Francis Bacon later formalized as the inductive method for the means of studying nature. It was a method grounded in empiricism and in search of increased objectivity, through empirical data gathering and generalization or extrapolation. Extrapolation, then, became a key element in the reemergence of a predictive natural science that relies upon strict objectivity. This was the deductive method. Many natural and social scientists now rely on the scientific method, (i.e., deductive research as discussed in more detail in this book).

The pursuit of objectivity became reified as the scientific method became widely used, leaving its proponents little tolerance for other, more subjective methods of gathering data. This was the position of the positivists who sought to rely on the most objective methods available and the logic that converted language into a mathematical form, abandoning emotion as subjective, noninformative, and purely emotive.

Positivism with its formal origins in the works of Comte in the mid-nineteenth century emerged in the twentieth century as modernism. It is characterized as structured, rigid, and highly rational. It revered the natural sciences for their certainty and rationality. However, the modernist tradition was marked by the emergence of multiple, rival paradigms to challenge the hegemony of positivism. Out of this came a theoretical, multidisciplinary synthesis that became known as postmodernism. It is characterized by its theoretical flexibility and pluralistic paradigms.

The differences among the belief systems and methodological debates involving positivism, modernism, and the postmodern movement occur within the framework of the distinction between the Greek terms "episteme" and "doxa." The term "episteme" comes from two terms: "epi" meaning "upon" and "(hi)stanai" meaning "to stand, or something on which we can stand, certainty and knowledge." The second term, "doxa," means "opinion or belief." In other words, "doxa" is "what we believe is true" and "episteme" is "what we know is true." "Episteme" is representative of positivism just as "doxa" is representative of postmodernism. In addition, the change in emphasis from a more positivist orientation to a more postmodern orientation involves a return to more inductive approaches to research.

Objectivity preoccupied the positivists, while more subjective perspectives were increasingly prevalent during the modern and postmodern periods from which many of the newer methodological approaches have emerged. First, keep in mind that when trends regarding the legitimacy of various types of knowledge (objective/ subjective) are considered, it is not the continuum's extremes that are being discussed. The methodological implications being considered here are to be viewed from a more generalist perspective. Second, if a theoretical exemplar of postmodernism were to be held up, constructionism might be a key. Constructionism is consistent with more subjective paradigms and methodological approaches. And, as in the case of symbolic interactionism, both qualitative (i.e., more subjective) and more quantitative (i.e., more objective or less subjective) approaches emphasize that the same theoretical paradigm can spawn multiple methodologies. Both quantitative (e.g., surveys, experiments) and qualitative (e.g., participant observation, interviews) methods are discussed in detail in this text.

DISCIPLINES, PARADIGMS, AND THEORIES

History and Context of Paradigmatic Change

Disciplines, paradigms, and theories are social constructions. They are not epiphenomenal in their origins. They are creations of scholars and theorists. They are not independent beings with lives separate from their creators. It is the reification of these concepts and the processes by which they are created and perpetuated that capture our attention here.

Numerous historians and sociologists of science have addressed these issues. Among the better known have been Thomas Kuhn, Nicholas Mullins, Charles Camic, and Stephen J. Gould. It is, however, Thomas Kuhn's formulation that has been more widely discussed, and he is best known for his views on paradigmatic revolution.[22] While Kuhn's position is not consistent with the one proposed here, he makes some important observations and is a good example of the dialectical process that occurs through intellectual exchanges.

Kuhn argues that paradigmatic revolutions are episodes, "in which a scientific community abandons one time-honored way of regarding the world . . . in favor of another, usually incompatible approach to its discipline."[23] He suggests that it is these "revolutionary episodes" that advance science. The process, he argues, is a competition for domination of a particular discipline. His argument begins with the acknowledgement that scholars tend to congregate in ideological communities or as Mullins noted, "theory groups." These are communities/groups in which members define themselves and are defined by others as being uniquely responsible for a specific set of shared goals, values, methods, and means of socialization.[24] The socialization processes include training their successors by passing on the rituals, myths, heroes, and traditions of the community. Thus, Kuhn's view that "[p]aradigms are something shared by members of such groups" becomes significant.[25]

In essence, Kuhn argues that paradigms are ways of collecting and understanding the nature of sense data. This is a process composed of the collection, understanding, and translation of sense data into theories and theories into paradigms that become a structuring device for understanding future data. This process is what he called the maturation of a paradigm. For Kuhn, "What changes with the transition to maturity is not the presence of a paradigm but rather its nature."[26]

When change comes for a mature paradigm, it does not come incrementally but in the form of a radical change—a revolution. Kuhn defines a revolution as "a special sort of change involving a certain sort of reconstructing of group commitments."[27] For example, Kuhn would argue that Einstein's theory of relativity was a revolutionary paradigmatic change within physics. This type of change is defined as revolutionary because it involves a sudden, unexpected change in the basic assumptions and theories grounding what was then Newtonian physics. While it was an extraordinary situation, Einstein's discovery was preceded by various theories regarding quantum mechanics and other foundational work in the general area of relativity that prepared the scientific community for Einstein's formulation. Hence, the ensuing reconstruction was less radical than we tend to recognize.

The processes associated with innovation tend to be dialectical in nature. Innovation builds on existing knowledge. New ideas are combined with existing belief systems, resulting in a synthetic concept. This is an incremental process with new ideas being introduced in cloistered intellectual environments until a new paradigm and the public are ready for its introduction.

In actuality, the dynamics of innovation tend to be incremental for utilitarian reasons. The process itself is gradual in nature. Discoveries often are limited in scope because researchers work in narrow environments. Next is the dialectical stage in which the new discoveries are interpreted in light of existing facts and circumstances, producing innovation. Finally, if people are not prepared for an innovation, if they cannot imagine it as possible, they will not intellectually invest in it. It will be simply viewed as an anomaly. Acceptance comes much more readily if people are prepared for change.

A familiar example of change that was slow to be accepted was the introduction of the online public access catalog (OPAC). The technology was available long before it was introduced in libraries on a large scale. In those communities that were gradually prepared for the move from the card catalog to the OPAC, the introduction was more easily accepted. It also helped that most communities operated both systems until patrons became familiar with using the new technology and that the International Standard Bibliographic Description (ISBD) record structure was familiar to patrons. Those who moved too fast with the introduction of the technology encountered much more resistance from patrons and others than those who were more deliberate.

Other examples of change introduced through technology are self check service for patrons and in some libraries the removal of the reference desk in favor of a more flexible and fluid staffing model, identified here as the "roving librarian" model. Libraries that planned for the implementation of these new models using lessons learned from earlier technological implementations found library staff members more accepting of the new services. In other words, the lessons learned from the adoption of earlier technologies pave the way for later innovations.

While innovation is viewed here as dialectical and incremental, it may appear to the public as revolutionary at first. It is also defined by most as progress. This is a value judgment that Gould argues is a bias of our species.[28] His argument begins with a criticism of the view that Darwinism is evolutionary in an upward cycle with Homo sapiens at the top of the hierarchy. This, he argues rightly, is an egocentric tendency that allows our bias to influence the interpretation of sense data. The data indicate that there are numerous species that change at their own rate and according to their needs without an innate natural order that favors mankind. Change is change for its own sake and out of necessity for survival based on its environment. This is the case with disciplines, paradigms, and theories. They change in response to their environments, which are socially constructed. The idea that the dynamic of change is progress implies an egocentric social construction. Change is the response to environmental variables and whether it betters our situation is a value judgment.

Another Perspective on the Emergence of New Paradigms and Disciplines

One way of looking at disciplinary development and change that is less value laden is to understand it as an incremental social process that can be analyzed and understood in terms of social theory. The following formulation has emerged out of the works of Kuhn, Mullins, Grover and Glazier; Powell and DiMaggio; Glazier and Hall and Glazier and Grover.[29] However, Mullins's seminal work on theory and theory groups as well as Powell and DiMaggio's work on the new institutionalism were central in formulating the general thesis presented here.

To begin, theories, paradigms, and disciplines, though reified, are merely labels we place on individuals so we can categorize their interests and beliefs.[30] Theories are no more than the people who develop them and believe in them. As with theories, paradigms are no more than the individuals who construct and subscribe to them. They are each comprised of people interacting with others. The unit of analysis is people and their social relationships. They are not ethereal phenomena that can be studied and understood as abstract entities. This having been said, we will now begin what will at the outset appear to be an abstract analysis of the dynamics of disciplines, paradigms, and theories. However, we should again remember that what we will actually be talking about are people, their relationships, and social constructions that structure their relationships.

The process of structuring the social constructions which enable research is referred to as "structuration" by Giddens.[31] This process of structuring phenomena in the form of the self and society; social and individual knowledge; and, discovered and undiscovered knowledge produces the context for the work of individuals as they endeavor to explain the conceptualization of the sense data they encounter as they go about both their daily activities and their specialized activities in the form of research. Glazier and Grover further argue that theories, paradigms, and, eventually, disciplines emanate from a context of these socially constructed arenas of knowledge discovery and production.[32]

As these dynamics work themselves out, often in the form of scholarly research which results in the theories that scholars come to represent, they are drawn together into what Mullins calls theory groups.[33] It is these theories which are the seeds of new divergent paradigms. Divergent paradigms are the products of initial research which is sporadic and yields loosely coupled, disorganized, and often inconsistent theories.[34] This is referred to as internal divergence. (See Figure 2 on page 37.)

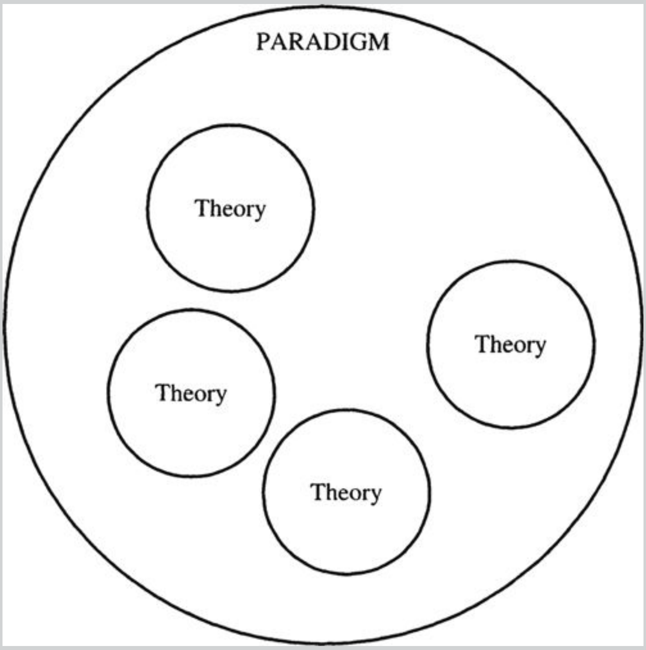

Figure 2. Paradigm Internal Divergence.

As research proceeds, the theories that make up each paradigm become more consistent, more organized, and more tightly coupled. This is referred to as internal convergence. (See Figure 3 below.)

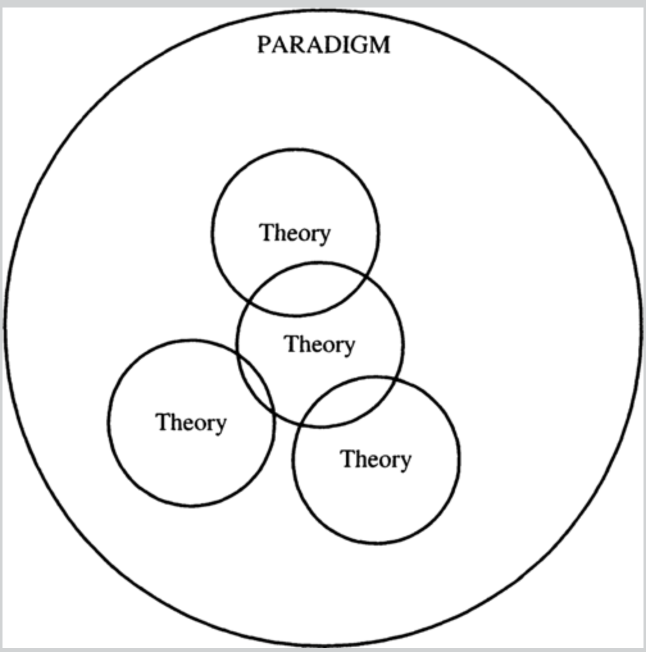

Figure 3. Paradigm Internal Convergence.

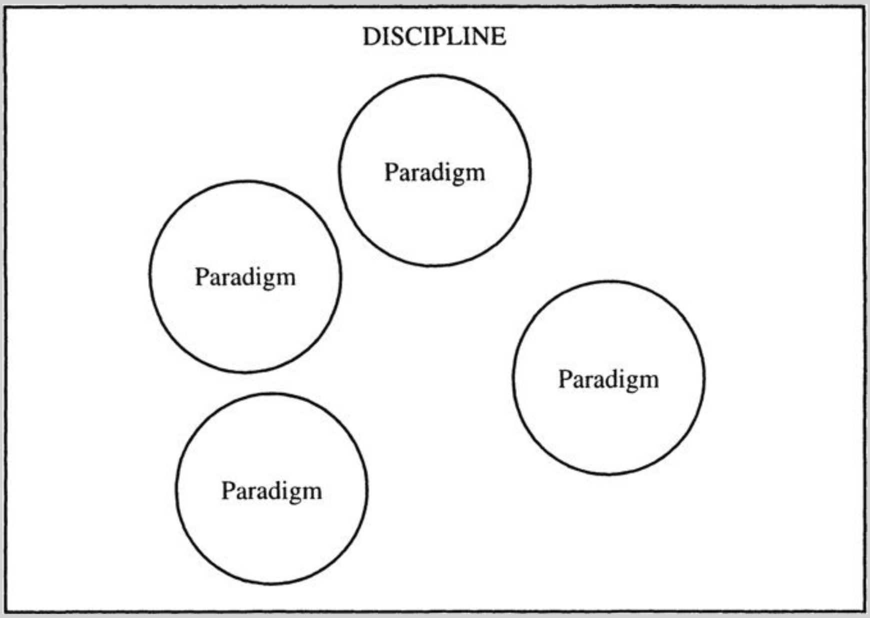

Figure 4. Discipline Internal Divergence.

Convergence yields planned research agendas and broader ranges of theorizing, resulting in the emergence of new paradigms. The more theories converge, the more consistent the paradigms. Again, initially these paradigms are externally divergent. The relations between divergent paradigms can be characterized as loosely coupled, accompanied by a high degree of environmental ambiguity, and generally lacking external consistency (see Figure 4 above). These relations also reflect the internal structure of divergent paradigms relative to their constituent theories discussed above.

It is important to keep in mind at this point that a paradigm is "a framework of basic assumptions with which perceptions are evaluated and relationships are delineated and applied to a discipline or profession."[35] The danger of studying paradigms is that they tend to become reified and treated as though they had a life of their own. They have a life only in the sense that their proponents use them to orient and direct their work.

Internal and external divergence and convergence of theories and paradigms are not the result of "natural law" or mystical force. Theoretical and paradigmatic change and organization are the result of the work of individual researchers and teachers working collectively or privately. Organizations are created between these loosely knit individuals and groups through both formal and informal communication. As a result, many of the same principles that we apply to the study of organizations and collectives are applicable here. In this case, the organizations and collectives are identified by the paradigms they employ. Dynamics such as power, resource allocation and dependency, socialization, environmental ambiguity, values, negotiated order, and dialectical relations are useful in understanding the political and social aspects of paradigms as organizational entities.

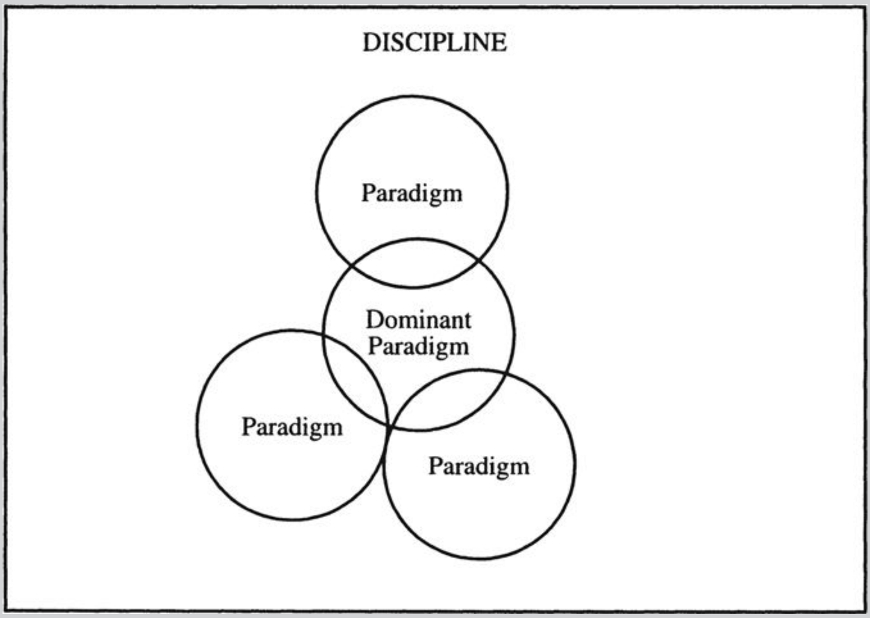

Figure 5. Discipline Internal Convergence.

The internal convergence of a paradigm is characterized by increased political and intellectual influence in the discipline in question (see Figure 5 above). Fully internally and externally convergent paradigms are what Kuhn refers to as mature paradigms.[36]

This convergence is based on the perceived degree of higher internal consistency and its increased ability to gain agreement to explain a given state of affairs or set of variables. The increase in influence of a paradigm means an increase in the power of the proponents of the paradigm to control vital resources, disciplinary norms, and definition of disciplinary and paradigmatic boundaries. When this level of influence is achieved and a paradigm has achieved its maximum degree of maturity, it is said to be the dominant paradigm in a discipline.

At this point in the development of a discipline, the emergence of a dominant paradigm tends to coincide with a general external convergence of other paradigms such as the information transfer paradigm in the discipline around that dominant paradigm. Such a state of general convergence can be methodological, ideological or both. While, in this case, the dominant paradigm tends to be more quantitatively oriented, emphasizing a systems perspective, subordinate paradigms tend to be more qualitatively oriented (though not exclusively) emphasizing the individual needs of the patrons. Most paradigms within the discipline do not give up their own identities. Subordinate paradigms continue to work out their theoretical inconsistencies through increased research while acknowledging the superordinate position of the dominant paradigm in the discipline. These processes relative to subordinate paradigms are characteristic of a state of internal divergence, until they are able to achieve internal convergence.

Disciplinary Dynamics Components

The tendency of external convergence can be best explained by viewing the discipline in social organizational terms. The discipline can be viewed as analogous to an organizational field and the various paradigms in the discipline would be viewed as one might view the organizations in an organizational field.

Organizational behavior under situations of stress that tend to be present when environmental ambiguity is present cause some notable patterns of organizational field structuration. In other words, divergent paradigms in a discipline behave in a fashion similar to organizations in an organizational field in which there is little leadership to assure needed resources. As convergence takes place over time, a dominant paradigm will frequently emerge that promotes disciplinary stability by bringing other paradigms in the discipline into conformity with the dominant paradigm.

Conformity is facilitated by resource dependency of subordinate paradigms to the dominant paradigm (in some cases multiple dominant paradigms). Resource dependency stems from dominant paradigms having proponents serving as editors and referees of important disciplinary journals, having proponents in control of key departmental positions at universities, and having proponents in positions in foundations that supply grant monies for research. All of these are resources that lend legitimacy and power to the dominant paradigm.

When applied to a discipline, the result is that proponents of alternative paradigms in the discipline are forced into conformity with the dominant paradigm. This is based on a perceived asymmetry of power favoring the proponents of the dominant paradigm. This power differentiation can be the result of inequities in the distribution and control of resources as well as other perceived power structures favoring proponents of the dominant paradigm. Hence, if one wants to get articles published in mainstream journals, or gain faculty and research positions at top universities and foundations, or get the grants that are the lifeblood of research, he or she must conform by acknowledging the gatekeeper role of proponents of the dominant paradigm.

Conformity is usually voluntary and frequently unconscious since most of those in the discipline have been socialized in light of the ideologies of the dominant paradigm. To resist conforming yields environmental ambiguity and uncertainty within the discipline. Conformity occurs when other paradigms echo the dominant paradigm by adopting similar methodologies and ideologies in order to receive favorable treatment in resource allocations or institutional appointments and so forth.

The final component of conformity to be discussed here is socialization of discipline members. Socialization occurs when the values, norms, and standards of the other paradigms are brought into conformity with the perceived definitions of values, norms, and standards of the dominant paradigm. This is evidenced in the control of the processes of socialization through education of a majority of the members of a discipline. These are the dynamics and processes in which member paradigms in a discipline conform to the dominant paradigm's definitions of the appropriate values, ideologies, and individual boundaries.

Conformity is viewed as the external convergence of the various paradigms in a discipline. However, the dominance of any individual paradigm is not necessarily assured for an indefinite length of time. This is because other variables besides internal convergence affect the dominance of any given paradigm. Those variables can include the perceived dominance of one discipline over another, the amount of ambiguity and environmental turbulence between disciplines, and the values acknowledged by disciplines. When definitions cease to be shared, external convergence is likely to dissolve into external divergence among member paradigms.

Divergence will tend to remain until another paradigm asserts its dominance. Theoretically, all paradigms in a discipline could be convergent to such a degree that zero growth is being experienced by the paradigm or the discipline as a whole. Zero growth, however, seems highly unlikely because of the number of variables involved. It is conceivable that when a dominant paradigm is experiencing zero growth, it is in such a strong position of dominance that the discipline as a whole may experience paradigmatic divergence yet not be able to gain dominance. If multiple, highly divergent paradigms continue to vie for disciplinary dominance, structural conditions develop that require one to give way to the other, or more likely, one will split from the existing discipline to establish a new discipline (for example, the separation of the natural sciences from philosophy).

SUMMARY

In our efforts to gain increasingly higher levels of objectivity, we must remain vigilant relative to our own inner subjective selves. We accomplish this by being as aware and reflexive as possible. We cannot deny our own belief and value systems, but we can control for them. We are aware of the role epistemology and ontology play in helping to locate ourselves ideologically with respect to the selection of research methodologies and specific methods as ways of controlling outside variables. This process is supplemented by sampling and other strategies for methodological selection discussed elsewhere in this book.

Finally, we began by locating the role of research in the process of theorizing. The role of theorizing also is dealt with in other sections of this text. However, research is a part of the context of paradigms and disciplines which tend to be self-structuring and self-reproducing. And as paradigms change so, too, do disciplines. These changes frequently come in the form of observable behaviors that can be studied using social science technologies. Theories, paradigms, and disciplines present observable behaviors because they are represented by individuals and groups which interact socially and, hence, have observable behaviors. These behaviors can be studied using social science methods and frequently understood using social science concepts and theories.

This approach to research is about change and innovation, which are the basis and reason for research in general. However, it is important to remember that change does not necessarily mean progress but only that some degree of difference is discernible. To make judgments beyond the fact that change has taken place is, as Gould reminds us, "egregiously biased."[37]

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10. Ibid., 388.

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14. David R. Maines and Shing-Ling Chen, "Information and Action: An Introduction to Carl Couch's Analysis of Information Technologies," in *Information Technologies and Social Orders*, ed. Carl J. Couch (New York: Aldine de Gruyter, 1996).

15. Jack D. Glazier and Robert Grover, "A Multidisciplinary Framework for Theory Building," *Library Trends* 50 (Winter 2002): 317–29.

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18. Maines and Chen, "Information and Action."

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21. Donald Polkinghorne, *Methodology for the Human Sciences: Systems of Inquiry* (Albany: State University of New York Press, 1983), 5.

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23. Thomas S. Kuhn, *The Essential Tension: Selected Studies in Scientific Tradition and Change* (Chicago: University of Chicago Press, 1977), 226.

24. Mullins, *Theories and Theory Groups.*

25. Kuhn, *The Structure of Scientific Revolutions*, 178.

26. Ibid., 179.
27. Ibid., 180–81.
28. Stephen J. Gould, *Full House: The Spread of Excellence from Plato to Darwin* (New York: Harmony Books, 1996).
29. Kuhn, *The Structure of Scientific Revolutions*, 180–81.
Kuhn, *The Essential Tension*, 226.
Mullins, *Theories and Theory Groups.*
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Glazier and Grover, "A Multidisciplinary Framework for Theory Building," 317–29.
30. Ibid.
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33. Mullins, *Theories and Theory Groups.*
34. Glazier and Grover, "A Multidisciplinary Framework for Theory Building," 317–29.
35. Grover and Glazier, "A Proposed Taxonomy of Theory," 234.
36. Kuhn, *The Structure of Scientific Revolutions.*
37. Gould, *Full House*, 14.

Other "techniques" which can be used to identify research topics or problems include disagreeing with some previous research and developing a study to test its findings, becoming involved in the design and development of research tools and techniques relevant to some area of interest, and attempting to deal with actual problems in real work situations (this last approach is more likely to lead to applied research, however). Networking, or sharing ideas and information, with colleagues can be a very productive activity as well.

But perhaps the two best methods for identifying research topics or problems simply involve being curious about items of interest and being a clear and critical reader and thinker. For again, research problems abound and one simply needs to recognize them. And only by being a curious, critical observer is one likely to do so with any regularity.

Characteristics of a Problem Suitable for Basic Research

In order to be suitable for basic research, a problem should exhibit several characteristics. First, the problem should represent conceptual thinking, inquiry, and insight—not merely activity. For example, simply collecting data and making comparisons are not activities representative of true research problems. Activities such as studying a subject field and reading earlier research are more likely to be indicative of a conceptually developed research problem.

Second, the variables related to the problem should represent some sort of meaningful relationship. The study of miscellaneous, unrelated facts is not likely to be true research, though it may lead to true research. For example, a tabulation of library circulation statistics is nothing more than a series of calculations, which at best may provide the basis for a thorough categorization of such statistics. On the other hand, if the circulation librarian wonders about the nature of the relationship between certain circulation statistics and certain user characteristics, he or she may in effect be conducting exploratory research and be well on the way to identifying a problem for more formal research.

Inherent in a problem representing some kind of relationship between two or more variables is consideration of the cause of the relationship. If evidence suggests, for example, a relationship between the level of college library use and the class level of student users, why does such a relationship exist? Why does a higher class level seem to "cause" greater use of the library? Again, what is the nature of the relationship, and does the research problem incorporate this concern? Or, if there is not a causal relationship between the variables, how are they related, if at all? To answer this, the problem must reflect some interpretation of the relationship. For example, perhaps the variables are not related directly but indirectly, through the influence of yet another variable or variables. Only a problem represented by a conceptual, insightful development and statement will be able to lead to this kind of understanding.

There are also several more practical considerations that the researcher should make before settling on a specific problem. Among these is the researcher's interest in the problem. Does it represent a topic that he or she is likely to enjoy researching after several months, if not years, of study? This is a question that is particularly important for doctoral students to ask of themselves.

Does the problem represent an area of research that is reasonably new? Does anyone have a prior claim to the area? Again, this is of particular concern to doctoral students. However, a problem does not have to be entirely new and unresearched in order to be worthy of investigation. Some of the most important research builds on and improves or refines previous research. The degree of uniqueness desired will depend, in part, on the purpose of the research.

More important is the question of whether the research will contribute to the knowledge of the field and ultimately have some impact, or does the problem represent a trivial question of no real importance? Again, whether the research should make a significant contribution to the field is determined in part by the purpose of the research. For example, if it is intended solely to meet the requirements for a doctoral dissertation, perhaps some justification can be made for emphasizing the design and conduct of the research over its likely contribution to knowledge of the field.

Last, but not least, the problem should point to research that is manageable. In short, is the problem researchable? Due to real constraints, such as time and money, perfectly designed research is not always possible. The researcher typically is in the position of having to compromise what is ideal and what is practicable. This is particularly true of research which is relatively applied in nature. As Martyn and Lancaster stated, "In any investigation within a library or information center, some compromises may be necessary between what is most desirable from the investigator's viewpoint and what appears feasible to the manager of the service."[17]

Statement of the Problem

Having identified a suitable problem for research, the next logical step is to write a statement of it for future reference. Perhaps it goes without saying, but the problem should be written in complete, grammatical sentences, not in mere phrases. For example, the problem statement, "library instruction and library use," would be better expressed as "The problem to be resolved is whether providing college students with library instruction will have some effect on their use of the library." The problem should be written as clearly as possible, and it should be stated in straightforward, unambiguous terms; vague terms and clichés are to be avoided.

In addition, the problem should be stated as precisely as possible. There should be no discrepancy between what the researcher writes and what he or she actually means. The problem statement should be both specific and explicit. Since this statement should guide all of the research that follows, it is essential that it be well developed and clearly expressed. In order to achieve an appropriately stated problem, it is a good idea to edit the problem statement as initially written, at least once, in order to eliminate needless or ambiguous words and to increase its precision and clarity.

As suggested by the characteristics of a researchable problem, it is also important that it be stated responsibly. It should not be so broad in scope that it will be unmanageable. For example, the problem statement just given was, "whether providing college students with library instruction will have some effect on their use of the library." While this was seen as an improvement on the preceding phrase, in light of our criteria for a suitable statement, it still needs work. Though it seems reasonably clear, it should be more precise or specific and thereby more manageable. An improved problem statement might be: The problem to be resolved by this study is whether the frequency of library use of first-year college students given course-integrated library instruction is different from the frequency of library use of first-year college students not given course-integrated library instruction.

Some research methods textbooks indicate that the research problem may be written as a question and/or as a purpose statement.[18] The view of this textbook is that a research question is typically more precise and specific than a problem statement and that the purpose and problem for a research study are not interchangeable. As Hernon stated, "Many studies published in LIS do not contain a problem statement or confuse such a statement with a statement of purpose."[19] The issue of absent or incomplete problem statements was mentioned again by Hernon and Schwartz in 2007. Based on lectures by David Clark, they suggest writing three, short sentences: "(1) the lead-in, (2) a statement about originality, and (3) a justification."[20] The *problem* is what the research is about and the *purpose* is why the research is conducted. The problem is in effect "the first proposition."[21] For example, one might conduct research on the relationship between certain teaching methods and the effectiveness of bibliographic instruction (the problem) in order to increase the success of future bibliographic instruction programs (the purpose).

Identifying Subproblems

Virtually all problems contain components or subproblems, which should be appropriate for study, if not solution. Subproblems can facilitate resolving a large problem piecemeal, as they are often more manageable or researchable than the general problem and can be investigated separately. They should be amenable to some realistic research method and suggest adequate data with which to resolve the problem. The interpretation of the data within each subproblem must be apparent. It should not be necessary to go outside the parameters of the study as dictated by the focus of the subproblem in order to relate data to the subproblem.

In addition, the subproblems should, when combined, equal the whole of the main problem. On the other hand, the subproblems should not add up to more than the totality of the main problem. If they do, it is likely that the main problem actually represents more than one problem. While rules of thumb should be used with caution, most well-defined research problems can be broken down into between two to six subproblems. More than that may suggest that the main problem was too broadly or vaguely conceived.

Another possible explanation for an excess of subproblems may be that some of the subproblems are in fact what Leedy and Ormrod have labeled "pseudosubproblems."[22] While related to the study, pseudosubproblems are more procedural in nature and do not actually relate to the conceptual matters raised by the problem. They often arise from such questions as how to select the sample or how to observe certain phenomena. For example, the question of how to *measure* library use as included in the earlier example of a problem would be more of a pseudo- than a true subproblem. It is more methodological than conceptual, though the distinction is sometimes fine, as is the case here.

Actually, identifying subproblems is generally a relatively straightforward process involving two basic, related steps: (1) the researcher should break the main problem down into its components, and (2) he or she should identify the words that indicate a need for the collection and interpretation of data. In order to illustrate this process, let us return to the last formulation of the problem. It was as follows:

> The problem to be resolved by this study is whether the frequency of library use of first-year college students given course-integrated library instruction is different from the frequency of library use of first-year college students not given course-integrated library instruction.

In analyzing this problem statement, one can see that there are three components that will require investigation before the main problem can be resolved. These three subproblems can be written as follows:

1. What is the frequency of library use of the first-year college students who did receive course-integrated library instruction?
2. What is the frequency of library use of the first-year college students who did *not* receive course-integrated library instruction?
3. What is the difference in the frequency of library use between the two groups of students?

As is commonly done, these subproblems have been posed as questions. Again, they are questions that must be answered before the main, more complex problem can be resolved. In many studies, the researcher will attempt to do no more than answer one or two subproblems or research questions; additional studies may be necessary to deal with the entire problem.

Having identified and stated what hopefully is a satisfactory research problem, the investigator must next turn his or her attention to providing further guidance for the study. For example, the researcher should indicate precisely the limitations of the problem, which in turn help to limit the goals of the study. Limitations implicit in the problem statement given above include the fact that it is concerned with the frequency of library use, not quality. It is concerned with course-integrated library instruction as opposed to the many other types that could have been considered.

The researcher should also consider providing both conceptual and operational definitions for important terms related to the study, particularly if they are used in an unusual sense or can be interpreted in more than one way. This procedure will be covered in more detail later, but, generally speaking, this step is necessary in order to indicate how certain terms are to be used by the researcher in relation to his or her study.

Further delineation of the problem can be achieved by stating assumptions, or what the researcher takes for granted. Returning to our problem on library instruction, the researcher appears to be assuming, for example, that those persons teaching the library instruction can in fact teach. The quality of their teaching is not something that will be tested in the study.

Finally, when feasible, the researcher should develop one or more hypotheses to further limit the problem and project. Development of the hypothesis, as well as identification of the basic assumptions, will be treated in greater depth later in the text.

THE ROLE OF THEORY IN THE DESIGN OF RESEARCH

Before taking up assumptions and hypotheses, we should consider the role of theory in the design of a research study. But before discussing theory, the term, metatheory, should be considered briefly although it does not appear much in LIS literature. "Metatheory can be seen as the philosophy behind the theory, the fundamental set of ideas about how phenomena of interest in a particular field should be thought about and researched."[23] Paradigm, as presented by Kuhn in the field of science, is closely related to metatheory.[24] Theory or theory construction, however, is the first major component of the scientific method of inquiry. It tends to be the base from which the subsequent stages of the scientific method flow. But exactly how does theory fit into or affect this process? An understanding of how a field of knowledge develops should help to explain the role of theory in the design of research.

As Goldhor and others have explained, a field of knowledge usually develops in a logical sequence of three stages.[25] The first stage typically involves the accumulation of specific facts regarding a variety of isolated phenomena. These facts are derived from actual experience or the observation of certain activities. The specific facts are usually historical or descriptive in nature and are unlikely to be quantitative. Bates refers to this and subsequent stages as "description, prediction, explanation."[26]

The second main stage typically involves the definition, review, and classification of these existing facts or data into a meaningful set of categories, a procedure that will be covered in more detail later. In this stage Bates believes "it should be possible to predict relationships, processes, or sequences associated with the phenomenon."[27] It is also worth noting that it is essential that the observations which produce the data be categorized as accurately as possible. The categorization can be improved or made more precise by quantifying the data to the greatest extent possible. For example, data relating to library use are difficult to classify if subjective in nature, but once they have been quantified in terms of frequency of use, number of books checked out, number of reference questions asked, and so on, it is a relatively simple, straightforward process to classify them.

Related to the simplification of complex phenomena, classification of the data can help to point out gaps in the existing knowledge. In attempting to observe and categorize all of the various activities that constitute library use, it is conceivable that the researcher may identify certain activities that represent heretofore unrecognized types of library use, or at least variants of already identified library use activities. For example, in studying the use of an academic library, the researcher may discover that part-time students use the library somewhat differently than do full-time students. Such knowledge could have important ramifications for the library's services and policies.

The classification of existing data can also help to identify relationships between various categories within the classification scheme. The formulation and testing of these groupings of data, or variables, make up the third main stage in the development of a field of knowledge. At this stage one should be able to develop a theory,[28] which can be considered the formal research stage of a discipline. Years ago Goldhor stated that this is probably the stage at which library and information science exists.[29] Goldhor's statement is still supported by Kim and Jeong, who conducted "a content analysis of 1661 articles in four LIS journals from 1984–2003" to identify the number and quality of articles that have contributed to the development or use of theory.[30] Forty-one percent of the articles were identified as contributing to or using theory. (The majority of these articles addressed the topics of information seeking, use, and retrieval.)

But to return to the original question, how does theory fit into the scheme of things? In fact, theory plays a crucial role in the just-mentioned research stage, which in turn often utilizes the scientific method of inquiry. Theory helps to make research more productive in that it organizes a number of "unassorted facts, laws, concepts, constructs, and principles into a meaningful and manageable form."[31] Or, as Goldhor observed, theory can explain a group of phenomena, suggest relationships between facts, structure concepts, organize facts into a meaningful pattern, and provide logical explanations for facts.[32] If certain facts or variables appear to be causally related, theory can help to explain the nature of the relationship.

Theory also can act as a guide to discovering facts. It identifies gaps to be investigated, crucial aspects on which to focus, and major questions to be answered. In short, theory can stimulate research in areas that warrant study.[33] The research can, in turn, develop new theories or improve existing ones. Theory also can help to connect studies and facilitate the interpretation of the larger meaning of research findings.

In addition, theory helps to produce an economy of research effort. It can be used to identify the most important and/or manageable propositions for testing, define and limit the area of research, and relate the research to other relevant studies. Theory can provide an economical or simple summary of actual or anticipated research results.[34] In short, the main value of theory in research derives from its ability to "summarize existing knowledge, to provide an explanation for observed events and relationships, and to predict the occurrence of as yet unobserved events and relationships on the basis of the explanatory principles embodied in the theory."[35]

Definition of Theory

Having determined the role and value of theory in research, it should be relatively easy to define. Babbie defines theory as "a systematic explanation for the observations that relate to a particular aspect of life."[36] It also has been defined as something which interrelates a set or sets of variables on the basis of the rules of logic. In a workshop for health science librarians, Marshall described a theory as "A set of related propositions that suggest why events occur in the manner that they do. The propositions that make up theories are of the same form as hypotheses; they consist of concepts and the linkages or relationships between them."[37] McGrath defines theory as "an explanation for a quantifiable phenomenon."[38] It can also be thought of as a unified explanation for discrete observations. Goldhor defines theory as "a deductively connected set of laws, in the logical form of an explanation and with all statements as generalizations."[39]

Goldhor goes on to point out that those laws (hypotheses whose validity is relatively established) that do the explaining are axioms, and those laws that are explained by, deduced from, or based on the axioms are theorems.[40] He also notes that the theorems usually are known first, and axioms must be identified in order to explain the theorems. On the other hand, axioms can be used to predict new laws not yet identified. If any axioms are found to be false, then the theory itself must be considered false.

The Formation of Theories

Suitable theories do not always exist for the researcher in need of one. In many cases they must be developed or "built." Goldhor defines theory building as the accumulation of empirical findings and the development of a system of intermeshing hypotheses concerning their relationships.[41] He notes that this process requires the identification of the variables that are appropriate for a theoretical system and represent the relevant concepts. Theory construction also requires that the person developing the theory have a thorough understanding of the already accepted facts and theories of the field in question, as well as of related fields.

Grover and Glazier propose a model for theory building, which displays relationships among phenomena and various levels of theory and research. Their taxonomy ranges from phenomena, or individual objects and events, through hypotheses, to a "world view" or general orientation.[42]

Mouly states that a good theory should meet the following criteria:

1. A theory, or theoretical system, should permit deductions that can be tested empirically; in other words, it should provide the means for its own testing.

2. A theory should be compatible with both observation and previously verified theories. It must be well grounded and should be able to explain the phenomena under study.
3. A theory should be stated as simply as possible. It should explain adequately the existing knowledge but should not be any more complex than necessary. This characteristic represents the so-called law of parsimony.[43]

At this point, based on previous research and recent observations, one could construct a theory related to the earlier stated problem involving the effect of library instruction on library use. Such a theory, even in an abbreviated version, might include the following:

> It has been observed, and previous research has indicated, that certain facts are related to student use of college libraries. Among these facts are (a) some students use their college library more than others, (b) some students have better library skills than others, and (c) appropriate library instruction is capable of teaching students how to use the college library. Based on these and other facts, one could formulate a theorem stating that some students use their college library more than others do because they have the necessary library skills (or at least more than the nonusers). At least one axiom which could help to explain the theorem might claim that students who know how to use the college library are more inclined to do so than those with fewer or no library skills because they are more aware of the library's resources, have more confidence in their abilities, and so on.

At this point, the theory already identified several facts, laws, and variables (library instruction, library skills, library use, confidence, etc.). It also has identified possible relationships among some of the variables and has suggested how and why they are related. In short, it is helping to bring some order to what would otherwise be a less meaningful group of facts and concepts.

Published examples of theory building include works by Mellon and Poole. Based on data gathered from diaries and essays, Mellon constructed a grounded theory (a unique theory based on the event or situation studied) of library anxiety.[44] Poole, after analyzing 97 studies published in the *Annual Review of Information Science and Technology*, constructed three theoretical statements on the behavior of scientists and engineers in formal information systems.[45] McKechnie and Pettigrew did a content analysis of 1,160 LIS articles published between 1993 and 1998 and found that 34.2 percent of the articles incorporated theory in the title, abstract, or text.[46]

Testing the Theory

Having developed, or at least identified, a suitable theory, the next requisite step is to test it. Much of the rest of this text will directly or indirectly concern itself with testing procedures, but a brief indication of some of the implications of theory testing is in order here. For example, it should be kept in mind that, in order to test a theory, one must determine how well each of its theorems and related propositions agrees with the observed facts in one or more test situations.[47]

Second, it should be noted that a well-constructed, informative theory would provide specific hypotheses or statements of certain relationships by which the theory can be tested. In fact, a theory can be thought of as a large hypothesis comprising a number of more specific, more testable subhypotheses, though a theory typically rests on a more sophisticated basis than does an individual hypothesis. Consequently, the entire theory can be tested by testing each of the hypotheses individually.

FORMULATING HYPOTHESES

Definitions of Hypotheses

The second major step in the standard scientific method of inquiry is the formulation of one or more theoretical hypotheses. A variety of definitions of hypotheses found in the literature reflect slightly different perspectives or emphases. Babbie defines the hypothesis as "a specified testable expectation about empirical reality that follows from a more general proposition."[48] Leedy and Ormrod view hypotheses as "tentative propositions set forth to assist in guiding the investigation of a problem or to provide possible explanations for the observations made."[49] Mouly considers a hypothesis to be "a tentative generalization concerning the relationship between two or more variables of critical interest in the solution of a problem under investigation."[50] Finally, Selltiz, quoting Webster, defines a hypothesis as "a proposition, condition, or principle, which is assumed, perhaps without belief, in order to draw out its logical consequences and by this method to test its accord with facts which are known or may be determined."[51]

To complicate the picture a bit more, there are several types of hypotheses, including the following:

1. Working or research hypothesis—the hypothesis with which a research study begins. It should help to delimit and guide the study.
2. Final hypothesis—the hypothesis that reflects the findings of the research study. It often is synonymous with the study's final conclusion.
3. Particular hypothesis—a hypothesis which merely explains a specific fact or situation; for example, "not all college students are skilled library users."
4. Causal hypothesis—a hypothesis which states that there is a causal relationship between two or more variables (i.e., that a particular factor or condition determines or affects another factor or condition).
5. Alternative hypothesis—a rival hypothesis which provides another possible and plausible solution to the problem (i.e., a different explanation of the same facts). This is sometimes used interchangeably with a "minor" or "secondary" hypothesis, though the latter, which has less well-accepted concepts, seems to suggest something quite different.
6. Null hypothesis—a hypothesis which asserts that there is no real relationship between or among the variables in question. It involves the supposition that chance, rather than an identifiable cause, has produced some observed result. It is used primarily for purposes of statistical testing.

7. Inductive hypothesis—a hypothesis which moves from the particular to the general, or a generalization based on observation.
8. Deductive hypothesis—a hypothesis which shifts from the general to the particular, or a hypothesis derived from a theory.
9. Nondirectional hypothesis—a hypothesis which merely indicates that a relationship or difference exists. It says nothing about the nature or direction of the relationship. For example, one might hypothesize that a student's grade point average and use of libraries are related without going so far as to argue that either factor causes the other.
10. Directional hypothesis—a hypothesis which indicates the nature of the relationship between or among variables. For example, it could logically be hypothesized that the assignment of term papers results in more library use by certain students.
11. Multivariate hypothesis—a hypothesis proposing a relationship among more than two phenomena or variables.
12. Bivariate hypothesis—a hypothesis proposing a relationship between two phenomena or variables.
13. Univariate hypothesis—a hypothesis concerned with only one phenomenon or variable. In that no relationship is involved, one could argue that this kind of statement does not meet the minimal criteria for a hypothesis. It might better be termed a research question.

Not all of these hypotheses are mutually exclusive. For example, one might begin a study with a research hypothesis that proposes a causal relationship between two variables and indicates which variable affects the other.

To complicate the picture yet again, Hillway states that "the terms hypothesis, theory, law, generalization, and conclusion all mean much the same thing in relation to a study."[52] He argues that what differences do exist are slight and relative. Other writers would disagree, however. It also may be worth noting here that the term "model" is often used interchangeably with hypothesis, as well as with theory, but in fact it has a slightly different meaning. Mouly defines a model as "a descriptive analogy designed to help visualize a complex phenomenon."[53]

Sources of Hypotheses

As was suggested earlier, one of the most convenient and logical sources of hypotheses is a theory, since it can be considered to be a broad hypothesis or a set of subhypotheses. However, theories seldom, if ever, simply appear when needed. They are a result of one's being thoroughly knowledgeable about a field, staying abreast of the literature, and so on. Indeed, the findings of other studies reported in the literature are excellent sources of hypotheses. Existing and assumed relationships reported in research results often provide the basis for formulating hypotheses. Similarly, certain relationships often can be observed in a work setting; such observations or hunches frequently lead to more formal hypotheses.

Pilot or exploratory studies also are good sources of hypotheses. In fact, Mouly states that some amount of data gathering, such as the recall of past experience, the review of related literature, or a pilot study, must precede the formulation and refinement of the hypothesis.[54]

Mouly also argues that "reasoning by analogy" is an excellent source of hypotheses.[55] In other words, if two situations agree with one another in one or more respects relevant to the problem in question, they will probably agree in yet other respects. Such an assumption may then be restated as one or more hypotheses.

Developing the Hypothesis

Again, the formulation of a hypothesis ideally begins with consideration of a theory, and more specifically, one or more components of a theory. But at the very least, this process starts with a set of specific facts or observations, which the researcher is attempting to explain. Generally, this explanation, or hypothesis, will be written as a statement of a possible relationship between two or more variables.

The basis for the hypothesis almost always rests on one or more assumptions. The most closely related assumption and the hypothesis are considered to constitute the premises from which the facts to be explained must logically be implied. In some research only the most basic assumption is referred to as the premise. Basic assumptions are assumed, for the purposes of a particular research study, to be true and therefore are not tested during the research.

Basic assumptions should not be confused with methodological assumptions. The former help to support or explain the hypothesis. For example, a hypothesis which predicts that older people are less likely to use information technology than are younger people might be partially explained by the assumption that older people have more anxiety regarding the use of technology. In conducting a study on the use of information technology by different age groups, one might make the methodological assumption that adequate numbers of people of different ages will be willing to participate in the study.

Goldhor points out that, having identified the hypothesis and basic assumptions, it should then be possible to develop additional explanations of relationships between or among the variables in specific situations.[56] These additional explanations constitute, in effect, alternative hypotheses.

The most viable hypothesis must then be identified by evaluating the various alternative hypotheses and eliminating the less effective ones. As was noted earlier, one guiding principle is the law of parsimony, which dictates selecting the simplest explanation or hypothesis and the one requiring the fewest assumptions. The hypothesis selected should nevertheless explain the most facts. Other characteristics of good hypotheses will be identified later, but next let us consider the major components of the hypothesis—the variables.

Variables

A *variable* may be thought of as "any property of a person, thing, event, setting, and so on that is not fixed."[57] Variables, or factors, can be perceived or labeled in a variety of ways depending on the nature of the relationship between or among them. For example, in a causal relationship the factor (or factors) typically identified first in the hypothesis is referred to as the *independent variable*. Other labels used for the independent variable include the predictor variable and the experimental variable. This is the variable that determines, influences, or produces the change in the other main factor.

The second main factor (or factors) in the causal hypothesis is usually referred to as the *dependent variable* or the subject variable. This variable is dependent on or influenced by the independent variable(s). The statement of the hypothesis should at least imply the nature of the relationship between the independent and dependent variables. For example, "the *more* library instruction a college student receives, the *more* he or she will use the college library."

However, hypotheses often take the form of conjectural statements. For example, "librarians are as assertive as other professional groups" or "the information needs of researchers are different from those of practitioners."[58] Thus, the independent and dependent variables are not always as easily identified as perhaps they should be. Given below are the titles of ten studies. Identify the independent and dependent variables within each title. For example, "assertiveness training" would appear to be the independent variable and "job satisfaction" the dependent variable in the title, "A note on the contribution of assertiveness training to job satisfaction of professional librarians."

1. A study of the relationship of role conflict, the need for role clarity, and job satisfaction for professional librarians.
2. Library design influences on user behavior and satisfaction.
3. An investigation of the relationships between quantifiable reference service variables and reference performance in public libraries.
4. The impact of differing orientations of librarians on the process of children's book selection: a case study of library tensions.
5. Book selection and book collection usage in academic libraries.
6. The effect of prime display location on public library circulation of selected adult titles.
7. Implications of title diversity and collection overlap for interlibrary loan among secondary schools.
8. The attitudes of adults toward the public library and their relationships to library use.
9. Early libraries in Louisiana: a study of the Creole influence.
10. The Great Depression: its impact on 46 large American public libraries; an inquiry based on a content analysis of published writings of their directors.*

***Title number 1:** independent variable—role conflict, dependent variables—need for role clarity and job satisfaction; *title number 2:* independent variable—library design, dependent variables—user behavior and satisfaction; *title number 3:* independent variable—quantifiable reference service variables, dependent variable—reference performance; *title number 4:* independent variable—differing orientations of librarians, dependent variable—process of children's book selection; *title number 5:* independent variable—book selection, dependent variable—book collection usage; *title number 6:* independent variable—prime display location, dependent variable—circulation of selected adult titles, *title number 7:* independent variables—title diversity and collection overlap, dependent variable—interlibrary loan among secondary schools; *title number 8:* independent variable—attitudes of adults toward the public library, dependent variable—library use; *title number 9:* independent variable—Creole influence, dependent variable—early libraries in Louisiana; *title number 10:* independent variable—Great Depression, dependent variable—large American public libraries.

As can be seen from these examples, relationships between variables often are indicated by the use of such terms as "influence," "impact," and "effect." But such clues are not always present, and they do not always convey the specific nature of the relationship nor distinguish between independent and dependent variables. In fact, a hypothesized relationship may not even include independent and dependent variables as such. The researcher may not be knowledgeable enough to predict that one variable causes another. For example, does an increase in grade point average cause an increase in library use or vice versa? In a given study, a variable might logically be viewed as either an independent or a dependent variable, or neither. Other types of variables include the following:

1. Intervening variable—any variable which occurs in the causal chain between some independent variable and its dependent variable. It also serves as an independent variable for the dependent variable. For example, we might hypothesize that library instruction (the independent variable) causes more library use (the dependent variable) when in actuality, library instruction produces greater confidence (the intervening variable), which in turn, causes more library use.
2. Antecedent variable—a variable which occurs prior to some already identified or hypothesized independent variable. In the previous example, had confidence been initially identified as the independent variable, then library instruction could have been thought of as the antecedent variable.
3. Extraneous variable—a variable at first perceived as the real cause of some effect when, in fact, it was only a coincidental correlate of that effect. It can also be defined as a variable that influences both the independent and the dependent variables so as to create a spurious association between them that disappears when the extraneous variable is controlled. (Extraneous variables are discussed in more detail in the section on experimental research methods.)
4. Component variables—two or more variables which represent the same variable. For example, reference questions and book loans are components of a variable called library use.
5. Conditioning or moderating variable—a variable which represents the conditions under which a hypothesized relationship between other variables holds true. For example, more library instruction might cause

more library use *only if* the instruction is relevant to the interests or needs of the learner.

6. Confounding or interfering variable—another influence that may affect the dependent variable but one in which the researcher is not interested.

Concepts

A researcher, in order to organize his or her data so as to perceive relationships among variables, must first make use of concepts. A *concept* may be defined as an abstraction from observed events or a shorthand representation of a variety of facts. Its purpose is to simplify thinking by subsuming a number of events under one general heading.[59] Library use is a concept representing or abstracting the many characteristics and types of library use. As indicated in the earlier example, there are a variety of specific kinds of library use such as reading, browsing, and borrowing books.

Not only can concepts be broken down into more concrete elements, they can be elevated to more abstract levels. These higher level concepts, often referred to as *constructs*, generally represent such phenomena as attitudes, perceptions, roles, and so on. For a specific phenomenon, the conceptual hierarchy would thus range from the construct, at the most abstract level, to the concept, and finally to the variable at the most concrete level.

It should be noted at this point that the greater the distance between the concepts or constructs and the facts to which they are supposed to refer, the greater the possibility of their being misunderstood or carelessly used. In addition, constructs, due to their greater abstractness, are more difficult to relate to the phenomena they are intended to represent. Therefore, it is important to define carefully the concepts and constructs, both in abstract terms and in terms of the operations by which they will be represented in the study. The former may be considered formal or *conceptual definitions*; the latter are referred to as working or *operational definitions*.

In providing a conceptual definition of a phenomenon such as "library use," the researcher would no doubt rely heavily on the already established definition as reflected in other studies. If a conceptual definition did not already exist, the researcher would need to develop his or her own, keeping it consistent, where possible, with current thought and attempting to link it to the existing body of knowledge using similar concepts or constructs.

In order to carry out the planned research, the investigator must translate the formal definitions of the concepts into observable or measurable events (i.e., variables) via working definitions. Most concepts cannot be directly observed, so they must be broken down into more concrete phenomena which can be measured.

Some argue that working definitions should state the means by which the concept will be measured and provide the appropriate categories. While this may not be a necessary part of the actual definition, at some point this step will be necessary, and the working definition should at least imply how the concept will be measured.

Returning to the example of library use, one could formally define library use, as did Zweizig, as "the output of libraries, the point at which the potential for service becomes kinetic."[60] While this may be a suitable conceptual definition, it does little to suggest how one would actually measure library use. Consequently, the researcher would need to develop one or more working definitions in order to operationalize "library use."

In fact, more than one working definition for a concept is generally considered to be desirable, if not necessary. A given concept may be too complex to be reduced to a single measurable phenomenon. In addition, having more than one working definition for a concept helps to increase the reliability of the findings, as the different measurements tend to serve as cross-checks for one another. For example, if a person were found to own a library card, which could be one definition of library use, but were found never to use the library, then one would question the validity of using card ownership to represent library use. The researcher would be better advised to utilize a variety of working definitions, including borrowing books, asking reference questions, requesting interlibrary loans, and so on.

Again, at some point, the researcher would need to specify exactly how the activities specified by the working definitions would be measured. For example, will only substantive, as opposed to directional, reference questions be counted? What categories, such as research, bibliographic, and so on, will be used to organize the questions? It should be kept in mind that working definitions are usually considered adequate only to the extent that the instruments or procedures based on them gather data that constitute satisfactory indicators of the concepts they are intended to represent. So, if the asking of reference questions does not represent the kind of library use that the researcher had in mind, then obviously it should not be used.

One other note of caution—in developing both conceptual and working definitions, one should avoid so-called *spurious definitions*. These are circular definitions, which tend to define terms using those same terms. If one defined "library use" as "using the library," then one would be providing a circular definition of no real value to the researcher or reader.

Desirable Characteristics of Hypotheses

In addition to representing the simplest possible explanation of a specific phenomenon or relationship, an ideal hypothesis should possess several other characteristics, including the following:

1. Generalizability, or universality—a hypothesis with this trait should hold up in more than one situation. On the other hand, valid hypotheses can be formulated legitimately for specific situations.
2. Compatibility with existing knowledge—a hypothesis is more likely to be generalizable if it has been based on the findings of other studies. The hypothesis should not be isolated from the larger body of knowledge.
3. Testability—the suitability of the hypothesis for empirical testing may be its most important characteristic. Regardless of its other traits, if it cannot be tested adequately, it is of little or no value. It even can be argued that the hypothesis should imply how it can be tested.

4. Invariability—simply put, the relationship stated in the hypothesis should not vary over a reasonable period of time.
5. Causality—the ideal hypothesis states a relationship that is causal in nature (i.e., that the independent variable(s) actually causes or determines one or more dependent variables). Many researchers also argue that the hypothesis should be predictive. Hillway states that "the success of a theory [of which the hypothesis is a part] for predictive purposes constitutes one of the most useful criteria by which it may be judged."[61]

Unfortunately, it often is not possible in the social sciences to formulate hypotheses that are causal or predictive in nature. Social science researchers frequently have to settle for associative type hypotheses, or hypotheses which state a correlational but not causal relationship between two or more variables. For example, one may argue that, as a student's library use increases, his or her grades improve, without being prepared to contend that greater library use actually causes the improvement in grades. It could be that some other factor, such as an interest in reading, is causing both the library use and the high grades. The concept of causality will be discussed in greater detail in the section on experimental research.

Goldhor, among others, argues that a good hypothesis should contain a "causal element" that explains why it is thought that the hypothesized relationship holds true. An example of a causal element is provided by Goldhor in the following hypothesis (the causal element follows the word "because"):

> The more a person is interested in a hobby, the more he will read books about that hobby, because the intensive development of a hobby calls for knowledge and skills usually available only in print.[62]

It may well be that the causal element is synonymous with the most basic assumption, or premise of the hypothesis. Regardless of the terminology used, however, the process of identifying why the relationship exists is an important one, producing several benefits. For example, the researcher cannot hope to explain why a certain relationship exists without acquiring a thorough understanding of the phenomenon under study. Explaining why a relationship holds true forces the investigator to go beyond mere description of it. Consideration of causality also forces the researcher to distinguish between the independent and dependent variables. Otherwise, one cannot state which factor causes which. Finally, after specifying why a relationship exists, the researcher is more likely to be able to predict what the hypothesized relationship will produce.

Testing the Hypothesis

In testing the validity of a hypothesis, the researcher typically employs the deductive method in that he or she begins with a theoretical framework, formulates a hypothesis, and logically deduces what the results of the test should be if the hypothesis is correct. This is usually accomplished in two stages.

First, the researcher deductively develops certain logical implications (also known as logical consequences and criteria) which, when stated in operational terms, can help to reject or support the hypothesis. These logical implications should indicate evidence which must be collected and which must be valid for an adequate test. Considering our hypothesis regarding library instruction and library use, several criteria could logically represent library use or provide evidence of use. Operationally defined, such criteria could include the number of visits to the library, the number of books borrowed, and so on.

The second basic step in testing a hypothesis involves actually subjecting it to a trial by collecting and analyzing relevant data. For example, one would, at this point, collect data on the subjects' actual library use, as evidenced by criteria already established. This stage requires the use of one or more criterion measures in order to evaluate the evidence that has been collected. "The choice of the criterion measure is crucial: not only must it be reliable and valid, it must also be sufficiently sensitive to detect changes as they occur."[63] If one were using the number of visits to the library as evidence of library use, it would be important to detect all library visits, not just some of them. It might also be necessary to determine types of library visits—their purpose and duration, for example.

As was indicated earlier, in order to measure library use adequately, it probably would be necessary to measure it in more than one way (i. e., employ more than one operational definition). If more than one operational definition is considered, then it follows that more than one logical consequence can be expected and that more than one criterion measure must be employed. In fact, establishment of "the truth of an hypothesis in the absolute sense is not accomplished until all possible logical consequences have been tested and the hypothesis becomes a law."[64] Until a hypothesis is tested in every appropriate situation, the researcher is at best building support for the hypothesis, not proving it. In effect, each logical consequence can provide several different bases for testing the same hypothesis or relationship.

Causality also plays an important role in the testing of hypotheses. As Goldhor has noted, "The testing or verification of an hypothesis is strengthened or augmented by analysis of available relevant data so as to show (1) that they agree with predictions drawn logically from the one hypothesis, (2) that they do not also confirm the consequences of alternative hypotheses, and (3) that they involve points in a logical chain of cause and effect."[65] Consideration of the causal relationship (when it exists) forces the investigator to employ or measure consequences that will provide evidence of the nature of the hypothetical relationship. This usually can be accomplished by utilizing data collection procedures and criterion measures that have the ability to support or reject the hypothetical cause of the relationship. For example, if college students who had high grades and who were heavy users of the library were found to be using the library strictly for recreational reading, we probably would have to reject the hypothesis and consider some phenomenon other than library use to be the cause of high grades. Such a finding might well suggest other possible relationships, however.

At this point, two reminders appear to be in order. One, it should not be forgotten that the hypothesis should be related to existing knowledge as closely as possible. This caveat also applies to the findings resulting from the testing of the hypothesis. This process is crucial if research is to build on previous studies and not merely produce fragmentary, unrelated bits of data.

Two, it is important to remember that scientific research should produce a circular movement from facts to hypotheses, to laws, to theories, and back to facts as the basis for the testing and refinement of more adequate hypotheses.

In other words, the research process should never end; it should merely continue to build on previous research, and to shape and reshape its findings.

An appropriate question to ask at this point is whether a hypothesis is always possible and/or helpful. In fact, it is not always possible, desirable, or justifiable to develop a formal hypothesis for a research study. This is particularly the case for exploratory research in areas too undeveloped to provide the basis for formally stated hypotheses and for most qualitative research. A formal research hypothesis can even be a hindrance to exploratory research, and the investigator may have more to gain by entering into an exploratory study with few preconceived ideas. It may not be possible, or at least not advisable, to predict relationships and outcomes of exploratory research because doing so may bias the researcher and encourage neglect of potentially important information.

Also, when fact-finding alone is the purpose of the study, which is often the case with descriptive surveys, there may be little use for a hypothesis. At the very least, however, the researcher should have some "research questions" which he or she is attempting to answer and which will help, in lieu of a hypothesis, to guide the research. Some researchers distinguish between "descriptive research questions," which ask what is the amount or extent of a given variable, and "explanatory research questions," which ask how or whether certain variables are related. The following are examples of the former: How many students use their college library during specific time periods? What are the subject majors of the users of a college library? The following are examples of the latter: Is there a relationship between the subject majors of students and how often they use their college library? Is there a relationship between the subject majors of students and the types of reference questions that they ask? It is probably safe to say, however, that most major studies, particularly those involving some interpretation of facts, should incorporate a research hypothesis. "Not the facts alone, but the conclusions that we can draw from them must be regarded as the chief objective of research."[66] Without the rigorous testing of a valid hypothesis, fully generalizable conclusions are not possible.

VALIDITY AND RELIABILITY

As one develops, and conducts, a research study, one should always be concerned with its validity and reliability. Generally speaking, research is considered to be valid when the conclusions are true, and reliable when the findings are repeatable. But validity and reliability are actually requirements for both the design and the measurement of research. Regarding the design, the researcher should ask whether the conclusions are true (valid) and repeatable (reliable).[67] Measurement, of course, is the process of ascertaining the dimensions, quantity, or capacity of something, and it is closely related to the notion of operational definitions discussed earlier. "More specifically, *measurement* is a procedure where a researcher assigns numerals—either numbers or other symbols—to empirical properties (variables) according to a prescribed set of rules."[68] Research design is the plan and structure of the research framework. It is influenced by the nature of the hypothesis, the variables, the constraints of the real world, and so on. Research design must occur at the beginning of a research project, but it involves all of the steps that follow.

Validity of Research Design

"Validity is a multi-faceted word or concept,"[69] and there are at least three types of validity as it relates to the design of research. One is referred to as *internal validity*. Briefly stated, a research design is internally valid if it accurately identifies causal relationships, if any, and rules out rival explanations of the relationships. Internal validity is particularly crucial to experimental research design.

Research design is considered to have *construct validity* if the variables being investigated can be identified and labeled properly. The design should permit the specification of the actual cause and effect and the identification of the concepts or constructs involved. (A somewhat different view of construct validity will be considered later in the discussion of validity as it relates to the measurement process.)

The third kind of validity critical to the design of research is external validity. Research has *external validity* or generalizability when its conclusions are true or hold up beyond the confines of a particular study. In other words, the findings should be generally true for studies conducted under a variety of circumstances or conditions (e.g., other times, people, places). The quality of external validity can best be determined by replicating a study or retesting to see if the results will be repeated in another setting. (This aspect of validity is similar to the concept of reliability.)

Validity in Measurement

In brief, the extent to which an instrument measures what it is designed to measure indicates the level of validity of that measure. Data collection instruments may be high in reliability and low in validity, or vice versa. For example, a test intended to measure the effect of library skills on library use might actually be measuring the influence of instructors on library use, and it would therefore be low in validity. On the other hand, repeated applications of the test, in comparable circumstances, may produce essentially the same results, indicating high reliability. Ideally, the instrument would be high in both validity and reliability.

As is the case for reliability, correlation coefficients can be calculated for the validity of an instrument. Reliability coefficients are correlations between identical or similar methods, while validity coefficients are correlations between dissimilar methods based on dissimilar operational definitions but measuring the same concepts. In other words, the validity coefficient indicates the extent to which independent instruments or observations measure the same thing.

One example of a method for calculating the validity of an instrument involves the multitrait-multimethod matrix, which is a table of correlations for two or more traits measured by two or more methods. The matrix should produce relatively high correlations between scores that reflect the same trait measured by different methods, while the correlations obtained from measuring two different traits with different instruments or measuring traits with the same instrument should be low. If two separate tests, measuring two different concepts, are highly correlated, then the two concepts are probably not truly separate and distinct.

For some standardized tests, such as IQ and personality tests, reliability and validity scores have been calculated based on past applications and validation studies and are available in the literature. For many tests or instruments, and obviously for newly developed ones, however, scores are not available. Reliability scores can be calculated by correlating the scores for repeated tests. The method used to evaluate the validity of an instrument is determined by the type of validity with which one is concerned.

The standard texts on research methods do not evidence unanimity on their categorization of validity. A careful reading of several works, however, suggests that the terminology and classification schemes vary more than the types of validity themselves. What follows is hopefully at least a consensual overview of the basic types of validity as they relate to measurement.

Logical Validity

Logical validity is a type of validity generally based on expert judgment. It includes content validity and face validity. *Content* validity represents the degree to which an instrument measures a specific content area. For example, a test designed to measure a student's mastery of library skills must measure what the student was supposed to learn.

In order to be adequate, content validity must contain both item validity and sampling validity. *Item* validity reflects whether the items of the instrument or test actually represent measurement in the intended content area. Does a question about the Library of Congress classification scheme in fact measure a student's understanding of how materials are arranged in a library's collection? *Sampling* validity is concerned with how well the instrument samples the total content area. A test on library skills should not be limited to measuring library users' ability to check out books. The test should cover catalog use, search strategy, and so on.

Face validity is similar to content validity, and the terms are sometimes used interchangeably. Face validity is a sort of catchall term often used rather loosely. It has been defined as "the degree to which a test appears to measure what it claims to measure."[70] Face validity is usually based on the opinion of subject experts who have been asked to evaluate an instrument. (This method of determining validity is quite subjective, but sometimes it is the only feasible one available.)

Empirical Validity

The second basic type of validity regarding measurement has been referred to as empirical and criterion-related validity. In contrast to logical validity, empirical validity is based on external, objective criteria. It includes concurrent validity and predictive validity.

Concurrent validity indicates the degree to which the scores on a test or other data collection instrument are related to the scores on another, already validated, test administered at the same time, or to some other valid criterion (e.g., grade point average) available at the same time. Concurrent validity also represents the ability of an instrument to discriminate among people (or whatever) who are known to differ. For instance, in developing an instrument to measure *how* people use a university library, one would expect it to distinguish between undergraduates and graduate students, as we already have evidence indicating that their library use differs. If members of these two groups "scored" the same on the test, then there would be a good chance that the test was actually measuring something other than types of library use—perhaps simply frequency.

Predictive validity has to do with the degree to which an instrument can identify differences that will evidence themselves in the future. If one were predicting that frequent library users were more likely to go on to graduate school than were infrequent or nonusers, then subsequent observations should support that prediction. A greater proportion of the people who scored relatively high on an initial library use questionnaire should be found enrolled in graduate school at a later date.

Construct Validity

It is possible for validity of measurement to be based on both logical judgment and external criteria. Such validity is usually known as construct validity. The definition for construct validity sounds like the definition for face validity in that construct validity represents the extent to which an instrument measures the concept or construct that it is intended to measure. As is the case with face validity, when selecting a test or instrument to employ in a research study, one must take care to choose one that accurately measures the construct of interest. This selection process should be based on the judgment of subject experts. Unlike face validity, however, construct validity requires more than expert opinion for determination. In order to ensure construct validity, it must be demonstrated that an instrument measures the construct in question and no other. In operational terms, construct validity requires that two or more measures of different constructs, using similar instruments, produce low correlations (i.e., *discriminant* validity) and that two or more measures of the same construct result in high correlations, even though different instruments are used (i.e., *convergent* validity). In other words, an instrument should be capable of measuring the construct (as represented by appropriate variables) it is supposed to measure, of distinguishing the construct from others, and of measuring other constructs simultaneously. (The multitrait-multimethod matrix discussed earlier represents one method for determining the convergent and discriminant validity of an instrument and thereby measuring its construct validity.)

Reliability of Research Design

If the design of a research study is reliable, then its findings should be repeatable or replicable and generalizable beyond the one study. Exact replications of the study, including specific procedures, can be made to assess the reliability of the design. (Conceptual replications of only the ideas or concepts can be used to evaluate the external validity of the design.)

Reliability in Measurement

As was stated earlier, research requires that one be able to measure concepts and constructs as represented by variables which often are translated into, or operationally defined as, a set of categories or a scale. Unfortunately, however, virtually all measurement is imperfect. Consequently, a measurement, or observed score, comprises the true score (which may never be known) and the error of measurement, or the discrepancy between the observed and the true scores. A measurement is generally considered to be reliable when the error component is reasonably small and does not fluctuate greatly from one observation to another. Thus reliability can be defined as the degree to which an instrument accurately *and* consistently measures whatever it measures. In short, a reliable data collection instrument is one that is relatively free from measurement error.

There are methods for assessing the reliability or *stability* of measurement techniques. One of the most commonly used methods results in what is known as a test-retest correlation. When the researcher employs this technique, he or she uses the same data collection instrument to observe or collect scores twice for the same group of subjects. (The instrument should be administered at different times but under equivalent conditions.) The two sets of scores are then correlated to see how consistent or reliable the instrument was in measuring the variables. The smaller the error of measurement, the more likely the correlation will be high.

If it is not feasible to repeat the measurement process, or if the *internal consistency* or homogeneity of the test is of concern, other methods can be used to determine the reliability of the instrument. For example, in utilizing the split-half method, the researcher splits the measuring instrument into two sets of questions or items after it is administered. The scores on the two halves are then correlated to provide an estimate of reliability. (The instrument should be split in equivalent halves, each of which is representative of the total. This can be done by assigning the odd-numbered items to one set and the even-numbered items to the other, or by using some random assignment technique. Keep in mind, however, that a data collection instrument may have been designed to measure one variable or several variables.)

Other methods for assessing the reliability of measurement include the average item-total correlation, in which each item's score is correlated with the total score, and the coefficients are averaged. With a technique called the average interitem correlation, each item is correlated with every other item, and the average of the coefficients represents a measure of internal consistency and indicates how well the items all measure the same construct. (If these conditions do exist, then the test-retest correlation of the total score will be higher than the test-retest correlation of the individual items.) When data are gathered by observers, it is important that their observations agree if they observed the same phenomena. *Interrater reliability* (also known as *intercoder reliability*) refers to the extent to which two or more observers agree.

Reliability also can be expressed in terms of the *standard error of measurement*, which is an estimate of how often one can expect errors of a given size. It is calculated with the following formula:

$$SE_m = SD\sqrt{1 - r}$$

where

SE_m = standard error of measurement

SD = standard deviation of scores

r = reliability coefficient.

A small standard error of measurement indicates high reliability and vice versa.

In considering the reliability of the data collection tool, one must, as has been stated, be concerned with the amount of measurement error. It is also essential that the instrument measure only the constructs of interest, not a variety of others. Otherwise it is difficult, if not impossible, to know which construct, or variable, to credit for the magnitude of the score.

A reasonable question to ask at this point would be, what is a satisfactory reliability coefficient? Ideally, every score or observation should have a reasonably high correlation with the construct or variable measured, but the determination of what constitutes a "high" correlation must be somewhat subjective. This question is comparable to asking what constitutes a high correlation between two variables. Both answers depend on a variety of factors. Regarding measurement, it should be noted that the reliability is always contingent on the degree of uniformity of the given characteristics in the population. The more homogeneous the population with regard to the variable in question, the more reliable the instrument is likely to be. For example, if an instrument has been designed to measure library use, and library use varies little among the subjects being studied, the instrument should be able to measure use consistently.

The level of reliability needed by a researcher also will vary according to the desired degree of distinction among cases. High reliability is more important, or at least more difficult to achieve, when making fine discriminations among cases than when merely identifying extremes. If the latter is all that is desired, a relatively crude measurement device should suffice. If a librarian merely wished to know what proportion of the library's patrons were children, young adults, and adults, then users could be observed and assigned to one of the three broad categories. If it were important to know exact ages, then patrons would have to be asked for that information on a questionnaire or during an interview. The resultant set of categories or the measurement scale would contain the number of ages reported and would require a more reliable data collection instrument.

Scales

The level of discrimination is in large part a function of the measurement scale used by the research instrument. The *American Heritage Dictionary* defines scale as "a progressive classification, as of size, amount, importance, or rank; a relative level or degree."[71] There are generally considered to be four types of measurement scales:

1. Nominal scale—The nominal or categorical scale consists of two or more named categories into which objects, individuals, or responses are classified. For example, a survey of academic library users could employ a nominal scale for the purpose of categorizing users by subject major. The simplest nominal scale is the dichotomous scale, which has only two values, such as male-female, yes-no, and so on. The important characteristic of the nominal scale is that the categories are qualitative, not quantitative.
2. Ordinal scale—An ordinal scale defines the relative position of objects or individuals with respect to a characteristic, with no implication as to the distance between positions. This type of scale is also referred to as a "rank order." Attitude or Likert-type scales are examples of ordinal

scales. (It should be noted, however, that some researchers do consider Likert-type scales to be interval level scales.) For example, one could rank order patrons' level of satisfaction on a scale such as the following:

Very Dissatisfied	Dissatisfied	Neutral	Satisfied	Very Satisfied

But one could not assume that the distance from "Very Dissatisfied" to "Dissatisfied" is the same as the distance from "Neutral" to "Satisfied." In other words, the second range might represent a greater change than the first range.

3. Interval scale—The interval scale provides a ranking of positions, as does the ordinal scale, but the intervals of measurement are equal. In addition, the interval scale has a zero point below which scores are given a negative value if they occur. A temperature scale is an example of an interval scale. Interval level data are less common than ordinal in the social sciences.
4. Ratio scale—The ratio scale is comparable to the interval scale except that it has an absolute zero, below which values cannot occur. The ratio scale allows one to compare the magnitude of responses or measurements. Frequency of library use could be considered to be ratio level data; in analyzing such information, one would be able to correctly state, for example, that one person has used the library twice as often as another. Ratio level data are relatively rare in the social sciences because few scales actually have true zero points.

In considering the issue of measurement, it should be kept in mind that measurement presupposes theory. In order for any measurement to have meaning, one must have a solid understanding of the relationship between the variable and the underlying construct that it represents. Kidder refers to this relationship as "epistemic correlation."[72] To some extent, epistemic correlation can be established by developing an intuitive theory regarding the relationship and identifying a second variable that also stands for the construct. If a significant epistemic correlation exists, then there should be a correlation between each variable and the construct, and between the two variables.

SUMMARY

As was stated earlier, a research project that adheres to the basic scientific method of inquiry consists of certain stages; this chapter has considered four of these stages: identification or development of the theory; identification of the problem; formulation of the hypothesis; and measurement as related to validity, reliability, and level. A research project is not likely to succeed unless careful attention has been paid to these steps. Yet it is tempting for the researcher to slight, if not ignore, these steps in order to get involved in the design of the study and the collection and analysis of data. Unfortunately, such research is generally inefficient and less productive and meaningful than it could be. Would-be researchers should realize that the time that goes into the conceptual development and planning of a research study is time well spent, and it will result in fewer problems in the later stages of the research. As has been written elsewhere, "A question well-stated is a question half answered."[73]

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Chapter 3

Selecting the Research Method

Having identified the research problem, identified or built a theory, and formulated a hypothesis (where appropriate), the researcher is ready to select a methodology for his or her study. The researcher must first decide whether the proposed research will be primarily applied or basic, and quantitative or qualitative in nature. As was previously indicated, the emphases of this book are basic and quantitative approaches to research. The methods that fall into those categories will be given minimal attention in this section as they are treated more fully later in the text.

APPLIED RESEARCH

As was noted in Chapter 1, there is a distinction to be made between basic and applied research. Basic research tends to be theoretical in nature and concerns itself primarily with theory construction, hypothesis testing, and production of new, generalizable knowledge. Applied research tends to be more pragmatic and emphasizes providing information that is immediately usable in the resolution of actual problems, which may or may not have application beyond the immediate study.

On the other hand, both types of research ultimately should add to the existing body of knowledge within a field, and in doing so, they may utilize similar methods and techniques. Such utilization is nicely illustrated by the discussion of the evaluation of information storage and retrieval systems in *Guide to Information Science* by Davis and Rush.[1] Davis points out that "the interplay between academics [basic researchers] and practitioners [applied researchers] can be extremely valuable," and it should be encouraged.[2] There is no good reason to assume that basic and applied research are mutually exclusive. In fact, basic and applied research can be considered as two parts of a continuum. Furthermore,

> Although the criteria for merit vary somewhat along the continuum, there is more overlap than typically realized. For example, basic research is judged by its clarity of purpose and interpretation, by its ability to support

> or refute particular hypotheses, by the incisiveness of the new hypotheses it generates, by the generalizability of the results, and by its technical accuracy, but in addition by the degree to which the results can be utilized in developing a product, a process, or a policy, to mention just a few types of application.[3]

Applied research, on the other hand, can validate theories and lead to the revision of theories. It "takes the theory and concepts from basic research and, by formal methods of inquiry, investigates 'real world' phenomena."[4]

Action Research

A major type of applied research, and one sometimes treated interchangeably with applied research, is action research. According to Wilson, "action research in the original sense is participative organizational research, focused on problem definition and resolution, which involves (usually) an external researcher who works with organizational members to arrive at workable solutions to their problems, within the framework of some theoretical perspective."[5] Action research differs from applied research in that "it has direct application to the immediate workplace of the researcher, whereas applied research may have the broader purpose of improving the profession at large."[6] Isaac and Michael, for example, state that the purpose of action research is "to develop new skills or new approaches and to solve problems with direct application to the classroom or working world setting."[7] They characterize action research as practical, orderly, flexible and adaptive, and empirical to a degree, but weak in internal and external validity.

Isaac and Michael identify the following basic steps in action research:

1. Defining the problem or setting the goal
2. Reviewing the literature
3. Formulating testable hypotheses
4. Arranging the research setting
5. Establishing measurement techniques and evaluation criteria
6. Analyzing the data and evaluating the results.[8]

As can be seen, these steps do not differ significantly from those typically followed in a basic research study. It is likely, however, that they would be carried out somewhat less rigorously than for basic research, and hypotheses, if any, would be treated in a more flexible manner. Typically, the data are provided to library decision makers who in turn take some action; for example, they may improve a service, develop a new one, or discontinue a service.

Kristiansson makes a case for the use of scenario planning as "an accompanying tool in the context of action research."[9] The purpose for building scenarios is to address critical events and uncertain conditions, and to create action plans. The technique provides opportunities for generating new ideas, which can be used for library strategic planning.

As an action research technique, scenario planning involves workshops or dialogue sessions "where participants discuss library development with focus on strategies, practices and knowledge about the library's surroundings."[10] Scenario planning provides an opportunity for library staff to gather information in a structured environment to create plans of action.

Evidence-Based Research

Evidence-based research for decision making could be considered a type of applied or action research and has become very popular within the library and information science domain during the past five years. This interest may have been spurred by the twentieth-century movement in healthcare and policy that calls for healthcare professionals to make decisions for medical practice based on the current best evidence provided by medical research and data. In an economic environment of decreasing library budgets for staff, materials, and services and increasing library usage, there is a demand for library and information professionals to make decisions based on current, valid data.

The quarterly, open access journal, *Evidence Based Library and Information Practice*, was first published in 2006 "to provide a forum for librarians and other information professionals to discover research that may contribute to decision making in professional practice."[11] Evidence-based research "reflects both the efforts of practitioners, who 'consume' the results of research in making those decisions, and the efforts of applied researchers, who strive to 'produce' the research evidence intended for use by practitioners."[12] Evidence-based research has been addressed by professional organizations, practitioners, and researchers.

School Library Journal's *2008 Leadership Summit* was titled, "Where's the Evidence? Understanding the Impact of School Libraries."[13] OCLC Online Computer Library Center, Inc., created a data mining research area to utilize the data that are created by library services and systems to provide intelligence to librarians to make informed decisions.[14] OCLC Research scientists also have published numerous papers and presentations using library-generated data, including WorldCat data,[15] to make collection decisions for preservation, digitization, and deaccessioning; to compare collections; to identify the characteristics of collections; and to determine whether to provide resources in electronic or paper format. The prevalence of the literature addressing evidence-based research exemplifies the interest and importance this method has gained in the library and information professions in the past several years.

Evaluative Research

Evaluative or evaluation research, as a type of applied research, has as its primary goal, not the discovery of knowledge, but rather a testing of the application of knowledge within a specific program or project. Thus it is usually practical or utilitarian in nature, and it is generally less useful than basic research for developing theoretical generalizations. In most evaluative studies there is an implicit, if not explicit, hypothesis in which the dependent variable is a desired value, goal, or effect such as better library skills and higher circulation statistics; the independent variable is often a program or service.

Evaluative research studies typically have a rather large number of uncontrolled variables, as they are carried out in real settings. They are usually limited in terms of time and space, and if the evaluative researcher has a vested interest in the project being evaluated, he or she is highly susceptible to bias.

Two *general types* of evaluative research are summative evaluation and formative evaluation. *Summative*, or outcome, research is concerned with the effects of a program. It tends to be quantitative in nature and often is used as the basis for deciding whether a program will be continued. *Formative*, or process, evaluation, which is done during a program, not following its completion, examines how well the program is working. It is often more qualitative and frequently is used for revising and improving programs. In both types, feedback from program participants is usually considered important. Other broad categories that can encompass a variety of methods include: quantitative, qualitative, subjective, and objective evaluation; and macroevaluation and microevaluation.

More *specific types* of evaluative research include the use of standards and cost analysis. "When applied to libraries . . . *standards* refer to a set of guidelines or recommended practices, developed by a group of experts, that serve as a model for good library service."[16] Simple *cost analysis* is basically a descriptive breakdown of the costs incurred in operating an organization. Cost related techniques more concerned with the assessment of whether monies are being spent in an optimal fashion usually fall into one of two groups—cost-effectiveness studies and cost-benefit analysis. "The term 'cost-effectiveness' implies a relationship between the cost of providing some service and the level of effectiveness of that service . . . Cost-effective analyses can be thought of as studies of the costs associated with alternative strategies for achieving a particular level of effectiveness."[17] Some examples of cost-effectiveness measures include: the cost per relevant informational resource retrieved, cost per use of a resource, cost per user, cost per capita, and cost by satisfaction level.[18]

Cost-effectiveness analysis can be seen as "a truncated form of cost-benefit analysis that stops short of putting an economic value on . . . outcomes [benefits] of programs."[19] " 'Cost-benefit,' clearly, refers to a relationship between the cost of some activity and the benefits derived from it . . . In effect, a cost-benefit study is one that tries to justify the existence of the activity by demonstrating that the benefits outweigh the costs."[20] A typical cost-benefit analysis involves determining who benefits from and pays for a service, identifying the costs for each group of beneficiaries, identifying the benefits for each group, and comparing costs and benefits for each group to determine if groups have net benefits or net costs and whether the total benefits exceed the total costs.

Types of cost-benefit analysis described by Lancaster[21] are

1. Net value approach—the maximum amount the user of an information service is willing to pay minus the actual cost.
2. Value of reducing uncertainty in decision-making.
3. Cost of buying service elsewhere.
4. Librarian time replaces user time (i.e., the librarian saves the user time by performing his or her task).
5. Service improves organization's performance or saves it money.

Other kinds of cost analysis discussed by Weiss[22] and Matthews[23] include:

1. Cost-minimization analysis—seeks to determine the least expensive way to accomplish some outcome.
2. Cost-utility analysis—considers the value or worth of a specific outcome for an individual or society.
3. Willingness-to-pay approach—asks how much individuals are willing to pay to have something they currently do not have.
4. Willingness-to-accept approach—asks individuals how much they would be willing to accept to give up something they already have.
5. Cost of time.

Performance measurement is another specific type of evaluative research. Performance or *output* measures are made in order to determine what was accomplished as a result of specific programs, services, and resources being available. Performance measures focus on indicators of library output and effectiveness, rather than merely on input such as monetary support, number of books, and number of staff. They are clearly related to the impact of the library on the community, are often concerned with user satisfaction, and can be used with longitudinal as well as current data. Other examples of performance measures have included service area penetration, level of use of facilities and equipment, circulation statistics, availability of materials and staff, and reference service use. Lately, the LIS profession has been concerned with using performance measures to evaluate electronic resources and services, including networked services (see Bertot, McClure, and Ryan, for example).[24]

A variety of techniques can be used for measuring performance; they have included the collection of statistics, questionnaires, interviews, observations, unobtrusive reference questions, diaries, consumer panels, and document delivery tests. One of the more recent approaches to measuring the performance of libraries and other organizations is benchmarking. Benchmarking "represents a structured, proactive change effort designed to help achieve high performance through comparative assessment. It is a process that establishes an external standard to which intended operations can be compared."[25] "Benchmarking not only allows for the establishment of a systematic process to indicate the quality of outputs, but also allows for an organization to create its own definition of quality for any process or output."[26] It is critical to keep in mind, however, that whatever technique(s) is used to assess performance, it should be related to the organization's goals and objectives.

Other relatively recent attempts to evaluate the effectiveness of libraries have focused on their *outcomes* or actual *impact*. In other words, rather than stop with the measurement of output or performance, an increasing number of researchers are attempting to determine how the lives of individuals are actually affected by their use of libraries and other information resources and services. For example, an impact assessment of a university library would go beyond measures of reference activity and circulation statistics and attempt to determine how the borrowing of books and procurement of answers to reference questions ultimately affect a student's test scores, papers, course grades, and so on. Impact or effect may well be the most important indicator of a library's effectiveness and represents its most meaningful approach to accountability, but, unfortunately, impact is elusive and no doubt more difficult to measure than input and performance. Steffen, Lance, and Logan measured the impact of public library services on the lives of library users.[27] Lance has also completed studies for individual states to measure the impact of school libraries on student achievement.[28]

In the past several years there has been much discussion of assessing library *service quality* based on customer feedback.[29] Hernon and Dugan argue that outcomes assessment must be linked to accountability, which can be measured by user satisfaction and service quality.[30] The economic environment, the convenience of the Internet, and the availability of mega-book stores with online presences have encouraged librarians to view library users as customers and to develop library services accordingly. This approach, derived from the business world, "cannot adequately be conveyed by output and performance measures."[31] In an attempt to assess university library users' perceptions of services, the Association of Research Libraries has undertaken a research and development project now called *LibQUAL+*. The project attempts "to define and measure library service quality across institutions and to create useful quality-assessment tools for local planning, such as the evaluation of a library's collections-related services from the user's point of view."[32] "Impact" and "outcomes" are often used interchangeably in the literature.

With regard to *methods and techniques*, evaluative research is much like basic research. Verification of the explicit or implicit hypothesis requires a design that will show that the desired effect was more likely to occur in the presence of the program than in its absence. Evaluative researchers must be concerned with threats to validity, such as intervening variables, measurement techniques, and faulty operational definitions. Evaluation research conceivably can employ most of the same methods that are used in basic research. Such methods are often labeled according to their primary design (survey, experiment, and the like). Another approach to categorizing evaluation methods used in library and information science is according to the program, service, or resource to be evaluated. A book by Wallace and Van Fleet,[33] for example, has chapters devoted to the evaluation of reference and information services and to library collections (see also an article by Whitlatch, on the evaluation of electronic reference services).[34] Bawden[35] presents a user-oriented approach for the evaluation of information systems and services. An issue of *Library Trends*[36] has chapters on the evaluation of administrative services, collections, processing services, adult reference service, public services for adults, public library services for children, and school library media services. Lancaster's text[37] includes the evaluation of collections, collection use, in-house library use, periodicals, library space, catalog use, document delivery, reference services, and resource sharing.

In order to conduct an evaluative study, the researcher must collect data or measure what needs to be measured. *Measurement* by itself is not true evaluation, but it is one of the building blocks for quantitative evaluation. Common types of measures for library evaluation studies include number and types of users, number and duration of transactions, user and staff activities, user satisfaction levels, and costs of resources and services. They can be related to input, output, effectiveness, costs, and so on.

It is critical that the measurement process and the measures be reasonably high in reliability and validity. The validity and/or reliability of measures can be affected by such factors as inconsistent data collection techniques, biases of the observer, the data collection setting, instrumentation, behavior of human subjects, and sampling. The use of multiple measures can help to increase the validity and reliability of the data. They are also worth using because no single technique is up to measuring a complex concept, multiple measures tend to complement one another, and separate measures can be combined to create one or more composite measures.[38] (See Chapter 2 for further consideration of validity and reliability.)

Many measures are in the form of *statistics*, which, in some cases, can be drawn from already existing sources of data. Types of statistics include administrative data, financial statistics, collections and other resources or inputs, use and other output/performance measures, outcomes, and staff and salary information. Sources of statistics include governmental agencies, professional associations, and other organizations such as state library agencies. Among the noteworthy sources of library-related statistics are the National Center for Education Statistics (NCES), American Library Association and its divisions (such as the Public Library Association's Public Library Data Service and the Association of College and Research Libraries' Trends and Statistics series), Association of Research Libraries, and federal programs such as the Federal State Cooperative System and the Integrated Postsecondary Education Data System. (See Chapter 10 for additional information about sources of statistical data.) The collection of data, must, of course, be followed by an *analysis* of data, as is the case for any other kind of research.

Readers wanting to consider evaluation research further may wish to consult a 2006 overview in *Library Trends*[39] and a recent book titled *The Evaluation and Measurement of Library Services*.[40] The latter work devotes considerable attention to evaluation process and models, methodological concerns, issues related to the evaluation of specific types of libraries and library services, and how to communicate the results of an evaluative study.

QUALITATIVE RESEARCH

In addition to having to decide whether one's research will be primarily basic or applied, the researcher must determine whether it will be quantitative or qualitative in nature. Quantitative research, which is emphasized in this book, "is appropriate where quantifiable measures of variables of interest are possible, where hypotheses can be formulated and tested, and inferences drawn from samples to populations. Qualitative methods, on the other hand, are appropriate when the phenomena under study are complex, are social in nature, and do not lend themselves to quantification."[41] Qualitative research (field studies and ethnographic techniques are related terms) focuses on attempting to understand why participants react as they do.[42] Qualitative research tends to apply a more holistic and natural approach to the resolution of a problem than does quantitative research. It also tends to give more attention to the subjective aspects of human experience and behavior. Small samples are often acceptable in qualitative studies.

Qualitative researchers have used a variety of methods and techniques, many drawn from anthropology and sociology. They have ranged from ones traditionally used in quantitative research, such as observation and the interview, to less common ones, such as mechanical recording and photography. Gorman and Clayton have written an excellent guide to qualitative research methods, with a practical, how-to approach for information professionals.[43]

While the bulk of basic research in library science has taken the form of quantitative research, which tends to adhere relatively closely to the scientific method of inquiry, qualitative methods have been employed to a greater degree in more recent years. In the report of a study utilizing structured observation, Grover and Glazier argue that qualitative research methods can be useful for gathering data about information users' behavior and information needs.[44] Qualitative methods can be especially useful in exploratory research. Chapter 7 of this book is devoted to qualitative research methods.

SPECIFIC RESEARCH METHODS

Having decided on the general approach to be taken in the research study, the researcher must next identify one, or more, specific methods that he or she wishes to employ to gather the necessary data. As was indicated at the beginning of this chapter, what follows is a brief introduction to a number of research methods. Several of the methods are treated in some detail; others are merely identified with an indication that more information is to be provided elsewhere in the text. A number of additional related readings are provided near the end of the chapter.

Survey Research

Survey research has been defined as "the research strategy where one collects data from all or part of a population to assess the relative incidence, distribution, and interrelations of naturally occurring variables."[45] This methodology, which is most commonly used in descriptive studies, is dealt with in Chapters 4 and 5.

Experimental Research

"In experimental research the researcher manipulates at least one independent variable, controls other relevant variables, and observes the effect on one or more dependent variables."[46] This method is considered to be the best method for testing causal relationships and is treated more fully in Chapter 6.

Historical Research

Isaac and Michael describe the purpose of historical research as one of "reconstruct[ing] the past systematically and objectively by collecting, evaluating, verifying, and synthesizing evidence to establish facts and reach defensible conclusions, often in relation to particular hypotheses."[47] Gay defines it as "the systematic collection and objective evaluation of data related to past occurrences in order to test hypotheses concerning causes, effects, or trends of those events which may help to explain present events and anticipate future events."[48] These are useful definitions, but they both raise issues related to the role of hypotheses in historical research, the feasibility of determining cause and effect, and so on. Such issues, and others, are addressed in Chapter 8.

Operations Research

Operations research (OR) is the application of scientific method to management operations in an effort to aid managerial decision making. It is used to identify optimal solutions to real problems, utilizing analytical mathematical techniques. Some general types of operations research are resource allocation, sequencing, inventory, replacement, queuing theory, and competitive strategies.

According to O'Neill, the standard approach to applying operations research includes the following steps:

1. Formulating the problem
2. Constructing a mathematical model to represent the system under study
3. Deriving a solution from the model
4. Testing the model and the solution derived from it
5. Establishing controls over the solution
6. Putting the solution to work: implementation.[49]

Modeling

Modeling, which is sometimes used synonymously with simulation, is "at the heart of the operations research methodology . . . A model is an abstraction, a mental framework for analysis of a system."[50] Modeling involves the use of simplified representations of real-world phenomena. Modeling is typically used to determine the performance of a real system (e.g., interlibrary loan) by observing the behavior of a representational or analogous system. Computers are often used in simulating complex problems. Modeling can also be part of the process used in the development of a theory.[51]

Systems Analysis

Systems analysis is another process that might better be thought of as a management technique than a research method; it actually has characteristics of both. It is similar in concept to operations research but tends to place greater emphasis on the total system and how the various components of the system interact. Systems analysis often utilizes operations research type techniques, and typically takes into consideration the objectives and performance, the environment, the resources, the components, and the management of the entire system. Libraries sometimes conduct systems analyses before adding a new service or revising an existing one, such as an online catalog.

Case Study

The case study is a specific field or qualitative research method and thus is an investigation "of phenomena as they occur without any significant intervention of the investigators."[52] It seems to be appropriate for investigating phenomena when "(1) a large variety of factors and relationships are included, (2) no basic laws exist to determine which factors and relationships are important, and (3) when the factors and relationships can be directly observed."[53]

Yin defines a case study as "an empirical inquiry that 1) investigates a contemporary phenomenon within its real-life context, especially when 2) the boundaries between phenomenon and context are not clearly evident . . . in which 3) there will be many more variables of interest than data points, and as one result 4) relies on multiple sources of evidence . . . with data needing to converge in a triangulating fashion, and as another result 5) benefits from the prior development of theoretical propositions to guide data collection and analysis."[54]

Leedy and Ormrod define case study research as "a type of qualitative research in which in-depth data are gathered relative to a single individual, program, or event, for the purpose of learning more about an unknown or poorly understood situation."[55]

The case study is often useful as an exploratory technique and can be used for investigating organizational structure and functions or organizational performance. In contrast to most survey research, case studies involve intensive analyses of a small number of subjects rather than gathering data from a large sample or population. A number of data collection techniques are usually employed in case studies. For example, an investigation of staff burnout in a reference department might utilize questionnaires, interviews, observation, and the analysis of documents.

If several phenomena exist, a multiple case design may be desirable. Leedy and Ormrod state that "many separate pieces of information must all point to the same conclusion"[56] for convergence or triangulation of the data. Yin also stresses replication logic, rather than sampling logic, for multiple case studies. "Each case must be carefully selected so that it either a) predicts similar results (a literal replication) or b) predicts contrasting results but for anticipatable reasons (a theoretical replication)."[57] Multiple case studies were conducted, in conjunction with individual interviews and task log analyses, in dissertation research by Connaway to investigate academic technical services librarians' levels of decisions and involvement in decision making.[58]

Most researchers consider the case study to be relatively low in internal and external validity (see Paris[59] for an alternative view), but it certainly has the potential to be a valuable research tool. As Paris points out, the nature of the problem is the major determinant of the most appropriate research methodology, and the case study is well suited to collecting descriptive data.

"The detailed observations that case studies provide are especially useful in documenting phenomena occurring over a period of time or whose implications are complex."[60]

Delphi Study

The Delphi study or technique "is a procedure using sequential questionnaires by which the opinions of experts can be brought to bear on issues that are essentially non-factual."[61] It can be employed for issues that are quantitative and non-quantitative in nature and helps to support informed decision making. The Delphi study is designed to generate consensus by systematically refining prior responses of study participants. "This form of data gathering is effective when policy level decision making is necessary."[62] For example, a library administrator might be faced with creating a collection development policy for electronic resources. After reviewing the professional literature, networking with colleagues at conferences, and so on, the administrator would develop a list of experts on the acquisition of electronic resources and a list of relevant issues. The latter list would then be distributed to the experts for their reactions, which could be suggestions for revision of the list and/or possible resolutions of the issues. The administrator would revise the list based on the responses. The list would be sent back to the experts for further suggestions, if any. This process would continue for more rounds of polling until a consensus among the experts had been reached. This methodology is also useful when the participants are hostile toward one another, argumentative, or unable to meet easily in person.[63]

Content Analysis

The *ALA Glossary of Library and Information Science* defines content analysis as "analysis of the manifest and latent content of a body of communicated material (as a book or film) through a classification, tabulation, and evaluation of its key symbols and themes in order to ascertain its meaning and probable effect."[64] Content analysis is essentially a systematic analysis of the occurrence of words, phrases, concepts, and so on in books, films, and other kinds of materials. Content analysis has been used, for example, to determine how frequently racist and sexist terms appear in certain books. Kracker and Peiling used content analysis to study students' research anxiety and their perceptions of research.[65] See Chapter 7 on qualitative research for more information about content analysis.

Bibliometrics

Bibliometrics is a special type of documentary research or inquiry into the tools of library and information science. It has been defined as "the application of mathematics and statistical methods to books and other media of communication."[66] It also has been referred to as "a series of techniques that seek to quantify the process of written communication"[67] and as "the quantification of bibliographical data."[68] Related terms are scientometrics, informetrics, and librametrics.

The early bibliometric studies produced three basic laws: 1) Bradford's Law of Scatter, which describes how the literature of a subject area is distributed in its journals and which forms the basis for calculating how many journals contain a certain percentage of the published articles; 2) Lotka's Law, a formula for measuring/predicting the productivity of scientific researchers; and 3) Zipf's Law, which describes the frequency of the appearance of certain words or, more specifically, suggests that people are more likely to select and use familiar, rather than unfamiliar, words. (See Wallace[69] and Osareh[70] for useful overviews of the origins of bibliometrics.)

Following early research, bibliometrics branched into quantitative analyses, qualitative studies, and most recently, studies combining quantitative and qualitative methods. Bibliometric research, especially if quantitative, involves the application of mathematical formulas and considerable counting and statistical analysis. Bibliometric analyses have greatly benefited from the availability of computerized bibliographic databases, citation indexes, and statistical programs.

Perhaps the most common type of bibliometric research is concerned with citations. Citation analysis is essentially concerned with "who cites whom."[71] The three basic concepts of citation analysis are 1) "direct citation, which establishes the relationship between documents and the researchers who use them;"[72] 2) bibliographic coupling, where the reference lists of two documents share one or more of the same cited documents;[73] and 3) co-citation, which occurs when two citations are cited together.[74]

Applications of bibliometric research identified by White,[75] von Ungern-Sternberg,[76] Wallace,[77] Osareh,[78] and others include:

1. Improving the bibliographic control of a literature
2. Identifying a core literature, especially journals
3. Classifying a literature
4. Tracing the spread of ideas and growth of a literature
5. Designing more economic information systems and networks
6. Improving the efficiency of information handling services
7. Predicting publishing trends
8. Describing patterns of book use by patrons
9. Developing and evaluating library collections
10. Evaluating journal performance (e.g., citation impact).

Bibliometric and informetric methods are being applied to Internet-based research. "Informetrics investigates characteristics and measurements of persons, groups, institutions, countries; publications and information sources; disciplines and fields; and information retrieval processes."[79] These methods are used to study Web documents, sites, information retrieval tools (such as search engines), and user studies. Webometrics, which focuses on the quantitative study of Web phenomena, encompasses a variety of types of research. Bertot, McClure, Moen, and Rubin, for example, considered the use of Web server-generated log files to evaluate the use of the Web.[80] Shachaf and Shaw analyzed email and chat reference transactions from public and academic libraries to identify core reference sources.[81] *The Journal of the American Society for Information Science and Technology* (*JASIST*) published a special issue on webometrics in December 2004, and covered such topics as structures, patterns, and topologies of hyperlinks on the Web; methodological issues related to the use of search engines; social, cultural, and linguistic factors in Web use; and Web impact measurements.[82]

There continues to be an interest in bibliometric research. A cursory examination of *JASIST* from 2004 through 2010 identified hundreds of published papers addressing the topics of bibliometrics and informetrics. The bimonthly newsletter, *Research Trends*, provides "objective, up-to-the minute insights into scientific trends based on bibliometric analysis."[83] Recognizing that "bibliometrics emerged as a field in its own right" almost 40 years ago, *Research Trends* interviewed Wolfgang Glänzel, of the Expertisecentrum O&O Monitoring in Leuven, Belgium. Glänzel stated that "the quantity and quality of bibliometric tools have increased and improved considerably during the last three decades."[84] However, he identifies three major challenges of bibliometrics: 1) the need for a different approach to bibliometric research to accommodate the different publication and citation practices of humanities and social science researchers; 2) "the development of web-based tools"[85] to document and reproduce results of scholarly communication has not kept pace with the changes in electronic communication made available by the Internet and open-access publishing; and 3) the capability to model and measure the social impacts of communication outside research communities. In other words, bibliometric and citation analysis are not without their limitations and potential problems. The three basic laws identified above have not held up in every situation where they have been applied. A number of people have concerns about using citation counts to evaluate the scholarship of researchers because of issues such as self-citation and incomplete citation databases. Sound bibliometric analysis can be followed by faulty interpretation, and quantity and quality of citations are not necessarily related. Treating Web links as citations begs questions about validity because of variability in the search engines, the lack of quality control, the automatic replication of links, and so on.

Task-Based Research

Task-based research is research that focuses on the scrutiny of specific tasks; it is not a research methodology per se. Task-based research has been designed to utilize multiple research methods within the linguistics, teaching and learning, and Human Computer Interface communities. Tasks play an important role in functional software and system and user interface design as well as understanding users' needs.

> This is normally done through observations, user studies, and interviews and from working experience with systems and people. The majority of today's systems use an interactive and event-driven paradigm. Events are messages the user, or the system, sends to the program. A keystroke is an event. So is a mouse-click. Interactive task based design systems place more emphasis on people and their needs to achieve a specific task.

> Identifying the user's tasks enables the designer to construct user interfaces reflecting the tasks' properties, including efficient usage patterns, easy-to-use interaction sequences, and powerful assistance features.[86]

Within the past decade task-based information-seeking theory[87] and modeling[88] has developed, enabling researchers to work within the user's task domain instead of within the technology domain. The emphasis is on the users and their tasks in order to identify their workflows for the development of embedded systems and user-centered interface designs. Task-based research design also recognizes that users' tasks can change with the integration of new technologies and systems and new designs may affect the way in which users perform tasks.

Comparative Librarianship

Interestingly, there is a long-standing debate over whether comparative librarianship is a research method or a subject matter. As a subject, it deals with phenomena in librarianship that can be compared. As a research method, it provides the framework for conducting an appropriate comparative analysis. In either case, comparative librarianship often has an international element. A definition that nicely incorporates all of these aspects, found in the *Encyclopedia of Library and Information Science*, reads as follows:

> The systematic analysis of library development, practices, or problems as they occur under different circumstances (most usually in different countries), considered in the context of the relevant historical, geographical, political, economic, social, cultural, and other determinant background factors found in the situations under study. Essentially it constitutes an important approach to the search for cause and effect in library development, and to the understanding of library problems.[89]

"It is commonly stressed in defining the term that (1) comparative librarianship involves two or more national, cultural, or societal environments; (2) the study includes a comparable comparison; and (3) it induces philosophical or theoretical concepts of librarianship through the analysis of similarities and differences of phenomena in various environments."[90] Danton and others have argued that the scientific method of inquiry is the most satisfactory method for comparative studies in librarianship while recognizing that history and comparison are essential elements of this process.[91] The four basic steps for research in comparative librarianship have been identified as description, interpretation, juxtaposition, and comparison. Specific data collection techniques have included case histories, personal interviews, observation, and documentary analysis.

Technology-Based Research Methods

As libraries and other information agencies embrace more and ever-changing technology, including social networking, and employ personnel with technological backgrounds, the profession must facilitate and encourage technology-based research. "One of the difficulties in doing so has to do with reconciling the scientific method with activities that are more similar to product development than to basic research."[92] A perusal of some of the information-related sections of *Dissertation Abstracts International* identifies turns up titles such as "Mining Help Desk Emails for Problem Domain Identification and Email Feature Engineering for Routing Incoming Emails," "Rewriting the 'Rules' of Online Networked Community Information Services: A Case Study of the mycommunityinfo.ca Model," "Using Social Network Analysis to Investigate Potential Bias in Editorial Peer Review in Core Journals of Comparative/International Education," and "Modeling the Role of Blogging in Librarianship." The inclusion of the technology-based research methods in the literature affirms the importance of developing new techniques for utilizing the data made available through new discovery and access technologies. As more libraries become involved in "Web 2.0" technologies and other social media, both qualitative and quantitative research into these technologies have slowly begun.[93]

"Geographic information system (GIS) technology is a rapidly growing and powerful method for managing and analyzing spatial data and information for libraries. . . . A GIS is designed for the collection, storage, and analysis of objects and phenomena where geographic location is an important characteristic or critical to the analysis."[94] While not a basic research method itself, GIS technology certainly has the potential to be a data collection and analysis tool for research, especially applied research. However, there has been little research published using GIS data, which is surprising given the growing popularity of Google Earth and MapQuest. Libraries have been using geographic information for decision making for the development of services and marketing.[95] "The basic operations for GIS spatial analysis are: retrieval, map generalization, map abstractions, map sheet manipulation, buffer generation, polygon overlay and dissolve, measurements, digital terrain analyses, and network analyses."[96] Ottensmann discusses how geographic information systems can be employed to analyze patterns of library utilization in public libraries with multiple branches.[97]

Libraries are particularly interested in utilizing appropriate methods to evaluate their new information technologies. Online catalog use, for example, has been evaluated with traditional research methods and techniques such as questionnaires, interviews, focus group interviews, observation, and experiments. A less common method, protocol analysis, has been found useful for studying the use of online catalogs. Protocol analysis has been called "the thinking aloud technique" because it represents an analysis of subject searchers' thoughts as they perform their subject searches at the catalog.[98] During a protocol analysis, the user verbalizes the decisions and behaviors that he or she is performing in order to search the catalog. A video camera may be used to record the activity being analyzed.[99] As a type of obtrusive observation, the process itself can affect the behavior being analyzed, but using a camera is likely to be less intrusive than direct human observation.

It is often difficult to recruit subjects for protocol analysis research projects; therefore, only two or three subjects may be included for each user group. Researchers may have assumptions about user behaviors or preferences skewing their observations and reporting of the protocols. It also is difficult to interpret and use the data generated by protocols unless behaviors are identified and defined, and quantitative metrics are developed prior to the initiation of the protocols.[100]

In contrast, transaction log analysis, transaction monitoring, search log analysis, or query log analysis has become more popular in the past several years and is not only unobtrusive but also takes advantage of the technology that is being evaluated. Online public access catalogs (OPACs) and Web search engines are able to record and monitor use of the catalog and site; transaction log analysis is the examination of those records. Transaction log analysis can take the form of macroanalysis and microanalysis. The former is concerned with aggregate use data and patterns, the latter with the dynamics of individual search patterns. The transaction log analysis methodology is used to study scholarly communication and productivity in bibliometric studies by analyzing the logs of online journals and data bases and to help researchers understand the behaviors of users of online information retrieval systems. The rationale of the analyses is for the development of information retrieval systems that will better fulfill the needs of users, based on their actual search behaviors. Peters, however, believes that log analysis has been underutilized in practice where it can provide data for library managers to develop systems and services for library users.[101] Banks suggests that practicing library managers could use OPAC usage transaction log data to schedule reference service staff based on the high and low usage patterns during a specified time period.[102]

One of the most important early online catalog use studies, begun in 1980, was sponsored by the Council on Library Resources (CLR) (now the Council on Library and Information Resources). This study utilized questionnaires, focus group interviews, and transaction log analysis as means to study use and users. Five organizations were involved in this research: 1) J. Matthews & Associates, 2) the Library of Congress, 3) Online Computer Library Center (OCLC), 4) Research Libraries Group, and 5) the University of California, Division of Library Automation and Library Research and Analysis Group.[103] A total of 29 academic, public, state, and federal libraries participated in the catalog study, represented by 16 online catalogs.[104] A questionnaire was developed and used by all five of the organizations involved in the CLR-funded research to examine patron and staff experiences with online public access catalogs. In addition to the questionnaire, OCLC conducted focus group interviews, and transaction logs were analyzed to study the use of online public access catalogs.

Since transaction logs provide a record of the search strategy employed by users without interfering with the searcher, an analysis of transaction logs can reflect users' actual online search experiences. This methodology clearly demonstrates how users really employ search strategies rather than how users describe their search strategies. There is also no chance of the interference of interviewer bias in the data collection.

Among other studies of transaction logs, Norden and Lawrence,[105] Tolle,[106] Dickson,[107] Nielsen,[108] Peters,[109] Hunter,[110] Zink,[111] Kalin,[112] Nelson,[113] Cherry,[114] Wallace,[115] Lucas,[116] and Millsap and Ferl,[117] examined transaction logs to study the search methods used by OPAC users. These studies report failures and successes of online searches in regard to the improvement of OPAC capabilities and screen presentation and of OPAC user instruction. Kalin, Lucas, and Millsap and Ferl studied the search methods of remote users.[118] Ciliberti, Radford, and Radford studied the transaction logs of library users of the OPAC and CD-ROM journal indexes to verify the accuracy of user self-reports on the availability of the resources.[119] Mudrock described how the University of Washington libraries used server usage statistics and email reference queries to create a user-oriented ready reference Web site.[120] Simpson has provided an exhaustive review of the literature on transaction log analysis.[121]

In addition to the report of search type and failure and success rates and search method types, errors and problems are also calculated for most of the studies. Unfortunately, the search types, failure or success rates, and errors or problems are not defined or calculated consistently throughout the published literature, and the data provided from each system are not standardized.[122] In addition to these disadvantages, the actual users are not identifiable from the transaction logs, and it is often difficult or impossible to determine when one searcher ends a search session and another begins a session. It is also impossible to discern from the transaction logs who is doing the search and why.

For these reasons, it is often useful to incorporate the transaction log analysis method with other data collection methods. Nielsen linked transaction log analysis data with user demographic data,[123] as did Millsap and Ferl, and Connaway, Budd, and Kochtanek.[124] Connaway, Budd, and Kochtanek interviewed subjects, using a questionnaire, after the subjects completed their online searches.[125] This enabled the researchers to link the transaction logs (subjects' search behaviors) with demographic data. Structuring a study in this way allows for the search behaviors to be analyzed in relation to the searchers' experience with online systems, educational background, reason for the search, and so on, thus requiring the researcher to infer less about the nature of the search and maintaining the validity of the study.

With the popularity and high visibility of the Internet, many researchers have used transaction or Web log analysis to investigate information retrieval on the Web. Zhang, Wolfram, and Wang "investigated eleven sports-related query keywords extracted from a public search engine query log to better understand sports-related information seeking on the Internet."[126] Keily and Moukdad and Large analyzed queries from the search engine WebCrawler.[127] Silverstein, Henzinger, Marais, and Moricz analyzed approximately one billion queries from Alta Vista during a 43-day period.[128] Smith, Ruocco and Jansen,[129] Xu,[130] Jansen, Spink and Saracevic,[131] Spink and Xu,[132] and Spink, Wolfram Jansen, and Saracevic[133] used queries from the search engine Excite to study information retrieval patterns on the Web. These studies have identified query characteristics submitted to several Internet search engines. Jansen and Pooch give an overview of the findings of several Web user studies.[134] The *Handbook of Research on Web Log Analysis* offers an overview of research-based approaches to log analysis, including methodological and ethical issues and limitations of the method.[135]

Covey provides an extensive overview of transaction log analysis.[136] Her study of the methods used by 24 libraries "to assess the use and usability of their online collections and services" includes why and how these libraries used the transaction log analysis approach. The problems and challenges associated with this methodology and information on the analysis, interpretation, and presentation of the data collected from transaction log analysis are outlined and discussed by Covey. The book also includes an excellent bibliography on the topic.

A special issue of *Library Hi Tech* provided a useful overview of transaction log analysis. Kaske's article in the issue addressed a number of issues and questions relevant to using transaction log analysis as a research method, including:

1. Basic constraints
2. Proposed general model
3. Research or management
4. Quantitative or qualitative methods
5. Micro or macro evaluation
6. Sample or population
7. Controlled or uncontrolled experiments
8. Ethics and transaction logs.[137]

The next-to-last item in the list above reinforces that transaction log analysis may be used in conjunction with other research methods; for example, transaction logs can be matched with questionnaire data, as discussed above. The last item serves as a reminder that any research method that is unobtrusive, or does not inform the subjects they are being observed, raises ethical questions related to the invasion of privacy.

ETHICS OF RESEARCH

Ethics are in fact of importance to all kinds of social and behavioral research, especially when the research involves human subjects. Unfortunately, unethical practices seem to have become more common in recent years, and a growing percentage of unethical practices are relatively difficult to detect. An increasing number of research studies are conducted by large groups of researchers, making it harder to observe misconduct and attribute it to the appropriate person(s). Experimental replication, a traditional safeguard against unethical conduct, is more problematic given the size, cost, and complexity of many contemporary studies. The proliferation of journals has resulted in less stringent editing, and more of what is published is going unchallenged. At the same time, the rate at which scientific journal articles are being retracted has increased significantly over the last several years. Finally, what is ethical practice and what is not is not always clear-cut.

General Guidelines

A book by Sieber provides a reasonably comprehensive, but succinct, guide to planning ethical research. In her opening chapter, she commented:

> the ethics of social research is not about etiquette; nor is it about considering the poor hapless subject at the expense of science or society. Rather, we study ethics to learn how to make social research 'work' for all

> concerned. The ethical researcher creates a mutually respectful, win-win relationship with the research population; this is a relationship in which subjects are pleased to participate candidly, and the community at large regards the conclusions as constructive.[138]

Or, as Hoyle, Harris, and Judd noted, the issue of ethics often comes down to balancing the costs of questionable practices against the potential benefits of the research.[139]

Sieber's first chapter also includes a discussion of IRBs, or Institutional Review Boards (also known as Human Subjects Committees, Human Investigation Committees, and Human Subjects Review Boards). The U.S. government requires that all universities and other organizations that conduct research involving human subjects and that receive federal funding for research involving human subjects (virtually all universities granting doctoral degrees) must have an IRB. "The purpose of the IRB is to review all proposals for human research before the research is conducted to ascertain whether the research plan has adequately included the ethical dimensions of the project."[140] They are to help ensure that no harm will come to human subjects, that they are informed of and consent to the protocol of the research study, and that their confidentiality or anonymity will be provided. Miller's textbook on research design includes facsimiles of the IRB documents used by the University of Kansas.[141] Those documents address submission criteria, application forms, audio and video recording of subjects, payment to subjects, subject selection considerations, implied consent, inclusion of research instruments, deception of subjects, the review process, and so on. Readers wishing to know more about IRBs may wish to consult *The IRB Reference Book*.[142]

Many professional associations have guidelines for ethical research. Miller and Salkind's book provides a reprint of the *Code of Ethics* published by the American Sociological Association.[143] That code covers issues such as professional competence, integrity, respect for people's rights, dignity and diversity, social responsibility, ethical standards, harassment, conflicts of interest, disclosure of financial support and relevant relationships, confidentiality, and the publication process.[144]

The other chapters in the book by Sieber cover the research protocol (proposal), general ethical principles, voluntary informed consent and debriefing (interaction with subjects immediately following their participation in the research), privacy, confidentiality, deception, elements of risk, benefits, research on children and adolescents, and community-based research on vulnerable urban populations and AIDS. Sieber's appendix includes sample consent and assent forms for use with older children.[145]

A number of other standard textbooks on research methods in the social and behavioral sciences devote space to ethics in research. Hoyle, Harris, and Judd, for example, give considerable attention to the ethical implications of research.[146] Johanson stated, "It is impossible for any research to avoid ethics. They are inextricably entwined."[147] He then proceeds to take a rather philosophical approach to ethics in research in discussing social ideals and research and principles and ethical codes, but he also addresses some of the more pragmatic concerns such as ethics committees and the publishing of research results. Johanson provides several useful examples or case studies relating to the links among practice, ethics, and research. Chapter 7 of this book discusses ethics in the context of qualitative research.

Schutt deals with ethical issues in experimental research and in survey research separately. He notes, "[subject] deception is an essential part of many experimental designs. As a result, contentious debate continues about the interpretation"[148] of research ethics. He then discusses the issue of deception in more detail and next considers the question of how much subjects may be harmed by the way benefits are distributed as part of a field experiment.

In his section on ethics in survey research, Schutt points out that "special care must be taken when . . . sensitive personal questions are to be asked."[149] He notes that many surveys employ questions that might prove damaging to the subjects if their answers were disclosed, and in such cases it is critical to preserve subject confidentiality, if not anonymity. Schutt stresses that the "cover letter or introductory statement that identifies the sponsors of, and motivations for, the survey"[150] must "point out that the respondent's participation is completely voluntary."[151] The cover letter or opening statement should also disclose the researcher's affiliation and the project's sponsors and identify any possible harm or benefits for subjects.

Kimmel focuses on ethics in applied social research.[152] He covers many of the same topics treated by other textbooks, but there is a particularly useful chapter on special problems in applied settings. One section of that chapter discusses some of the ethical issues in organizational research, which often deals with issues such as personnel evaluation, program evaluation, and the implementation of interventions designed to improve employee performance and relations. Such activities are quite susceptible to ethical abuse. He also addresses some of the unanticipated consequences of prevention research. For example, a preventive intervention designed to increase worker productivity might cause psychological harm. Kimmel concludes the chapter with a consideration of ethical issues that may arise after the research is completed related to possible consequences of applying the results, misuse of the new knowledge, and responsibilities of the applied social researcher.

A brief consideration of ethical issues regarding the use of and reporting of the results of statistical analysis is provided by Losee and Worley.[153] Some of those issues relate to the biased use and/or interpretation of statistical techniques and data. Others have to do with "the level of effort researchers should make to ensure that no errors in their research or in the writing up of their results will appear in print or in distributed electronic form."[154] Krathwohl raises two possible ethical issues related to ownership of the data: availability of the data to others for secondary analysis and apportionment of credit on publication.[155]

Goetz makes a case for making dark data (the data that did not support the researchers' hypotheses) openly accessible for further analysis. He premises his discussion on the idea of publication bias, "where science gets skewed because only positive correlations see the light of day."[156]

Guidelines for LIS Professionals

"Although LIS has imported [methodologies] from other disciplines, it has not turned its attention to 'research ethics' to the extent of the fields it borrows from."[157] However, a few books and articles have been concerned, at least in part, with ethical issues somewhat specific to LIS practitioners and researchers. Westbrook, for example, in her book on the analysis of community information needs, incorporates guidelines for ethical practices as appropriate. These guidelines stress that anonymity, or confidentiality, of everyone involved must be maintained; that library services should never appear to depend on patron participation in the study; and that no harm should come to any subject.[158] She reminds the reader that, upon completion of the study, all confidential data should be destroyed, including interview transcripts, lists of subject names, and observation notes, and that both electronic and paper files should be weeded as much as possible. Westbrook also stresses the importance of emphasizing ethical practices when training staff to conduct information needs analyses.

In his article on the ethical considerations of information professionals, Froehlich discusses the ethical issues that can arise when decisions are being made about who should publish research results and take the credit. Other issues related to the publication process can include plagiarism, falsification or fabrication of data, dual submissions of manuscripts to journals, and duplicate publication of identical or largely identical manuscripts without permission from the editors.[159] Losee and Worley, in their book about research for information professionals, also provide brief, but useful, information about ethics in the dissemination of research results.[160] They, too, deal with plagiarism and the submission of results to more than one journal or conference at the same time. Hauptman's book includes a discussion of ethical issues related to research and publication by academic librarians.[161]

Smith focuses on the ethics of research about the uses of information provided by librarians. In other words, to what extent are librarians justified in investigating the information use activities of patrons in order to improve information services provided to them? What are the ethics of user studies? Smith noted that there is a need for guidelines for research on user needs and information use, but one concludes that such guidelines should not scare practitioners away from "the serious evaluation and research that needs to be conducted if librarians are to serve the public and to preserve the profession."[162]

Carlin, while pointing out the need for more consideration of the place of ethics in LIS research, presents several cases and debates from other disciplines so as to raise the visibility of research ethics for researchers in LIS.[163] He also discusses the possibility of an "ethics of interdisciplinarity" and stresses the importance of being accountable for the presentation of research strategies and accurately distinguishing between primary and secondary sources.

Ethics for Research on the Internet

As Case indicated, a relatively new ethical issue has to do with the uses of the Internet for research:

> The ubiquity of information exchange on the Internet, for example, has led to discussion among researchers regarding the ethics of collecting public submissions to mailing lists, discussion boards, and Web sites. Although chat rooms and individual e-mail exchanges are considered to be "private,"

> some researchers maintain that postings to public channels like Usenet and open mailing lists are fair game for analysis and reporting. Yet the increasingly common practice of collecting electronic discussions, particularly on controversial topics, raises the issue of whether the contributors are "fully informed" that they are subjects of study. Whatever individual investigators think about the ethicality of studying public discussions, institutional review boards typically ask for evidence that research subjects are informed of possible observation and its consequences. If the investigator is taking an active role in the discussion—posing questions to the list, for example—the issue becomes even more complex.
>
> As computer and biomedical technology provide increased monitoring capability of overt behavior and physical responses, we can expect more challenges to the boundaries of acceptable research. Witness the increased awareness of privacy brought about by use of the Internet. Many users gradually became aware that commercial entities were not only tracking the most obvious data—their demographic background (such as they were willing to supply voluntarily) and electronic purchases—but were even recording their visits to Web sites in which transactions were not conducted. The pervasive use of tracking cookies and of online forms and questionnaires, coupled with the ability to aggregate and cross-reference data by individual computer user, has led to massive collections of data on electronic information seeking. That much of this has been collected without the full consent and understanding of Internet users is an example of how far things can go if ethical data-collection principles are not observed.[164]

Most existing guidelines for ethical research were not developed with such information technologies in mind. Jones pointed out, for example, that issues such as public versus private information and informed consent in an electronic environment are not adequately addressed by the guidelines provided by the typical research university. He cautioned researchers to recognize the limitations of existing guidelines and to take steps to ensure that research on the Internet is just as ethical as any other research.[165] To help meet the need for more information on these issues a new journal, *International Journal of Internet Research Ethics*, was founded in 2008.

Scientific and Research Misconduct

As Krathwohl stated, ethical standards are, in effect, a constraint on research; and they can be divided "into two aspects: (1) the legal and institutional constraints designed to protect the people from whom data are gathered and (2) the responsibility of the individual researcher for proper conduct above and beyond legalities. The former, covered by U.S. federal regulations, ensures that the researcher's institution provides adequate safeguards for the protection of human subjects in all federally funded research."[166] Hence the Institutional Review Boards discussed earlier.

In addition to IRBs, many universities have policies and procedures regarding scientific misconduct. Wayne State University, in Detroit, Michigan, for example, has a four-page policy that provides necessary definitions and procedures for handling allegations of scientific misconduct, initial inquiries, formal investigations, possible resolutions, and appeals. Other mechanisms for minimizing scientific misconduct have included 1) the mentor-apprentice relationship, in which the senior researcher imparts the importance of intellectual honesty; 2) the communal review of research results via scholarly communication; 3) the replication of research results; and 4) the review of proposals before the research is conducted.[167]

In spite of the guidelines and codes of ethics for research, scientific/research misconduct can and does still occur. In fact, "the Commission on Research Integrity, which was created as part of the National Institutes of Health Revitalization Act of 1993, proposed new procedures for addressing scientific misconduct"[168] "because, beyond the high-profile cases, widespread problems in the conduct of research remain."[169] "The lay public presumes that professions are self-regulating. . . . However, the effectiveness of self-regulation in the academic profession is currently being challenged."[170]

There is at least a perception that research misconduct in library and information science is less of a problem than it is in other fields, "principally because the stakes are not terribly high in LIS, as compared with fields such as biology, physics, medicine, and the like."[171] Or as Wiberley stated, "there is less of it than in other fields that have greater funding or greater prestige. The greater the stakes, the more incentive there is to cheat."[172]

But what is scientific or research misconduct; how is it defined? According to Wayne State University's policy, "scientific misconduct includes fabrication, falsification, plagiarism, or other practices that seriously deviate from commonly accepted practices within the scientific community for proposing, conducting, or reporting research. Misconduct does not include honest error or honest differences of interpretation in judgments of data. Nor does it include the innocent failure to comply with the terms of research grants."[173] Altman noted an agreement among professional organizations, governmental agencies, and scientists "that fabrication, falsification, or plagiarism in proposing, performing, or reporting research constitute scientific misconduct."[174]

Library and information professionals desiring more information about scientific and research misconduct are encouraged to consult a book edited by Altman and Hernon.[175] Chapters in that work address such issues as misconduct and the scholarly literature, implications of misconduct for bibliographic instruction, and implications of research misconduct for libraries and librarians. Also included are appendices with references to codes of ethics from professional societies, guidelines for instructions to authors, and sources for information about cases of research misconduct.

Another useful resource is a special issue of the *Journal of Information Ethics* (1996) devoted to research misconduct.[176] Articles treat, among other topics, information ethics in the workplace, the lure of scientific misconduct, the influence of academic departments/disciplines on misconduct, federal actions against plagiarism, misconduct involving digital imaging, and the legal aspects of scientific misconduct. Finally, readers interested in electronic guides to research ethics can consult the bibliography on Tom Wilson's Web site: *InformationR.net*[177] (see the section Electronic Resources for Information Research Methods); and Sharon Stoerger's *Research Ethics Webliographies*,[178] which include resources on research ethics in general, plagiarism, and research ethics in specific subject fields.

SUMMARY

This chapter pertains to the fifth stage of the basic scientific method of inquiry—the methodology. The reader is reminded that the researcher must first decide if his or her research will be quantitative and/or qualitative in nature, applied or basic. Then a number of specific research methods are introduced. The list and discussion of various methods and their uses in LIS is not, however, exhaustive. Nor are the descriptions detailed enough to provide adequate instruction in how to use the methods. Readers wishing to employ one or more of these methods should refer to the relevant sections of this work, other standard texts on research methods, and appropriate readings listed below. The last section addresses the important issue of ethics in research.

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Chapter 4

Survey Research and Sampling

The survey is a group of research methods commonly used to determine the present status of a given phenomenon. The basic assumption of most survey research is that, by carefully following certain scientific procedures, one can make inferences about a large group of elements by studying a relatively small number selected from the larger group. For example, if one wanted to learn the opinions of all academic librarians in the United States regarding information literacy, one could study a sample of several hundred librarians and use their responses as the basis for estimating the opinion of all of them. For a discussion of sampling in-library use, see the section written by Mundt after the Nonsampling Error section of this chapter.

SURVEY RESEARCH

The word *survey* literally means to look at or to see over or beyond or, in other words, to observe. *Observations* made during the course of a survey are not limited to those of the physical type, however, and techniques commonly used for collecting survey data will be considered later.

As was just indicated, a key strength of survey research is that, if properly done, it allows one to generalize from a smaller group to a larger group from which the subgroup has been selected. The subgroup is referred to as the *sample*, and techniques for drawing samples will be treated in considerable detail later. The larger group is known as the *population;* it must be clearly defined, specifically delimited, and carefully chosen.

The observations or measurements made during survey research, or any other kind of research, generate *data* or information. These data are particularly susceptible to *bias* introduced as a result of the research design (and at other stages in the research process), so that problem will be considered here and other places throughout this work.

MAJOR DIFFERENCES BETWEEN SURVEY RESEARCH AND OTHER METHODS

As has been noted, survey research has characteristics common to most other research methods, but at the same time, it exhibits certain important differences. For example, survey research is used to gather contemporary data, while historical research is, of course, primarily concerned with past data. Some argue that historical research, at least at present, is less bound to the scientific method of inquiry.

In contrast to experimental research, survey research does not enable the researcher to manipulate the independent variable, provides less control of the research environment, and therefore is not considered capable of definitely establishing causal relationships. In other words, survey research is considered to be less rigorous than experimental research.

On the other hand, survey research is better suited than experimental research to studying a large number of cases, including those that are geographically dispersed. Also, survey research is generally considered to be more appropriate for studying personal factors and for exploratory analysis of relationships.

TYPES OF SURVEY STUDIES

In selecting a research method, and a type of survey research in particular, the researcher must keep in mind the research problem, the sources of the desired information, the nature of the data to be collected, and the major purpose of the research. For example, if the purpose of the study is to formulate a problem for a more precise investigation or to develop more formal hypotheses, then a formative or exploratory type of survey may well be in order.

Exploratory Surveys

An exploratory survey, often conducted as qualitative research, can increase the researcher's familiarity with the phenomenon in question; it can help to clarify concepts, it can be used to establish priorities for future research, it can identify new problems, and it can be used to gather information with practical applications, although such results cannot always be anticipated. Specific kinds of exploratory research surveys include:

1. *Literature surveys.* Literature surveys or reviews are in some respects exploratory in nature in that they often focus on developing hypotheses, based on previous research, that may suggest further research. Literature surveys may stand alone, but more often they are a part of a larger study. In the latter case, they are considered to be supportive of the research that follows rather than as research studies themselves.
2. *Experience surveys.* Experience surveys, as the name suggests, are surveys that gather and synthesize the experiences of specialists and/or practitioners in a particular field. They too are exploratory in that their

aim is to obtain "insight into the relationships between variables rather than to get an accurate picture of current practices or a simple consensus as to best practices."[1] The researcher's primary interest is in gaining provocative ideas and useful insights (i.e., suggestions for future research, rather than specific statistics). Experience surveys, as well as suggesting hypotheses, can provide information on the feasibility of doing other research. For example, they can provide information on where the facilities for research can be obtained, which factors can and cannot be controlled, how readily available the necessary data are, and so on. Experience surveys also may help to establish priorities for research in the area and to summarize the knowledge of practitioners regarding the effectiveness of various methods and procedures, or best practices in a particular field.

3. *Analysis of "insight-stimulating" examples.* Where there is little experience to serve as a guide, researchers have found the intensive study of selected examples to be a useful method of stimulating insights and suggesting hypotheses for future research. This method differs from the case study approach in that it tends to be more intensive and narrow in scope. The types of examples or cases likely to be of most value depend on the problem under study, but, in general, cases that provide sharp contrasts or have striking features tend to be the most useful.

Speaking of exploratory surveys in general, it is important to remember that exploratory studies merely suggest insights or hypotheses; they cannot test them. By selecting examples that have special characteristics, one no longer has cases that are typical, but a biased sample instead. In addition, exploratory studies do not provide enough control of extraneous variables, nor should they, to permit the testing of a specific relationship. "An exploratory study must always be regarded as simply a first step; more carefully controlled studies are needed to test whether the hypotheses that emerge have general applicability."[2]

Analytical and Descriptive Surveys

A second general type of survey, but one that is seldom labeled as such in the literature, is the analytical survey. Leedy describes the analytical survey method as "appropriate for data that are quantitative in nature and that need statistical assistance to extract their meaning."[3] In practice, however, most researchers seem to consider an analytical survey essentially as a kind of descriptive survey, and they do not distinguish between the two. In fact, descriptive surveys are the most common type of survey, and many researchers use "survey research methods" and "descriptive surveys" synonymously.

Other Types of Surveys

In a workbook developed for an ACRL workshop, Golden listed nine different types of surveys, some of which could no doubt be subsumed under the broader types of surveys just discussed. These nine types are the following:

1. Cross-sectional study—a typical survey, such as a Gallup poll, designed to measure one or more phenomena across a sample representative of the population or whole.
2. Trend study—a survey conducted over a period of time so as to measure trends, patterns, or changes.
3. Cohort study—a survey conducted in order to collect data from the same population more than once. The same people are not surveyed, but the subjects are selected from the same population.
4. Panel study—a survey designed to collect data from the same sample of subjects, often over time. In fact, the trend study and the panel study may be treated as *longitudinal* studies.
5. Approximation of a longitudinal study—an attempt to simulate a true longitudinal study by asking people to recall past behavior and activities.
6. Parallel samples study—a survey of separate samples regarding the same research problem. For example, a study of university library use might necessitate surveying both students and faculty.
7. Contextual study—a survey of a person's environment, conducted so as to learn more about the person. For example, a study of a person's information use might benefit from a consideration of the information resources available to that person.
8. Sociometric study—a comprehensive survey of more than one group, including the interrelationships among the groups. For example, a thorough study of children's literature might well entail surveying authors, critics, publishers, librarians, parents, and children.
9. Critical incident study—an in-depth examination of a specific event or activity rather than a broad survey of many occurrences; similar to the "analysis of insight-stimulating examples" described above.[4] The critical incident technique (CIT) was used by John C. Flanagan as part of his behavior studies in the United States Army Air Forces during World War II.[5]

Readers wishing to know more about these specific types of studies should consult some of the standard texts on survey research.

BASIC PURPOSES OF DESCRIPTIVE SURVEYS

The basic purposes of descriptive surveys usually are to describe characteristics of the population of interest, estimate proportions in the population, make specific predictions, and test associational relationships. (They can be used to *explore* causal relationships.) Looking first at describing the population, it should be kept in mind that a description of characteristics of the population is often based on a description of the characteristics of a (hopefully) representative sample—hence the importance of the sampling technique.

Having identified characteristics of the population, it then becomes important to estimate (if using a sample) their proportions in the population. Without such data, one can say little about the significance of the traits. For example, it may be interesting to learn that some academic librarians hold subject master's degrees, but little can be done to interpret the possible impact of this phenomenon without knowing what percentage of all academic librarians hold subject master's degrees.

Information regarding characteristics or proportions is also necessary in order to make predictions about specific relationships. In the course of the study just alluded to, one may find that a high percentage of libraries with an acquisitions budget of a certain size employs librarians with subject master's degrees. On the basis of such data, the researcher may be prepared to predict that, in most cases, libraries having an acquisitions budget over a certain amount will indeed have librarians with subject master's degrees.

In fact, the researcher may wish to go a step further and "test" the relationship between budget size and librarians' credentials. The testing of a relationship between two or more variables will be described in greater detail later, but it should be noted that some tests are more rigorous than others. The consensus is that descriptive survey research can consider but not test causal relationships, but that it can test associational relationships. In other words, by using a survey, the researcher may find that libraries with large acquisitions budgets do tend to have more librarians with subject master's degrees, but such a study legitimately could conclude only that there seemed to be a correlation between budget size and librarians' credentials, not that budget size caused librarians with subject master's degrees to be hired. There are other factors or variables, such as degree of departmentalization, faculty role in book selection, and so on, that could have had as much or more influence than budget size on the criteria for hiring certain librarians. As the survey research study could not control these other variables, it could not test a causal relationship. (As was discussed earlier, the relationship must make sense conceptually as well, regardless of the methodology or technique used.)

Yet descriptive survey research, while usually less rigorous than experimental research, is stronger than exploratory research for testing relationships between variables. In gaining rigorousness, however, it tends to lose flexibility. In short, it tends to provide a compromise method for studying specific phenomena.

BASIC STEPS OF SURVEY RESEARCH: AN OVERVIEW

Formulating Objectives

As is true of any research, in selecting the method (and in designing the techniques to be employed) one must consider the objectives of the study, or how the data will be used. In turn, the objectives should be based on the problem to be investigated or the questions to be answered. The important concern here is that the method selected be precise enough to ensure that the data collected will be relevant to the question or problem under study.

Selecting Data Collection Techniques

Having selected the method (e.g., survey, historical, experimental), the next basic step is to select or design the specific technique or techniques to be used to collect the necessary data. Such techniques as observation, interviews, and questionnaires often are used, but if no suitable technique already exists, then a new one must be devised.

This stage is a critical point at which safeguards against bias and unreliability should be introduced. As Leedy and Ormrod warn, "bias can creep into a research project in a variety of subtle and undetected ways. It can be easily overlooked by even the most careful and conscientious researcher;"[6] therefore, the researcher should safeguard the data from the influence of bias. Leedy and Ormrod define bias as "any influence, condition, or set of conditions that singly or together distort the data."[7] Bias can creep into a study at several points, including during sampling and data collection activities. Bias is difficult, if not impossible, to avoid completely, but at the very least it should be minimized. When bias does appear to exist, the researcher should acknowledge its presence and indicate how it affects the results of the study. Examples of such occurrences will be given later when these topics are discussed.

It is important to pretest the data collection tool at this time. This step will be covered in the section on questionnaires, but the desirability of pretesting applies to all data collection techniques.

Selecting the Sample

Another activity to be treated at some length later is the selection of the sample, a necessary step for all surveys based on portions of a population. It is worth reemphasizing at this time, however, that findings based on a sample should provide a reasonably accurate representation of the state of affairs in the total group, and consequently considerable attention must be given to the sampling technique.

Also, it is worth noting that, in deciding how representative of the total group the sample is, the researcher should consider both statistical and practical differences between the sample and total group. For example, in comparing libraries of a sample with their total group on collection size, one may find that a difference of a few thousand volumes in collection size indicates a statistically significant difference. If one were looking at small, or possibly even medium-sized libraries, this statistical difference might be noteworthy. But if one were studying large university library collections of two million volumes or more, a difference of a few thousand volumes would probably have no real significance, regardless of what the statistics indicated. In other words, the average size of the sample library collections might differ from the average collection size of the population being sampled, but one could still have a reasonably accurate or representative sample for most purposes.

Collecting the Data

Having selected an appropriate data collection tool and the sample to which it will be applied, the next basic step is to collect the data. If one is conducting a relatively large survey, there is a good chance that it will be necessary to employ one or more field workers—persons charged with actually gathering the data. It goes without saying that such field workers should be well trained in the techniques of data collection and should be familiar with the specific tool being used in the researcher's study.

Throughout the survey, the collectors should be supervised closely, and checks should be established to help ensure that they are accurate and that their data are unbiased. As soon as possible after collection, the data should be checked for completeness, comprehensibility, consistency, and reliability. This step is often referred to as "cleaning" the data, and a thorough cleaning of possibly "dirty" data can avoid numerous problems in subsequent statistical analysis. Cleaning the data can involve everything from simply reading the results, looking for surprising responses and unexpected patterns, to verifying or checking the coding of the data.

Analyzing and Interpreting the Results

The process of analyzing the data gathered basically involves coding the responses, or placing each item in the appropriate category (more on this later); tabulating the data; and performing appropriate statistical computations. It is advisable to improve the economy of the study by planning these steps well in advance and in considerable detail. As was indicated earlier, it is also important to provide safeguards against error. This can be accomplished, in part, by checking the reliability of the coders and by checking the accuracy of the tabulations and statistical analysis.

Looking ahead to the interpretation phase, it is useful to be systematic in describing the treatment of the data. The researcher should state clearly and specifically what data are needed to resolve the problem, where they are located, and how they were obtained. The researcher also should describe fully the different steps that will be taken to interpret the data. In addition, he or she should try to ensure that the statistics calculated have a rational base (i.e., explain why they were chosen; their limitations, if any; and how they will be used). Finally, the researcher should distinguish between the mere presentation of the data and the interpretation of the data. The former is basically descriptive in nature; the latter involves analysis and explanation.

Survey Research Designs

The most straightforward type of survey research is descriptive, and it is designed to ensure that the sample is reasonably representative of the population to which the researcher wishes to generalize, and that the relevant characteristics have been accurately measured.

Where more than mere description and simple tabulations are desired, for example in an analytical survey, it may be necessary to develop a more sophisticated design. A common design for survey research, and one that facilitates the analysis of relationships, is known as the "static-group comparison." It is quite similar to a so-called preexperimental design and can be diagrammed as follows:

$$\begin{array}{cc} X & O \\ \hline & O \end{array}$$

With more than one level of X, the design becomes

$$\frac{X_1 \quad O_1}{X_2 \quad O_2}$$

This design depicts two groups, as indicated by the two lines or rows, with two levels of X. The "independent" variable X could represent age, and X_1 retired adults and X_2 middle-aged adults. The "dependent" variable O could represent library use, with O_1 representing library use for the retired adults and O_2 representing library use for the middle-aged adults. In other words, the Os represent observations or measurements of the dependent variable—library use.

The line between the two groups means that they are naturally occurring groups, or that X is a naturally occurring condition, in this case, age. This is in contrast to the manipulated independent variables to be discussed in the section on experimental research.

In analyzing the results of a survey employing the latter example of a static-group comparison design, the researcher would compare the O scores of the comparison groups to determine whether there is a relationship between X and O. In other words, does one age group seem to use the library more than the other?

The difficulty in interpreting the results of a static-group comparison is that there is a real possibility that other differences between the two groups may also be affecting library use. For example, retired adults may have more leisure time than middle-aged adults and therefore may be more inclined to use libraries. Or, had the middle-aged adults been found to be heavier library users, it might have been because they tended to have higher incomes and that something about higher income encourages library use.

As has been stated, the best that survey research can demonstrate is correlational or associational relationships, and correlation does not demonstrate causation. On the other hand, correlation is necessary for causation, so evidence of a strong correlation between two variables would strengthen the case for causation.

A second, relatively common example of a survey research design is known as the "panel design." The panel design is a slightly stronger design than the static-group comparison because it takes into account the time sequence and changes over time by collecting data on the Xs and Os at two or more times. The panel design is diagrammed as follows:

$$\frac{X_{1_1} \quad X_{1_2} \quad X_{1_3} \quad O \ldots X_{1_2} \quad X_{1_3} \quad O \ldots X_{1_2} \quad O}{X_{2_1} \quad X_{2_2} \quad X_{2_3} \quad O \ldots X_{2_2} \quad X_{2_3} \quad O \ldots X_{2_2} \quad O}$$

The first of the two subscripts on the Xs indicates the level of the "independent" variable, for example, for gender—male and female. The second subscript represents the variable identification. For example, X_{1_1} could represent males with a certain level of income, X_{1_2} males with a certain educational background. The Os represent the "dependent" variable or, in this example, frequency of library use. The line continues to indicate naturally occurring groups. The fact that the Xs and Os occur more than once in each group indicates that the data are collected and observations are made more than once for at least some of the variables.

In analyzing the results of survey research employing this design, the researcher may conclude that females, in conjunction with certain levels of income, education, and age, are more likely to use libraries than males with comparable values on those variables. But the researcher should draw such conclusions cautiously, as the time intervals may not be adequate to allow the Xs to effect changes in library use and, once again, there may be other important group differences affecting library use that have not been taken into account. Such designs do, however, help the researcher to understand and analyze relationships between variables and to generalize from natural processes that have occurred. While they cannot establish causation, they can help to build a case for it.

Survey research has been applied in library-related research for a variety of purposes. It has been proven to be particularly useful for use and user studies, state-of-the-art surveys, and library performance evaluations. Busha and Harter review in some detail a selection of projects that were based on survey methods and that they consider to be successful.[8] Library surveys are indexed in *Library Literature & Information Science*. A book by Fink provides a useful step-by-step guide to conducting surveys in any discipline.[9]

Survey Research Costs

Survey research tends to be relatively inexpensive, at least if the sample or population being surveyed is not large, but it is still often desirable to reduce the costs. Recommended guidelines for reducing survey costs include the following:

1. Shorten the length of data collection
2. Reduce the number of follow-ups
3. Limit pilot or pretesting to a small number of participants
4. Shorten time spent developing data collection instruments by adapting already existing instruments
5. Make the instrument as short as possible
6. Use nonmonetary incentives to encourage respondents
7. Minimize staff costs
8. Shop around for least expensive supplies and equipment
9. Reduce the number of survey activities
10. Minimize the amount of time each activity takes.[10]

SAMPLING

As was indicated earlier, sampling is often one of the most crucial steps in survey research. In fact, rigorous sampling methods have been developed and used primarily within the context of survey research. However, “the basic logic and many of the specific techniques of sampling are equally applicable to other research methods such as content analysis, experimentation, and even field research."[11]

Basic Terms and Concepts

Before considering some standard techniques of sampling, it is important to have an understanding of the following basic terms and concepts related to sampling.

1. Universe—the theoretical aggregation of all units or elements that apply to a particular survey. For example, if one were surveying librarians, the study universe would include all librarians, regardless of type, location, and so on. Universe is not frequently used today; it is often used synonymously with "population" and is essentially a useless term.
2. Population—the total of all cases that conform to a prespecified criterion or set of criteria. It is more specific or better defined than a universe and is in effect a designated part of a universe. For example, American academic librarians would be part of the universe of librarians and could represent the population for a survey study. The population is the aggregation of units to which one wishes to generalize the results of a research study.

   Selection of the population must precede the selection of the sample, assuming a sample is to be drawn, and is crucial to the success of the sampling stage. Selection of the population must be done carefully with regard to the selection criteria, desired size, and the parameters of the survey population. It is also important to consider costs, in terms of time and money, when selecting a population. If the population is too large or expensive to manage, then the study is handicapped from the start. Obviously, the members of the population must be readily accessible to the researcher; otherwise, it will be difficult, if not impossible, to collect the necessary data.
3. Population stratum—a subdivision of a population based on one or more specifications or characteristics. A stratum of the population of all U.S. academic librarians could be U.S. academic librarians of libraries with a collection of at least one million volumes or with a budget of a certain size.
4. Element—an individual member or unit of a population. Each academic librarian would be an element of the population of academic librarians. The total number of elements of a population is usually designated by N.
5. Census—a count or survey of all the elements of a population, and the determination of the distribution of their characteristics. A complete census is usually not possible, or at least is impractical and unnecessary, so typically a sample of the population rather than the entire population is surveyed
6. Sample—a selection of units from the total population to be studied. It is usually drawn because it is less costly and time consuming to survey

than is the population, or it may be impossible to survey the population. However, one can never be absolutely certain how representative a sample is of its population, unless a census is also made, which would obviate using the sample. The concept of representativeness is crucial to sampling and will be treated in greater depth later.

7. Case—an individual member of the sample. The total number of cases in a sample is usually designated by lower-case n.
8. Sampling frame—the actual list of units from which the sample, or some part of the sample, is selected. It is often used interchangeably with "population list." One problem with email surveys is the acquiring of email address lists, but the Web has made it possible to select samples without having to know respondents' email addresses.[12]

TYPES OF SAMPLING METHODS

It is useful to distinguish between two basic types of sampling methods—probability sampling and nonprobability sampling. Probability sampling is the more scientific and useful of the two methods, and the bulk of this section will be devoted to that technique. Nonprobability sampling will be considered first.

Nonprobability Sampling

With a nonprobability sample, the researcher cannot state the probability of a specific element of the population being included in the sample. In fact, one cannot be assured that a specific element has any probability of being included in the sample. Therefore, nonprobability samples suffer from important weaknesses. When selection probabilities are unknown, one cannot make legitimate use of statistical inference. That is, a nonprobability sample does not permit generalizing from the sample to the population because the researcher has no assurance that the sample is representative of the population. Nor can the researcher, relying on a nonprobability sample, evaluate the risks of error involved in making inferences about the sample.

On the other hand, nonprobability samples are usually easier and cheaper to obtain than are probability samples, and for some purposes, such as where the focus is on the sample itself, may be quite adequate. "Samples of several" are commonly used for pretests. In some cases nonprobability samples may be the only feasible samples. There are measures one can take to try to improve the representativeness of nonprobability samples; these techniques will be referred to when discussing some of the different kinds of nonprobability samples that follow.

Accidental Sample

In utilizing an accidental sampling technique, the researcher simply selects the cases that are at hand until the sample reaches a desired, designated size. If one wished to conduct an academic library user study, one might elect to survey library patrons as they entered or exited the library, on a "first-come, first-served" basis. There would be little or no preferential selection of respondents.

Obviously, there would be relatively little if any assurance that the sample was reasonably representative of the library's users. One could not assume that the accidental sample was not atypical. The researcher might query users during some other time period and end up with quite different responses. Accidental sampling is seldom adequate for any kind of survey. Synonyms include convenience and availability samples.

Quota Sample

A type of nonprobability sample that improves somewhat on the simple accidental sample is the quota sample. Quota sampling is the same as accidental sampling except that it takes steps to ensure that the significant, diverse elements of the population are included. The quota sample method also attempts to ensure that the different elements are included in the sample in the proportions in which they occur in the population.

Returning to the researcher who wishes to survey the users of an academic library, he or she, in selecting a quota sample, would take measures to ensure that the sample includes the same percentages of faculty, graduate students, and so on as exist in the entire academic community. Or the researcher may choose to sample the same number of persons representing each element of the population, and then to assign them a weight according to their portion of the total population. The latter technique obviously requires knowledge of the proportions of the population according to each element.

Among the problems inherent in quota sampling is the difficulty in determining that the proportions for each element are accurate. Second, biases may exist in the selection of cases representing the various elements, even though their proportion of the population might have been accurately estimated. For example, the researcher sampling academic library users may survey the correct proportions of seniors, graduate students, and so on, but for whatever reason may tend to query those inclined to be more competent library users. If one were investigating library skills, such a bias would be damaging to the validity of the study.

Yet quota samples, while they should be used cautiously, are useful for exploratory studies, as are other nonprobability sampling techniques. Quota sampling is often used for public opinion surveys.

Snowball Sample

Some refer to this type of sampling as accidental sampling. It is an appropriate method to use when members of the population are difficult to identify and locate, such as migrants and homeless individuals. The researcher contacts members of the population who can be identified and located and then asks these individuals to provide information to identify and locate other members of the population to participate in the research. This type of sampling is cumulative, hence the name, snowball sampling.[13] This type of nonprobability sampling is used in exploratory research since the technique can result in "samples with questionable representativeness."[14] It is commonly used in qualitative research and is described in Chapter 7 of this book.

Purposive Sample

At times, it may seem preferable to select a sample based entirely on one's knowledge of the population and the objectives of the research. In designing a survey of the directors of large university libraries that are in the process of developing electronic reference services, one may decide that the easiest way of obtaining a sample of such libraries would be to select libraries known to the researcher to be engaged in such activities.

The researcher would be making the assumption that such a sample would be reasonably typical of all university libraries involved in developing electronic reference services. Unfortunately, such an assumption may not be justified. There is no assurance that a purposive sample is actually representative of the total population. Any sampling method not utilizing random selection is overly susceptible to bias.

Self-Selected Sample

As the label suggests, a self-selected sample is a group of cases, usually people, who have essentially selected themselves for inclusion in a study. A researcher might, for example, publish a notice in a professional journal asking individuals to volunteer to submit certain information or to participate in some other way. Again, there would be a strong possibility that these volunteers would not be representative of the entire population to which they belong.

Incomplete Sample

An incomplete sample, while not originally intended to be a nonprobability sample, in effect becomes one. For example, if a large percentage of the cases selected do not respond or participate in a study, then assurance that the sample is representative of the population is quite possibly lost, even though the sample may have been selected randomly. Another example of an incomplete sample is one drawn from an incomplete population list. Again, the sample may have been drawn randomly, but as the faulty list was in effect biased or not fully representative of the population, the sample must be considered unrepresentative and in effect a nonprobability sample.

Probability Sampling

As was indicated earlier, the primary purpose of sampling is to select elements that accurately represent the total population from which the elements were drawn. Probability sampling enhances the likelihood of accomplishing this objective and also provides methods for estimating the degree of probable success; that is, it incorporates probability theory, which provides the basis for estimating population parameters and error.[15] The crucial requirement of probability sampling is that every element in the population has a known probability of being included in the sample. A discussion of major types of probability sampling follows.

Simple Random Sample (SRS)

Simple random sampling is the basic sampling method of survey research. The technique of simple random sampling gives each element in the population an equal chance of being included in the sample. It also makes the selection of every possible combination of elements equally likely. In other words, if one had a population or sampling frame of 500 elements, in drawing a simple random sample of that population one should be as likely to include elements 1 and 3 as 2 and 4, or 1 and 2, and so on.

In order for the probabilities of including each element and each combination of elements to be equal, it is necessary that there be independence from one draw to the next. This means that the selection of an element should have no effect on the chances of remaining elements being selected. But this condition cannot be met fully unless the sampling is done with replacement. In sampling with replacement, the researcher would place every element back in the population list after being selected for the sample so that it is again available for selection. If replacement is not done, then the remaining elements would not have the same likelihood of being drawn as did the elements already selected. The remaining population would decrease in number as elements were selected, and the elements still in the population would have an increasingly greater chance of being selected. Similarly, the likelihood of every combination being selected would not remain constant, because, as some elements were removed from the population and not replaced, certain combinations would no longer be possible.

However, if the elements selected for the sample are subsequently put back in the population list (after making note that they are now a part of the sample), then there is the possibility that some of them may be selected for the sample again. This obviously presents practical problems, so sampling with replacement is not often done. This normally does not invalidate the sample, however, as the sample usually represents a relatively small percentage of the population, and the chances of any element being selected two or more times is slight. But if the sample is as much as one-fifth the size of the population, technically one should introduce correction factors if possible. However, samples drawn without replacement do tend to be more representative.

There are mathematical formulas that can be used to correct for sampling without replacement, but if the sample represents a relatively small proportion of the population, use of a formula is unnecessary. In addition, exact correction factors are seldom known. Yet, if correction does seem to be warranted, using such formulas is generally preferable to sampling with replacement and taking a chance of drawing some elements more than once. Those readers interested in correction formulas should refer to a standard text on sampling.

Selecting the Simple Random Sample

There are several techniques available for selecting a simple random sample. Traditional methods include the roulette wheel or lottery type approach. Such methods have been criticized as being at least potentially biased, or not fully random, however, because of physical or logistical imperfections. For example, if one were drawing ping pong balls from a large bowl or revolving drum, there is the possibility that the balls might not have been adequately mixed to begin with and that those placed in the container early, or late, have a greater chance of being selected. Consequently, it is advisable to consider other, more reliable techniques.

One recommended method commonly used for drawing a simple random sample involves the use of a table of random numbers. A well-known example is the Rand Corporation's *A Million Random Digits* (see Table 4.1 for an illustrative page). A table of random numbers is simply that—a listing of randomly arranged numbers. The basic steps involved in using such a table are as follows:

1. The first step would be to number sequentially the elements of the population. Let us assume that we have a population of elements numbered from 1 to 500. (Obviously, each element now has a unique number.)
2. The next step is to determine how many of the elements are to be selected for the sample. Techniques for determining a desirable sample size will be discussed later, so for now let us assume that we have decided on a sample of 50.
3. As there are three-digit numbers in the population, it will be necessary to select three-digit numbers from the table in order to give every element a chance of being selected.
4. The next step is to choose the starting point in the table and the pattern for moving through the table. Pure chance must determine the starting point. A simple way of selecting the starting point is to close one's eyes and place a pencil point on the table. The number under or nearest the pencil point then becomes the starting point.
5. For ease of illustration, let us assume that the pencil came down at the head of the fifth column of the table. As we must select three-digit numbers, we could then consider, along with the seven, the next two digits, and 732 becomes the first number to be considered for our sample. (It would be possible to move down the column from seven and consider 722 as the first three-digit number.) Regarding the pattern of movement, we could proceed from there across to the right, or left, down, or diagonally through the table. All that matters is that we be consistent.
6. As stated, we will first consider 732 for our sample. But as it is larger than any number in our population (the largest is 500), we will have to reject or ignore it and move to the next number. Assuming we have decided to move down the three-digit column to the bottom and then back up to the top of the next three-digit column, the next number to be considered would be 204. The number 204 does fall within the population, so the element represented by 204 would be included in the sample. This process would continue until 50 elements had been selected. If sampling without replacement, we would skip numbers that have already been included in the sample.

TABLE 4.1 Random Numbers[a]

10 09 73 25 33	76 52 01 35 86	34 67 35 48 76	80 95 90 91 17	39 29 27 49 45
37 54 20 48 05	64 89 47 42 96	24 80 52 40 37	20 63 61 04 02	00 82 29 16 65
08 42 26 89 53	19 64 50 93 03	23 20 90 25 60	15 95 33 47 64	35 08 03 36 06
99 01 90 25 29	09 37 67 07 15	38 31 13 11 65	88 67 67 43 97	04 43 62 76 59
12 80 79 99 70	80 15 73 61 47	64 03 23 66 53	98 95 11 68 77	12 17 17 68 33
66 06 57 47 17	34 07 27 68 50	36 69 73 61 70	65 81 33 98 85	11 19 92 91 70
31 06 01 08 05	45 57 18 24 06	35 30 34 26 14	86 79 90 74 39	23 40 30 97 32
85 26 97 76 02	02 05 16 56 92	68 66 57 48 18	73 05 38 52 47	18 62 38 85 79
63 57 33 21 35	05 32 54 70 48	90 55 35 75 48	28 46 82 87 09	83 49 15 56 24
73 79 64 57 53	03 52 96 47 78	35 80 83 42 82	60 93 52 03 44	35 27 38 84 35
98 52 01 77 67	14 90 56 86 07	22 10 94 05 58	60 97 09 34 33	50 50 07 39 98
11 80 50 54 31	39 80 82 77 32	50 72 56 82 49	29 40 52 41 01	52 77 56 78 51
83 45 29 96 34	06 28 89 80 83	13 74 67 00 78	18 47 54 06 10	68 71 17 78 17
88 68 54 02 00	86 50 75 84 01	36 76 66 79 51	90 36 47 64 93	29 60 91 10 62
99 59 46 73 48	87 51 76 49 69	91 82 60 89 28	93 78 56 13 68	23 47 83 41 13
65 48 11 76 74	17 46 85 09 50	58 04 77 69 74	73 03 95 71 86	40 21 81 65 44
80 12 43 56 35	17 72 70 80 15	43 31 82 23 74	21 11 57 82 53	14 38 55 37 63
74 35 09 98 17	77 40 27 72 14	43 23 60 02 10	45 52 16 42 37	96 28 60 26 55
69 91 62 68 03	66 25 22 91 48	36 93 68 72 03	76 62 11 39 90	94 40 05 64 18
09 89 32 05 05	14 22 56 85 14	46 42 72 67 88	96 29 77 88 22	54 38 21 45 98
91 49 91 45 23	68 47 92 76 86	46 16 28 35 54	94 75 08 99 23	37 08 92 00 48
80 33 69 45 98	26 94 03 68 58	70 29 73 41 35	53 14 03 33 40	42 05 08 23 41
44 10 48 19 49	85 15 74 79 54	32 97 92 65 75	57 60 04 08 81	22 22 20 64 13
12 55 07 37 42	11 10 00 20 40	12 86 07 46 97	96 64 48 94 39	28 70 72 58 15
63 60 64 93 29	16 50 53 44 84	40 21 95 25 63	43 65 17 70 82	07 20 73 17 90
61 19 69 04 46	26 45 74 77 74	51 92 43 37 29	65 39 45 95 93	42 58 26 05 27
15 47 44 52 66	95 27 07 99 53	59 36 78 38 48	82 39 61 01 18	33 21 15 94 66
94 55 72 85 73	67 89 75 43 87	54 62 24 44 31	91 19 04 25 92	92 92 74 59 73
42 48 11 62 13	97 34 40 87 21	16 86 84 87 67	03 07 11 20 59	25 70 14 66 70
23 52 37 83 17	73 20 88 98 37	68 93 59 14 16	26 25 22 96 63	05 52 28 25 62
04 49 35 24 94	75 24 63 38 24	45 86 25 10 25	61 96 27 93 35	65 33 71 24 72
00 54 99 76 54	64 05 18 81 59	96 11 96 38 96	54 69 28 23 91	23 28 72 95 29
35 96 31 53 07	26 89 80 93 54	33 35 13 54 62	77 97 45 00 24	90 10 33 93 33
59 80 80 83 91	45 42 72 68 42	83 60 94 97 00	13 02 12 48 92	78 56 52 01 06
46 05 88 52 36	01 39 09 22 86	77 28 14 40 77	93 91 08 36 47	70 61 74 29 41
32 17 90 05 97	87 37 92 52 41	05 56 70 70 07	86 74 31 71 57	85 39 41 18 38
69 23 46 14 06	20 11 74 52 04	15 95 66 00 00	18 74 39 24 23	97 11 89 63 38
19 56 54 14 30	01 75 87 53 79	40 41 92 15 85	66 67 43 68 06	84 96 28 52 07
45 15 51 49 38	19 47 60 72 46	43 66 79 45 43	59 04 79 00 33	20 82 66 95 41
94 86 43 19 94	36 16 81 08 51	34 88 88 15 53	01 54 03 54 56	05 01 45 11 76

[a]*Source*: The RAND Corporation. *A Million Random Digits* (Glencoe, II.: Free Press, 1955).

If the population list or sampling frame is in an electronic file, a random sample can be selected by a computer. In effect, the computer numbers the elements in the population, generates its own series of random numbers, and prints the list of elements selected. Computer generation of samples is particularly useful when drawing very large samples or working with large populations.

Systematic Sample

A method of selecting a random sample that is considered by most to be as reliable and accurate as simple random sampling is systematic sampling. This technique involves taking every nth element from a list until the total list has been sampled. For example, the researcher may have a population list of 1,000 elements and decide to select every tenth element for the sample. This would be a sampling interval of 10, and would result in a sampling ratio of 1:10 and a sample of 100. The list should be considered to be circular in that the researcher would select every nth name, beginning with a randomly chosen starting point and ending with the first name of the interval immediately preceding the starting point.

Systematic sampling is easier and faster than simple random sampling for long lists. If one wished to draw a random sample from a telephone directory, for example, it would be considerably faster to take every nth name than to use a table of random numbers.

However, with systematic sampling not every combination of elements has an equal chance of being drawn. So, if the list is not randomly arranged, such as is the case with an alphabetical listing, the sample would not be random. (For some variables or problems, however, an alphabetical arrangement would have no relevance and could be treated as a randomly arranged list.) For example, ranked lists such as lists of personnel, and hierarchically arranged, or cyclical lists, such as lists of houses, can easily produce biased samples. To elaborate on the first example, if one were selecting every 10th individual from an organization's personnel list arranged by department and rank within the department, and if the departments had approximately the same number of employees, then the sample might tend to include people of the same rank. If these individuals tended to have certain characteristics in common, then the sample would be biased. In short, systematic sampling is generally as satisfactory as simple random sampling, but only if the population list exhibits no trends or patterns.

Stratified Random Sample

In selecting a stratified random sample, one must first divide all of the population elements into groups or categories and then draw independent random samples from each group or stratum. This technique represents a modification of simple and systematic random sampling in that it reduces the number of cases needed to achieve a given degree of accuracy or representativeness. The strata should be defined in such a way that each element appears in only one stratum. Different sampling methods may be used for different strata. For example, a simple random sample may be drawn from one stratum and a systematic sample from another.

There are two basic types of stratified random samples—proportional and disproportional. In drawing a proportional stratified sample, one would draw the same percentage from each stratum. If there were 1,000 elements in a population, divided into ten strata of 100 each, and if one desired a total sample of 100, then ten elements, or 10 percent, would be drawn from each stratum. (It is more likely, however, that the strata would not all have the same number of elements. In that case, the same percentage would still be taken from each stratum, but the resulting numbers would vary.)

If a researcher were to stratify all public libraries in a state according to budget size, it is probable that there would be different numbers of libraries in each group. But if the groups were roughly equal in their number of libraries, and if the categories tended to be internally homogeneous, then it would be reasonable to select the same percentage of libraries from each stratum or to use a constant sampling rate. Doing so would produce a *proportional stratified sample* with libraries of certain budget sizes being included in the sample in the same proportions in which they occur in the population.

On the other hand, if there were considerable variations within individual strata, or if some strata were so small as to be in danger of barely being represented in the total sample, if at all, the researcher would be well advised to draw a *disproportional stratified sample*, sometimes referred to as optimum allocation. In doing so, one would draw approximately the same number of elements from each stratum regardless of its size. In order to do so, it would be necessary to use different sampling fractions or to select different percentages of cases from the strata. Consequently, some cases would represent a greater percentage of the sample than of the population. "Optimum precision is attained if sampling fractions in the different strata are made proportional to the standard deviations in the strata."[16]

This method would provide enough cases per category to allow meaningful comparisons among categories. As is true for proportional stratified sampling, it would help to assure a more representative total sample than might be expected with simple or systematic random sampling. Unlike proportional sampling, it could do so even when the groups are lacking in internal homogeneity. Disproportional stratified random sampling also can be used to take a relatively large sample from the stratum from which it is cheapest to gather data. In an interview survey of libraries, for example, this may be the group of libraries closest to the researcher. However, the increase in precision over proportional stratified sampling tends to be small, and optimizing the sample for group comparisons means the sample is no longer optimal for estimating the total population.

The choice of stratification variables typically depends on which ones are available and which ones are presumably related to the variables that one wants to represent accurately. Returning to the survey of public libraries within a state, it may well be that the researcher would decide to stratify public libraries by known budget size on the assumption that budget size would correlate with collection size—the actual variable to be studied, but yet to be determined. In other words, stratifying on budget size would help to ensure that there would be proper representation of collection sizes, and other variables, related to budget size. In general, the stratified sample would be more representative of a number of variables than would a simple random sample taken for the same purpose.

Table 4.2 presents stratification figures for a hypothetical population of 1,000 public libraries. As can be seen in the first row, 100 libraries have budgets of

TABLE 4.2 Proportional and Disproportional Stratified Sampling

	Library Budget in Thousands of Dollars			
Strata/Samples	**0–100**	**101–250**	**251–500**	**501**
Strata	100	300	400	200 (N = 1000)
Proportional sample	10	30	40	20 (n = 100)
	10%	10%	10%	10%
Disproportional sample	25	24	24	24 (n = 97)
	25%	8%	6%	12%

$100,000 or less, 300 libraries have budgets of $101,000–$250,000, and so on. If one were to draw a proportional stratified sample using a uniform sampling ratio of 10 percent, then the sample would contain 10 libraries with budgets of $100,000 or less, and so on. The researcher might conclude, however, that a sample of 10 is too small to be very reliable and that comparisons of samples of such disparate size might be chancy. Therefore, he or she might decide to vary the sampling ratio across strata in order to end up with samples of about the same size (see the bottom line where sampling ratios vary from 6% to 25%). With either sampling technique, the total sample contains about 100 cases.

One statistical note—when computing estimates of means and estimating standard errors for disproportional stratified samples, one should compute values separately for each of the strata and then weight them according to the relative size of the stratum in the population. (This is not necessary for proportional stratification, as it is in effect "self-weighting.") In addition, it should be recognized that, in theory, one cannot make legitimate use of various nonparametric statistical tests, tests for the significance of correlation, analysis of covariance, and so on, without substantial modifications. Unfortunately, statistical textbooks seldom address this issue.

Cluster Sample

In social science research, it is not unusual to encounter situations where the populations cannot be listed easily for sampling purposes. Examples include the populations of countries and states, all college students within the United States, and so on. When it is impossible or impractical to compile an exhaustive list of the elements of a total population, cluster sampling may be used effectively.

Essentially, the technique of cluster sampling involves dividing a population into clusters or groups and then drawing a sample of those clusters. In fact, the population might already be grouped into subpopulations, and cluster sampling becomes merely a matter of compiling a list of the subpopulations, or clusters, and selecting a random sample from them. For example, while a list of a city's residents may not exist, people do live on discrete blocks. Therefore, one could draw a sample of city blocks, compile lists of persons residing on those blocks, and then sample the people living on each block.

In using cluster sampling, it is desirable that each cluster's units be as heterogeneous as possible, but that characteristics of the clusters themselves be similar. This is particularly important if all members of each selected cluster are to be included in the final sample. Yet, typically, the elements constituting a given natural cluster within a population are more homogeneous than are all the elements of the total population. Therefore, relatively few elements may be needed to represent a natural cluster, while a relatively large number of clusters will be required to represent the diversity of the total population. The more heterogeneous the clusters, the fewer will be needed. "With a given total sample size, however, if the number of clusters is increased, the number of elements within a cluster must be decreased,"[17] unless the clusters are known to be especially heterogeneous.

Cluster sampling may be either single-stage or multistage sampling. Single-stage cluster sampling occurs only once. In the earlier example involving the selection of city blocks, all elements or persons residing on each block would be included in a single-stage design. In a two-stage design, the simple random sampling of city blocks would be followed by a random sampling of the persons living on the blocks. Or, in a more complex design, a sampling of census tracts could be followed by a random sampling of smaller clusters of blocks, followed by a sampling of individual houses, and conclude with a sampling of persons living in those houses. A combination of probability and nonprobability sampling may be used in multistage sampling, but the researcher should keep in mind the likely loss of accuracy with nonrandom sampling.

The sampling procedure illustrated in Figure 4.1 is a combination of cluster, stratified, and simple random sampling that has been employed by the Institute for Social Research at the University of Michigan. The procedure involves the following steps:

1. The entire geographical area of the 48 continguous states is divided into small areas called *primary sampling units* (PSU). The PSUs are usually counties, metropolitan areas, or telephone exchange areas. A stratified random sample of about 75 PSUs are selected from the total list.
2. Each PSU is stratified into large cities, smaller cities and towns, and/or rural areas. Each unit within a stratum is referred to as a *sample place*, and one or more sample places is selected from each stratum.
3. Each sample place is divided into *chunks*, which are distinct areas such as blocks. A number of chunks are randomly selected from each sample place.
4. The chunks are broken down into *segments*—areas containing from 4 to 12 dwelling units. Segments are then randomly drawn from each chunk.
5. *Dwelling units*, selected from each segment, constitute the final sample. A city directory can be used to obtain telephone numbers for the dwelling units so chosen.

As was noted earlier, cluster sampling may be the only feasible or practical design where no population list exists. It also tends to be a cheaper sampling method for large surveys. But multistage cluster sampling does sacrifice accuracy, because sampling error can occur at each stage. In a two-stage sampling

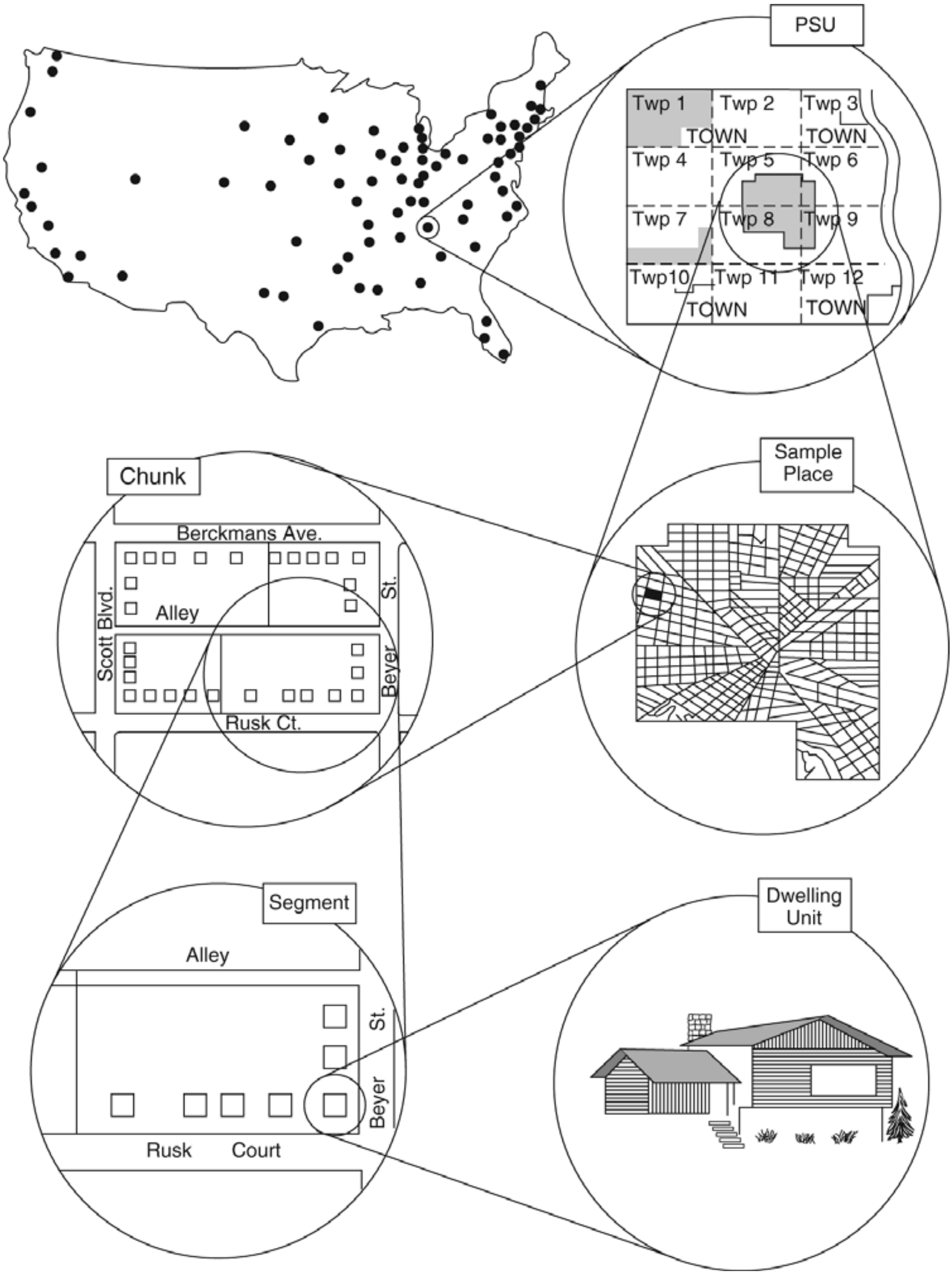

Figure 4.1 Cluster Sampling Method. From Survey Research Center, *Interviewer's Manual*, rev. ed. Ann Arbor: Institute for Social Research, University of Michigan, 1976, p. 8–2.

design, the initial selection of clusters is subject to sampling error, and the sampling of elements within each cluster is subject to error. The researcher must decide if the greater efficiency gained from cluster sampling is worth the greater risk of sampling error, and must attempt to minimize the error by optimizing the number of clusters and elements selected. Theoretically, cluster sampling

TABLE 4.3 Population Characteristics and Appropriate Random Sampling Techniques

Population Characteristics	**Example of Population Type**	**Appropriate Sampling Technique**
A general homogeneous mass of individual units	First-year students of a private university	Simple random sampling (systematic sampling if the population list is long)
Definite strata, each as internally homogeneous as possible and of approximately the same size.	All undergraduate students of a private university; each level represents a stratum	Proportional stratified sampling
Definite strata, some of which are quite small and/or internally heterogeneous	All public libraries in a state, stratified by budget size, resulting in an upper budget category containing only a few libraries	Disproportional stratified sampling
Clusters whose group characteristics are similar, but whose elements or internal characteristics are quite heterogeneous	A population consisting of the users of the major urban public libraries in the nation; the libraries tend to be similar, but their users vary widely in characteristics	Cluster sampling

necessitates using special statistical formulas, especially when the clusters are of greatly differing sizes. Again, a text on sampling should be consulted if more information about this issue is desired.

With the availability of Web 2.0 social media, "such as blogs, forums, and instant polls, researchers are building communities to freely discuss issues."[18] These communities provide opportunities for researchers with individuals who may not respond to other types of data collection methods. However, these individuals only represent a small percentage of the population who are comfortable using this medium to communicate; therefore, researchers should use social media as sample frames only when they represent the intended target groups.

In summarizing the characteristics of some major random sampling techniques, the somewhat simplified outline presented in Table 4.3 may be helpful.

DETERMINING THE SAMPLE SIZE

The general rule of thumb for the size of the sample is, quite simply, the larger the better. Babbie states that probability samples of less than 100 are not likely to be very representative of the population.[19] Yet there is no point in utilizing a sample that is larger than necessary; doing so unnecessarily increases the time and money needed for a study. There are at least four general criteria that can help to determine the necessary sample size. One is the degree of precision required between the sample and the population. The less accuracy needed, the smaller the necessary sample. Two, the variability of the population influences the sample size needed to achieve a given level of accuracy or representativeness. In general, the greater the variability, the larger the sample needed. (Statistics commonly used to estimate the variability of a population will be noted in the chapter on data analysis.) Three, the method of sampling to be used can affect the size of the appropriate sample. As was noted in the discussion of random sampling, stratified sampling requires fewer cases to achieve a specified degree of accuracy than does simple or systematic random sampling. Four, the way in which the results are to be analyzed influences decisions on sample size. Samples that are quite small place significant limitations on the types of statistical analyses that can be employed.

Use of Formulas

Statistical formulas have been developed for calculating appropriate sample sizes. They typically take into account the confidence level, which relates to the probability of the findings, or differences between samples, being due to chance rather than representing a real difference. The confidence level is equal to 1 minus the level of significance, or 1 minus the probability of rejecting a true hypothesis. Formulas also consider the degree of accuracy with which one wishes to estimate a certain characteristic of the population and the variability of the population, usually as represented by its estimated standard deviation—a standard measure of dispersion. (The greater the spread of scores about the mean, the larger the standard deviation.)

One such formula is stated as follows:

$$n = \frac{S^2}{[S_1 E_1 (\bar{x})]^2}$$

where

n = sample size,

S = standard deviation of the variable or characteristic of the population (estimated), and

$S_1 E_1 (\bar{x})$ = standard error of the mean or sampling error.

The difficulty in using formulas is that S, the population's standard deviation, must be estimated. It is known only if the total population is analyzed, therein eliminating the need for taking a sample. In addition, if the sample represents a large proportion of the population, a finite population correction has to be included. "Usually, sampling units have numerous attributes, one or more of which are relevant to the research problem."[20] Therefore, if more than one variable is to be studied, a sample that is adequate for one variable may not be satisfactory for another. One should consider the variability of all of the variables; the sample size tends to increase as the number of variables increases.

A proportional allocation formula, based on the assumption that a characteristic occurred 50 percent of the time, was used by Krejcie and Morgan to develop

TABLE 4.4 Table for Determining Sample Size from a Given Population

N	*S*	*N*	*S*	*N*	*S*
10	10	220	140	1200	291
15	14	230	144	1300	297
20	19	240	148	1400	302
25	24	250	152	1500	306
30	28	260	155	1600	310
35	32	270	159	1700	313
40	36	280	162	1800	317
45	40	290	165	1900	320
50	44	300	169	2000	322
55	48	320	175	2200	327
60	52	340	181	2400	331
65	56	360	186	2600	335
70	59	380	191	2800	338
75	63	400	196	3000	341
80	66	420	201	3500	346
85	70	440	205	4000	351
90	73	460	210	4500	354
95	76	480	214	5000	357
100	80	500	217	6000	361
110	86	550	228	7000	364
120	92	600	234	8000	367
130	97	650	242	9000	368
140	103	700	248	10000	370
150	108	750	254	15000	375
160	113	800	260	20000	377
170	118	850	265	30000	379
180	123	900	269	40000	380
190	127	950	274	50000	381
200	132	1000	278	75000	382
210	136	1100	285	1000000	384

Note: N is population size, S is sample size. The degree of accuracy = 0.05.
From Krejcie, Robert V., and Daryle W. Morgan, "Determining Sample Size for Research Activities," *Educational and Psychological Measurement* 30 (Autumn 1970): 608.

a table of sample sizes for given population sizes. This table is presented here (see Table 4.4) but, as was noted earlier, a variety of factors can influence desirable sample size. A table of sample sizes may represent a rather simplistic, and quite possibly conservative, method for ascertaining a sample size.

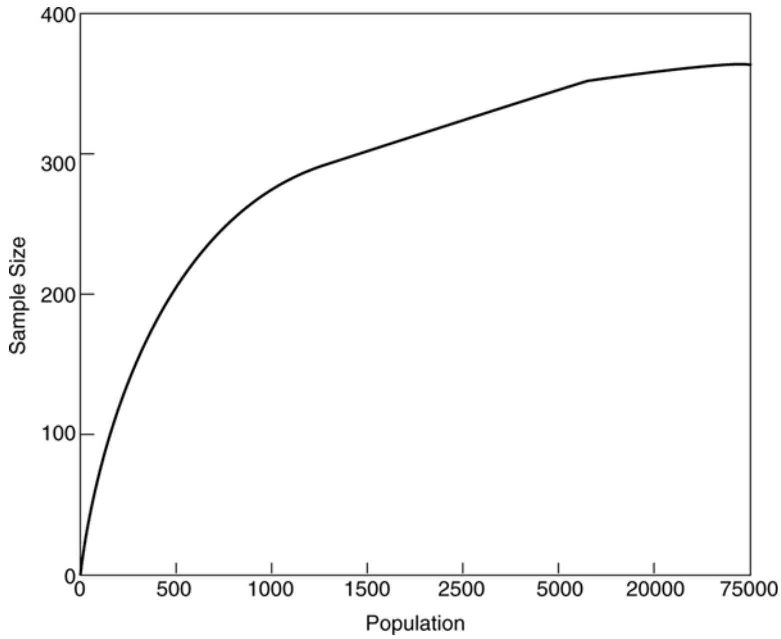

Figure 4.2 Relationship between Sample Size and Total Population. Adapted from Krejcie, Robert V., and Daryle W. Morgan, "Determining Sample Size for Research Activities," *Educational and Psychological Measurement* 30 (Autumn 1970): 609.

Again, there is seldom much justification for using a sample that is larger than necessary.

Table 4.4 does not require any calculations. To obtain the required sample size, one need only enter the table at the given population size (e.g., 9,000) and note the adjacent sample size (368). Figure 4.2 illustrates the relationship between sample size and total population. It, as well as the table, indicates that, as the population size increases, the rate of requisite increase in sample size decreases.

To calculate the optimal sample size when dealing with a continuous variable such as age, one could use the following formula:

$$n = \frac{z^2 s^2}{E^2}$$

where

n = sample size

z = z score for desired confidence level (see the chapter on analysis of data for a discussion of z scores)

s = standard deviation of the population

E = allowable error.

Readers wanting to know more about determining sample size may wish to refer to works by Kraemer and Thiemann, Hernon, and Cohen.[21] The last work provides several tables of sample sizes as functions of the type and power (the probability that a statistical test will yield statistically significant results) of the statistical test being used.

Sample size calculators also are freely available on the Web. Both Creative Research Systems http://www.surveysystem.com/sscalc.htm and DSS Research http://www.dssresearch.com/toolkit/sscalc/size.asp provide sample size calculators that will determine the sample size and the confidence level.

SAMPLING ERROR

Formulas are also available for estimating the "sampling error" or, as it is often referred to, the "standard error of the mean." The standard error of the mean represents how much the average of the means of an infinite number of samples drawn from a population deviates from the actual mean of that same population. For example, if a population consisted of 50 libraries with collections averaging 500,000 volumes, one should be able to draw all possible sample combinations of 10 libraries, average the means of all the samples, and end up with 500,000 volumes as the mean of the sampling distribution. If the mean of the sampling distribution were based on a limited number of samples, it is possible that it would deviate somewhat from the actual population mean, thus indicating some sampling error.

If the population is large relative to the sample, the formula for calculating the standard error of the mean, or in fact the standard deviation of the sampling distribution of means, is as follows:

$$S_1E_1(\bar{x}) = \frac{S}{\sqrt{n}}$$

where

S = the standard deviation of the population

n = the number of cases in the sample.

If the sample represents a relatively small proportion of the population, or if the population standard deviation is not known and must be estimated, as is usually the case, then modified versions of the formula must be used. The formula for the first situation is as follows:

$$S_1E_1(\bar{x}) = \sqrt{\frac{S^2}{n} \cdot \frac{N - n}{N - 1}}$$

where

S = the standard deviation of the population

N = the number of elements in the population

n = the number of cases in the sample.

The formula for the standard error of the mean, where the population standard deviation is not known, requires substituting an unbiased estimate (s), or the standard deviation of the sample, for the standard deviation of the population (S). "The term *unbiased estimate* refers to the fact that as one draws more and more samples from the same population and finds the mean of all these unbiased estimates, the mean of these unbiased estimates approaches the population value."[22]

The formula for the standard deviation of the sample is as follows:

$$s = \sqrt{\frac{\sum_{i-1}^{n} (x_i - \bar{x})^2}{n - 1}}$$

where

x_i = sample score,

$\bar{x}$ = sample mean, and

n = the number of cases in the sample.

Dividing by n–1 instead of n is done in order to reduce bias or, according to some texts, to help compensate for a small sample. The value for s can then be substituted for S in the first formula given for calculating the standard error of the mean:

$$S_I E_I(\bar{x}) = \frac{s}{\sqrt{n}}$$

As was indicated earlier, there is a point of diminishing returns with regard to the sample size and sampling error. Starting with a sample of one person and then increasing the sample size, the accuracy of the sample will improve rapidly up to about 500 cases. Beyond 500, a relatively large increase in the number of cases is needed in order to increase significantly the accuracy of the sample. For example, if 600 cases are drawn for the sample, the amount of sampling error involved is about 4 percent. To decrease this to 3 percent, it would be necessary to increase the sample size to 1,067; to reduce error to 2 percent requires an increase to 2,401 cases. In other words, after a certain point is reached, increasing the sample size will increase the researcher's workload without appreciably improving the accuracy of the sample. Thus, the researcher is well advised to base his or her decision regarding sample size on desired precision and confidence levels, and not to decide arbitrarily that some percentage of the population represents an optimal sample size. (See Figure 4.3 for an illustration of the relationship between sample size and error in this example.)

Again, one of the main purposes for selecting and analyzing samples is to obtain information about the population from which the sample has been drawn. "If an unbiased sample were taken from the population, it would be hoped that the sample mean would be a reasonable estimate of the population

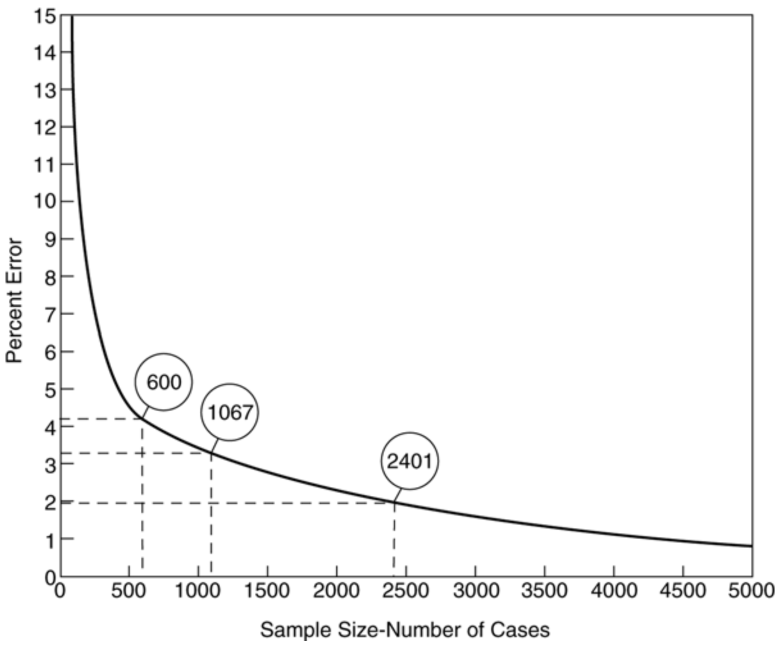

Figure 4.3 Relationship between Sample Size and Percent Error. From Benson, Dennis K., and Jonathan L. Benson, A *Benchmark Handbook: Guide to Survey Research Terms*, Columbus, OH: Academy for Contemporary Problems, 1975. 2.

mean. Such an estimate is known as a *point estimate* but it is unlikely that the mean of a sample will be identical to the mean of the population."[23] Statisticians often content themselves with calculating *interval estimates* or the ranges within which the actual population means are likely to fall.

Other Causes of Sampling Error

The size of a sample, or, more specifically, having too few cases, is not the only cause of sampling error. A variety of factors can contribute to a sample's being less representative of its population than is satisfactory. If not guarded against, bias of one sort or another can easily contaminate a research study. Bias is particularly a problem with nonrandom samples, as there is less of a safeguard against personal attitudes, preferences, and so on affecting the researcher's selection of cases. For example, if a researcher were selecting library users for an interview on library services, he or she might be inclined, if even unconsciously, to slight persons who appeared to be unskilled library users or were sloppily dressed.

Even utilizing probability or random sampling techniques, the unwary researcher can end up with a biased or inaccurate sample. Bookstein, in a *Library Quarterly* article, discussed several faulty selection procedures that can result in inadequate samples.[24] The first of these he referred to as "faulty use of random-number tables." This problem includes any techniques used by the researcher resulting in each element in the list not having an equal chance of being included.

The second general category of faulty selection procedures is labeled by Bookstein as "frame problems." In this case, he is referring to problems related to faulty listing of the population. For instance, if one desired to draw a random sample of a library's holdings, and did so by selecting a random sample of catalog records, a certain amount of bias would be unavoidable. This is so because there is not a one-to-one correspondence between books and catalog records, and the more records representing a title in the catalog, the greater the probability that that book will be selected. Books tending to be represented by a large number of catalog records probably tend to have certain characteristics in common, hence a biased sample.

The third general category of "bad" sampling discussed by Bookstein is referred to as "unintentional modification of population." This category represents more subtle problems than does "frame problems," and it is even more difficult to deal with. Bookstein includes an illustration of this type of problem in which he considers how one might attempt to randomly sample a library's holdings without using a list or catalog. In one simple example, he points out that if one sampled the collection by randomly sampling locations on the shelves, fat books would have a greater chance of being selected than would thin books. In another example, if a researcher were attempting to survey catalog use by randomly selecting times and then randomly selecting users during those times, this technique would be biased toward users tending to spend more time using the catalog. Users of subject headings, for example, might be more likely than some others to be included in the sample.

As Bookstein notes in his conclusions, some of these problems can be corrected by such methods as using weighted averages to compensate for biased sampling techniques. Regardless, it is important for the researcher to be careful to avoid faulty selection techniques. It is critical that random samples be drawn correctly if one is to have "some insurance against the impact of extraneous factors that can distort our results, but whose existence we may not be aware of at the time the sample is taken."[25]

NONSAMPLING ERROR

The information gathered from a sample can be inaccurate not only as a result of the inaccuracy or the lack of representativeness of the sample but also errors of measurement. For example, in responding to a questionnaire or interview, persons may lie about their age or report figures inaccurately for a variety of reasons. Nonsampling error is difficult to estimate but, generally, as sample size goes up, so does nonsampling error. Another way of stating this relationship is that as sampling error decreases, nonsampling error tends to increase. Since sampling error generally decreases as sample size increases, one is faced with some conflict between sampling and nonsampling error. Some sort of balance is usually desirable, and the largest sample size possible is not necessarily the best.

Sampling In-Library Use

by Sebastian Mundt

Whenever a full count or census is practically impossible, too time-consuming or costly and/or too monotonous, libraries traditionally apply sampling procedures to study specifics of the collection and to revise their card catalogues.[1] More recent applications focus on sampling for user surveys and on collecting data for performance indicators.[2]

In general, sampling has been used to reduce complexity by selecting and analyzing a subset of the population in question. It can be "selective" as regards

1. time (e.g., reporting period)
2. location (e.g., branches or service points)
3. objects of library use (e.g., collection)
4. subjects of library use (e.g., users).

Literature on sampling in libraries regularly provides thorough information and guidance on estimating *percentages;* examples mostly focus on user surveys. Statistics of library use, however, usually aim at *total numbers*. Selecting over time is the most widely applied form of sampling totals and will be the focus of this section. Other perspectives of "selecting" a sample have been described in the literature: Cullen and Gray have sampled branches and service points of a public library system;[3] Fussler and Simon,[4] Line and Sandison,[5] and Baker and Lancaster[6] have gone into detail about the methodology and issues of sampling collections. For the basics of sampling, especially for random and nonrandom sampling methods, sampling and measurement error and the calculation of sample sizes, the reader should refer to the relevant sections of this chapter.

NONRANDOM SAMPLING

To achieve the highest possible accuracy, "official" library statistics have usually required that all statistical reporting should be based on a full count: "Data referring to a period should cover the specified period in question, not the interval between two successive surveys."[7] In most countries, important activities of use were therefore not reported on a national level.

The revised International Standard ISO 2789:2003 "Information and documentation—International library statistics" now allows for the use of sampling procedures to estimate annual totals of library visits, in-house use and information requests. It denotes that "the annual total is to be established from a sample count" and "the sample should be taken in one or more normal weeks and grossed up."[8] This principle was regarded as the "highest common factor" for statistical reporting on the international level. It takes into consideration that this kind of purposive (judgement) sampling only requires basic statistical knowledge. Expanding upon this definition, the ANSI/NISO Z39.7 details in its Data Dictionary a *typical week* as "*time that is neither unusually busy nor unusually slow*" and "*in which the library is open its regular hours*."[9] Holidays, vacation periods, days when unusual events are taking place in the community or in the library should be avoided.

In the following example, gate count data from Münster University Library are used to discuss the potentials and pitfalls of (1) weekly sampling and (2) sampling by judgement. Figure 1 displays the average number of gate counts per weekday between 1998 and 2000. Although the number of visits per weekday was not found to be normally distributed, visits to the library seem to follow a weekly pattern with relatively low standard deviation. Note that the average number of visits (gate counts) starts to decline on Tuesday, and due to the academic week Fridays and Saturdays (and Sundays if applicable) are generally less busy. Weeks can therefore be regarded as *clusters* which represent various activity levels in recurrent order. Depending on the level of detail required, other (e.g., daily) sampling units may be preferable. Cullen and Gray[10] and Maxstadt,[11] for example, chose to sample service hours as they had to consider different opening hours across several service points in a public library system. Clearly, one week of sampling requires less organizational input than an equivalent number of separate days or hours, and many libraries therefore prefer to count in weekly intervals.

In contrast to a random selection of the sample, the deliberate preselection of *normal* or *typical* weeks implies detailed knowledge about the variable in question. It is well known that, for example, daily use of academic libraries' services is being influenced by general factors like the "academic year," events inside the library, and the availability of "competitive" library services on the campus. It can be argued furthermore that a number of

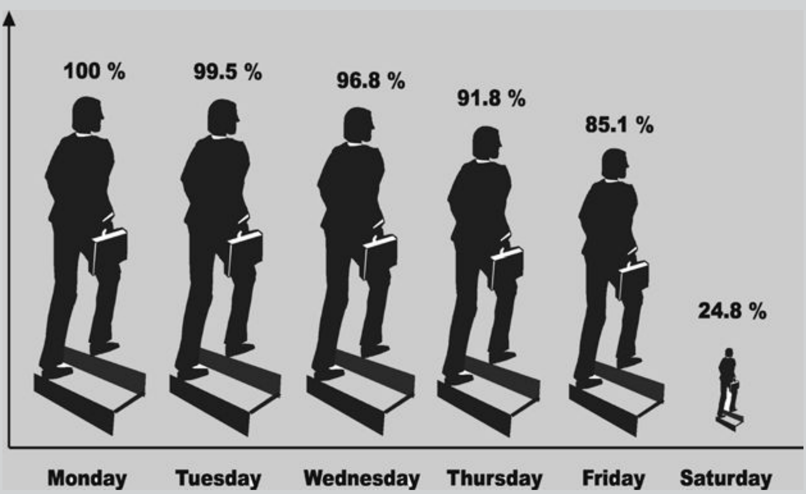

Figure 1 Average Gate Counts per Weekday (Münster University Library, 1998–2000).

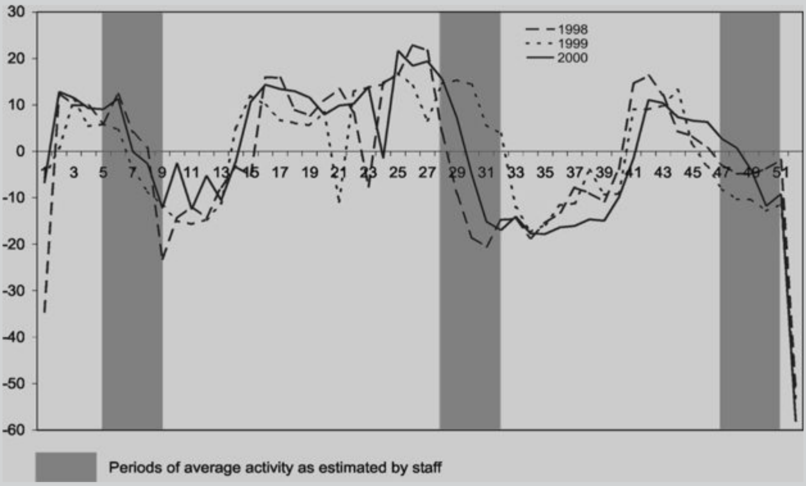

Figure 2 Weekly Gate Counts in Percent of Deviation from Yearly Mean (Münster University Library, 1998–2000).

randomized factors like technical readiness of buildings and systems, local daily weather conditions, or important cultural or other events in the vicinity will blur any set of in-library use data.

Even if it is difficult, if not impossible, to take these fuzzy elements into consideration, the selection of "normal" weeks implies that data of previous years provide sufficiently reliable information on weeks representing an average level of activity, and that library staff are aware of these patterns. Figure 2 underlines this problem by displaying adjusted data of weekly gate counts at Münster University Library for the years 1998 to 2000.

Hardly any week or even longer time frame can be identified as a reliable basis for purposive sampling over several years, as many weeks show varying gate counts over the years in question, and periods of high use blend into periods of lower use. Furthermore, experienced members of staff in user services were asked to determine periods of average in-library use intensity. As seen in Figure 2, gate counts in the periods chosen by staff still vary between +15.8 and –20.5 percent from the mean. Staff in other libraries may even come to different results. Thus, the significantly smaller variation of values indicates that staff judgement can in fact improve the sample, but it is not a very solid foundation for statistical reporting and comparisons.

RANDOM SAMPLING OVER TIME

While nonrandom sampling cannot be counted on for precision, the "accuracy" of random samples can be measured in terms of error and confidence level. The following examples apply different methods of random sampling to reference and other use statistics. As the methods were applied to different library settings, the results and boundaries were generally not compared except where indicated.

A description of the "purest" sampling method, a simple random sample of opening hours throughout the year, can be found in Maxstadt.[12] For the fiscal year 1986/87, staff at Louisiana State University Libraries calculated a sample size of 52 hours (of 4,103 hours of service a year) setting a confidence level of 90 percent and error boundaries of ± 10 percent. With an increased sample size of 60 hours, the actual overall error range was later determined as ± 11.23 percent. The yearly total of reference questions was estimated by linear extrapolation of the sample count.

To avoid any bias or service delays, additional library staff were assigned to collect the sample data. If no extra staff are available, this method may be criticized because the hourly count as practiced here requires a great deal of coordination, especially in large libraries with several service points.

Kesselman and Watstein[13] describe the use of additional information to stratify the sample and thereby reduce its variation, compared to a simple random sample. Based on fully counted reference statistics at New York University's Bobst Library from the year 1982/83, weekly reference counts were stratified in high, medium and low activity. Given a 95 percent confidence limit and an error of ± 400 (≈ 10%) a sample size of 15 weeks was calculated, which represented the number of weeks in each of the classes or "strata." The yearly total was estimated by linear extrapolation of the weighted class means.

It was recognized, however, that the stratification of reference weeks may vary from year to year for a number of reasons, academic or school holidays being the most obvious. Consequently, library staff may find it difficult to determine in advance whether information from previous years is still reliable. In the Bobst Library case, the sample mean of medium weeks was higher than the one of high weeks. The problem was solved by merging both into one stratum, thereby losing some of the expected improvement.

Starting from the procedure chosen at Bobst Library, Lochstet and Lehman[14] developed a correlation method that makes use of a highly significant, almost linear direct correlation (+.957) between weekly reference statistics values and door counts as found by staff at Thomas Cooper Library, at the University of South Carolina in 1996. In this case, the door count was used as a boundary distribution to extrapolate the reference sample values and estimate the yearly total.

The correlated total and the total sampled from the same weeks differed by only .05 percent. The standard error with the correlation method, however, was considerably high. The authors recommend collecting and correlating data of two variables for one or even two years to provide a substantial set of comparable data before the correlation method can be regarded as a functional alternative. After an accurate correlation coefficient is obtained, however, it is expected that the amount of time spent on recording reference statistics can be significantly reduced. Only a small random sample of a few weeks will be needed to verify that the correlation has not changed.

Staff at Münster University and Regional Library in Germany examined whether the correlation method used at Thomas Cooper Library could be extended to certain datasets from the library system. At first all in-library usage data were regarded as possible high correlates to the gate count because all these activities could only be initiated by persons who had

TABLE 1 Correlation between Weekly Gate Count and Data from Automated System (Münster University Library, 1999/2000)

	Visits	**Reference**	**Reservations (in library)**	**Reservations (remote)**	**Account information**	**Renewals**	**Textbook loans**	**Normal loans**
Visits	1.000							
Reference	.876**	1.000						
Reservations (in library)	.802**	.751**	1.000					
Reservations (remote)	.437**	.347	.269**	1.000				
Account information	.800**	.765**	.796**	.220**	1.000			
Renewals	.523**	.512*	.568**	.256**	.759**	1.000		
Textbook loans	.473**	.383	.558**	.117	.312**	.140*	1.000	
Normal loans	.506**	.057	.656**	–.019	.508**	.283**	.483**	1.000

**The correlation is significant at the 0.01 level (2-sided).
*The correlation is significant at the 0.05 level (2-sided).

previously entered the library. Second, the data to be analyzed should be collected automatically by the library system, i.e., available with only minimal staff input. Weekly gate counts (and reference questions) were then correlated with the selection of automated data shown in Table 1.The highest correlation values (> +.75) with gate counts and reference were found in (a) user-initiated reservations and (b) accesses to user accounts from PC workstations inside the library.

In contrast, loans and reservations from workstations outside the library premises are obvious examples of unsuitable correlates. While loans differ in their seasonal patterns from library visits over a year, users frequenting the automated system from outside the library are unlikely to be included in the gate count on the same day; yet it seems likely that remote use can also show high correlation values, e.g., online reference with virtual visits of the library Web site.

Seemingly corresponding data may in fact be pure coincidence as the correlation coefficient only measures the nature and extent, but not the causal connection ("direction") of a relationship between two variables. Before high correlation values can be used, it is therefore important to preselect possible correlates carefully and analyze them for logical consistency, and to monitor the correlation values over a longer period of time to ensure that the correspondence is not purely accidental.

CONCLUSIONS

- Sampling procedures have always been widely applied in libraries because the full count of some data was impossible or too costly. The introduction of sampling in international statistical reporting reflects a general shift of focus from input to output measures, many of which can only be counted in sample form.
- From the point of data collection management, it seems useful to choose a week as the sampling unit. "Normal" weeks, when selected by judgement, may be difficult to anticipate even from data collected over several years, and the precision of judgement sampling cannot be calculated in terms of error and confidence level.
- It is likely that certain usage data show significant correlation and can provide useful information for estimating totals. The significance of the correlation, however, should be revised at regular intervals as correlation only indicates the extent, not any causal connection, of a relationship between variables.
- Due to the lack of comparable data, it seems unreasonable to recommend an overall "best" or "most appropriate" sampling method for international statistical reporting. Libraries are therefore asked to apply sampling methods carefully with respect to all possible sources of error, and their regional and national institutions will have to monitor and actively supervise the quality of data delivered to them.

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SUMMARY

"The strength of survey research is in answering questions of fact and in assessing the distributions of the characteristics of populations."[26] It does not permit causal inferences, although it can facilitate the analysis of relationships between variables, particularly correlational relationships. Survey research is typically weak on internal control or validity, but, if based on random sampling, it is strong in external validity. This is because survey research generally concerns itself with naturally occurring variables in natural settings.

However, the only reliable way to ensure that the results of survey research can be generalized from a sample to a population or beyond a single study is to draw a representative sample. The most common, and one of the best, techniques for selecting a representative sample is simple random sampling. Depending on certain characteristics of the population, or on the purpose of the research, other probability techniques may be preferable in a given situation.

Other closely related concerns include the size of the sample and sampling error. There are formulas for estimating these properties, but, again, the nature of the population and the purpose of the research should be considered. There are no absolute criteria for sample size and sampling error. What is satisfactory for one study may not be for another. There may even be occasions where nonprobability sampling is preferable to probability sampling, but the researcher should keep in mind that the generalizability of studies using nonprobability samples is open to serious question.

NOTES

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Chapter 5

Data Collection Techniques

This chapter will deal with three frequently used data collection techniques—the questionnaire, the interview, and observation. (See Chapter 7, Qualitative Research Methods, for additional information about interviews, observation, and content analysis.) These methods for gathering data are most commonly, but not exclusively, used in survey research. They are data collection techniques or instruments, not research methodologies, and they can be used with more than one methodology. Observation is the possible exception, in that some texts do treat observational research as both a technique and a methodology. Regardless, their purpose is to collect data. Achievement tests, aptitude tests, and so on are, of course, often used to collect data for educational research and to assess or evaluate performance, ability, knowledge, and behavior. Readers wishing to learn more about that type of data collection tool should refer to texts by Gay, Mills, and Airasian.[1]

THE QUESTIONNAIRE

Pre-Questionnaire Planning

The planning that should precede the design of a questionnaire is not that different from the planning that should go into the early development of a research study. The process will be given here in brief outline form as a way of reviewing the major steps and of emphasizing decisions that should be made before the data collection instrument is selected or designed.

1. Define the problem (and purpose).
2. Consider previous, related research, the advice of experts, and so on.
3. Hypothesize a solution to the problem (or at least identify research questions, the answers to which will shed some light on the problem).
4. Identify the information needed to test the hypothesis. This step should include deciding which aspects of the problem will be considered

and planning ahead to the presentation and analysis of the data. Deciding how the data will be organized, presented, and analyzed can significantly influence what types of data will have to be collected. It may be useful at this point to construct so-called dummy-tables, or tables presenting the important variables with hypothetical values, to help anticipate possible problems regarding presentation and analysis.

5. Identify the potential respondents or subjects. As noted earlier, practical questions should be asked at this time, such as, "Are the potential respondents accessible? Are they likely to respond?"
6. Select the best or most appropriate technique for collecting the necessary data. It is here that the researcher should consider the relevant advantages and disadvantages of the questionnaire, interview, observation, and other techniques in relation to the more general methodology to be used.

To some extent, research findings are affected by the nature of the data collection technique used. In fact, findings strongly affected by the technique can lose their validity. Consequently, a researcher may elect to use two or more techniques and methods to test hypotheses and/or measure variables; this process often is referred to as *triangulation*. Burgess believed that triangulation implies "the notion of three points of view within a triangle;"[2] therefore, Gorman and Clayton suggest using the term, "mixed methods" "to allow the researcher to use a range of methods, data, investigators and theories within any study."[3] For example, information about library use could be collected with questionnaires, interviews, documentary analysis, and observation. Consistent findings among the different data collection techniques would suggest that the findings are reasonably valid. Discrepancies among the results would indicate a need for further research. Morgan provides a discussion of the different approaches for combining qualitative and quantitative methods, as well as identifying the challenges of combining the two methods.[4]

Advantages of the Questionnaire

The questionnaire, which the *American Heritage Dictionary of the English Language* defines as "a form containing a set of questions, especially one addressed to a statistically significant number of subjects as a way of gathering information from a survey,"[5] offers several important advantages over other techniques or instruments for collecting survey data. Among them are the following:

1. The questionnaire, especially the mail, email, and Web-based questionnaire, tends to encourage frank answers. This is in large part because it is easier for the researcher to guarantee anonymity for the respondent when using a mail questionnaire. In addition, the respondent can complete the questionnaire without the researcher's being

present. Thus the questionnaire can be quite effective at measuring attitudes (see number 4 below for another consideration).

2. The characteristics of the questionnaire that help to produce frank answers also eliminate interviewer bias. This is not to say that the questions could not be worded in a biased manner, but that there is no style of verbal presentation which can influence the response. (The problem of biased questions is a serious one and will be treated in greater detail later.)
3. Another way of stating the second advantage is that the fixed format of the questionnaire tends to eliminate variation in the questioning process. Once the questions have been written in their final version and included in the questionnaire, their contents and organization will not change. However, this does not rule out the possibility of respondents interpreting the same question in different ways.
4. The manner in which a mail questionnaire is distributed and responded to also allows it to be completed, within limits, at the leisure of the participants. This encourages well thought out, accurate answers. On the other hand, if the researcher is more interested in obtaining spontaneous or immediate reactions, as in an attitudinal survey, then the relatively large amount of time allotted for completion of the questionnaire could be a disadvantage.
5. Questionnaires can be constructed so that quantitative data are relatively easy to collect and analyze.
6. Questionnaires can facilitate the collection of large amounts of data in a relatively short period of time. Questionnaire-based surveys of several thousand people are not unusual, and responses typically are expected within one to two weeks.
7. Last, but not least, questionnaires are usually relatively inexpensive to administer.

Disadvantages of the Questionnaire

While the advantages of the questionnaire seem to outweigh the disadvantages, there are several of the latter that should be noted:

1. Use of the mail questionnaire eliminates personal contact between the researcher and the respondent. However, this also can be seen as an advantage, for, as stated earlier, the absence of direct contact eliminates interviewer bias from the questioning process.
2. The mail questionnaire does not permit the respondent to qualify answers to ambiguous questions or, at least, makes it more difficult. On the other hand, the more difficult it is for respondents to qualify answers, the more likely the researcher is to obtain consistent responses.
3. Studies have shown that persons who are highly opinionated regarding the subject of a questionnaire are more likely than others to be

motivated enough to complete and return it. This phenomenon tends to result in a biased sample or return, as the less opinionated members of the sample will be underrepresented and may well have certain characteristics in common.

4. Questionnaires may be more difficult for uneducated participants to complete, again possibly resulting in a biased return. The researcher can minimize this problem by keeping his or her audience in mind when developing the questionnaire and writing the questions.
5. In general, there simply seems to be a resistance to mail questionnaires. In the extreme case, this can result in some participants attempting to "sabotage" a survey by purposefully responding incorrectly to some questionnaire items. This problem can be alleviated through appropriate research design, specific techniques of which will be mentioned later.
6. Nonresponse rates are relatively high for mail, email, and Web-based questionnaires, although Web-based surveys often first use another survey method to recruit participants. Since survey respondents are usually female, more educated, and older than those who do not respond to surveys, nonresponses reduce the sample size and may introduce sampling error by eliminating a subset of the population. The researcher should correct for sampling bias incurred from nonresponse or minimize nonresponse rates by combining several data collection techniques.[6]
7. If the questionnaire is distributed electronically, it will reach only those who have access to and are comfortable using email and Web technology.

CONSTRUCTING THE QUESTIONNAIRE

Proper construction of the questionnaire is essential to its success. In general, the researcher must consider his or her information needs and the characteristics of the participants. The former concern will be dealt with first.

Type of Question According to Information Needed

In selecting or writing specific types of questions, the researcher must first consider what kind of data he or she needs. The major types of questions, according to the kind of information needed, include the following:

1. Factual questions: questions used to ascertain such things as the respondent's age, gender, and so on. They are probably the most straightforward type of questionnaire item.
2. Opinion and attitude questions: questions intended to determine a person's ideas, inclinations, prejudices, convictions, and so on.

(Questionnaires used for an attitudinal survey are usually known as "attitude scales" or "indexes.") They tend to be considerably more subjective than factual questions and are more difficult to validate externally.

3. Information questions: questions designed to measure the respondent's knowledge about some topic. They typically require the greatest response time.
4. Self-perception questions: questions quite similar to attitude questions, but restricted to one's opinions about himself or herself.
5. Standards of action questions: questions used to determine how respondents would act in certain circumstances. For example, one may ask library patrons how they would react to a new library service or a change in hours.
6. Questions about actual past or present behavior: questions that potentially fall within some of the categories of questions already identified but tend to be narrower in that they focus on behavior. For example, the kind of information gathered to describe past or present behavior could be factual, attitudinal, or informational in nature. Behavioral questions also tend to be rather subjective but usually become more valid as they become more specific. Data on past and present behavior can serve to some extent as a predictor of future behavior.
7. Projective questions: questions that allow respondents to answer questions indirectly by imposing their personal beliefs, attitudes, and so on onto others. In other words, they permit the respondent to indicate how he or she would react to some question or situation by reporting how peers, colleagues, and so on would react in the same situation. This technique can be particularly useful for eliciting responses on a topic about which participants may be reluctant to express their own, true feelings openly or directly. For example, certain public librarians could be asked how their colleagues feel about censorship, with the researcher assuming that the attitudes of the respondents are similar to the attitudes of the colleagues. The researcher must be aware, however, that such measures may be weak in validity as indicators of the characteristics they are designed to measure.

   Projective questions are considered to be a type of indirect method of questioning people and as such require only minimal cooperation on the part of the individuals being studied. Hoyle, Harris, and Judd discuss a variety of specific projective methods, as well as several more structured indirect tests.[7] The reader interested in learning more about indirect assessment should consult Hoyle, Harris, and Judd, keeping in mind that the validity and reliability of indirect methods are open to question. Such techniques are probably most appropriate for exploratory research.

All or most of the items in a questionnaire may be focused on one specific topic and, in aggregate, considered to constitute a *scale* for the topic of interest.

In the typical survey in LIS, however, the questionnaire is likely to consist of a variety of questions addressing a number of components of a broader topic.

Type of Question According to Form

In selecting or designing questionnaire items, the researcher must consider the question format that will best obtain the information desired. The form of the question in turn determines the method of response. The researcher must decide which response format will be the easiest for the respondent while still producing adequate, definite, and uniform answers. Whenever possible, it is recommended that consistent response formats be employed. This results in less confusion for the respondent and makes speedier replies possible.

There are two basic types of questions—open-ended questions and fixed-response questions. *Open-ended*, or *unstructured questions*, as the name indicates, are designed to permit free responses from participants rather than ones limited to specific alternatives. They are especially useful for exploratory studies; they "are called for when the issue is complex, when the relevant dimensions are not known, or when the interest of the researcher lies in exploration of a process or of the individual's formulation of an issue."[8]

On the negative side, as there is almost no limit to the possible responses to an open-ended question, their answers are usually more difficult to categorize and analyze than responses to structured questions. Open-ended questions may also discourage responses because they typically take longer to answer.

Examples of open-ended questions are

1. What do you think about the library?
2. Which library services do you value the most?
3. I typically use the library in order to _______.

Fixed-response or *structured questions*, also known as closed questions, limit the responses of the participant to stated alternatives. The possible responses may range from a simple "yes" or "no," to a checklist of possible replies, to a scale indicating various degrees of a particular response.

Structured questions have several advantages and disadvantages in comparison with unstructured questions. Structured questions more easily accommodate precoding in that the possible responses are generally known and stated. The precoding, in turn, facilitates the analysis of the data gathered by the questions. Precoding essentially involves anticipating responses, establishing numerical codes or symbols for the various responses, and including the codes on the questionnaire. An example of a precoded questionnaire item follows:

	Yes	No
Do you have a current library card?	1	2

In this example, the respondent would be asked to circle the number representing his or her answer. A 1 or a 2, whichever the response happens to be,