RESEARCH in COMMUNICATION SCIENCES and DISORDERS

Methods for Systematic Inquiry

Fifth Edition

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CONTENTS

Preface *xi*

Chapter 1. Empirical and Nonempirical Research: An Overview **1**
Main Points 1
Systematic Inquiry 2
Some Roles for Research 2
Types of Research 6
Variables 9
Getting Started With Research 9
Summary 11
Review Questions 12
References 13
Appendix 1–1. Tips for Reading a Research Article 16

Chapter 2. Ethical Considerations **17**
Main Points 17
Protection of Human Participants 18
Special Protections 21
Historical Perspective 22
Institutional Review Boards 26
Current Perspective 27
Research Integrity 29
Avoiding Conflicts of Interest 29
Credit for Intellectual Effort 30
Attribution of Ideas 31
Accuracy in Reporting Information 32
Data Management 33
Confidentiality and Privacy 34
Health Insurance Portability and Accountability Act 34
Summary 36
Review Questions 36
Learning Activities 37

References 38
Appendix 2–1. Research Scenario 42

Chapter 3. Identifying and Formulating Research Questions 45
Main Points 45
Identifying Important Questions 46
Formulating Research Questions 49
Ways to Formulate a Research Problem 51
Evidence-Based Practice Questions 55
Criteria for Well-Formed Questions 58
Summary 60
Review Questions 60
Learning Activities 61
References 62

Chapter 4. Completing a Literature Search 65
Main Points 65
Purposes of a Literature Search 66
Planning and Conducting a Search 68
Search Tools 68
Finding Information From Books 72
Designing a Search Strategy 73
Organizing and Documenting Your Literature Search 75
Summary 75
Review Questions 76
Learning Activities 76
References 77
Appendix 4–1. Electronic Literature Search 79

Chapter 5. Writing About Research: Literature Reviews and More 87
Main Points 87
Research Phases 87
Purposes of a Literature Review 88
Organization 88
Note Taking 91
Writing the Paper 92
Example of an Outline 92
Summary and Conclusions Section 93
Citations and References 94
Example 1: Paraphrase From a Single Source 94
Example 2: Paraphrase From a Single Source 94
Example 3: Short Quote Within a Sentence 94

Example 4: Short Quote Within Parentheses 94
Example 1: Entry for a Journal Article From a Print Source 95
Example 2: Entry for a Journal Article With a DOI Number 95
Example 3: Entry for a Journal Article Without a DOI Number 95
Example 4: Entry for a Book 95
Example 5: Entry for a Chapter in an Edited Book 95
Example 6: Entry for a Website Document 95
Literature Review Checklist 96
Types of Literature Reviews 96
Writing a Research Proposal 97
Summary 98
Review Questions 99
Learning Activities 99
References 100

Chapter 6. Nonexperimental Research Design 103
Main Points 103
Nonexperimental Research Designs 104
Survey Research 104
Case Studies 105
Longitudinal Research 108
Correlation and Regression 109
Group Comparisons 111
Causal-Comparative Research 111
Qualitative Research 114
Sources and Analysis of Qualitative Data 116
Ethnography 117
Grounded Theory 117
Phenomenological Analysis 118
Case Study 119
Conversation Analysis 120
Scientific Rigor in Qualitative Research 122
Summary 123
Review Questions 124
Learning Activities 125
References 125
Appendix 6–1. Examples of Research Designs 133

Chapter 7. Research on Assessments and Diagnostic Approaches 137
Main Points 137
Key Concepts in Measurement 137
Measurement Accuracy 139

Face and Content Validity 139
Criterion Validity 141
Construct Validity 144
Measurement Consistency 146
Rater Reliability 146
Reliability Across Time 148
Internal Consistency Reliability 149
Item Response Theory 150
Summary 153
Review Questions 155
Learning Activities 156
References 156

Chapter 8. Experimental Research and Levels of Evidence 159
Main Points 159
Experimental Research Designs 161
Posttest-Only Designs 161
Pretest-Posttest Randomized Control Group Design 162
Solomon Randomized Four-Group Design 163
Switching Replications Design 164
Factorial Designs 164
Importance of Experimental Control 169
History 171
Maturation 171
Statistical Regression 171
Instrumentation 172
Selection 172
Mortality 173
Quasi-Experimental Approaches 173
Nonequivalent Control Group Designs 174
Repeated Measures Group Design 175
Single-Subject Designs 177
Single-Subject Design Quality 184
Experimental Designs and Levels of Evidence 184
Summary 188
Review Questions 189
Learning Activities 190
References 192
Appendix 8–1. Research Scenario 196

Chapter 9. Research Participants and Sampling 199
Main Points 199

Populations and Samples 200
Sample Characteristics 201
Sampling Methods 203
Simple Random Sampling 203
Systematic Sampling 203
Stratified Random Sampling 204
Cluster Sampling 205
Purposive Sampling 206
Random Assignment 206
Sample Size 207
Summary 210
Review Questions 211
Learning Activities 212
References 212

Chapter 10. Data Analysis: Tools for Describing Data 215
Main Points 215
Levels of Measurement 215
Visual Representation of Data 218
Descriptive Statistics 222
Frequencies and Percentages 222
Measures of Central Tendency 224
Measures of Variability 226
Means as Estimates 227
Shapes of Distributions 229
Summary 232
Review Questions 233
Learning Activities 234
References 234

Chapter 11. Data Analysis: Measures of Association and Difference 237
Main Points 237
Inferential Statistics 237
Measures of Association 240
Pearson Product-Moment Correlation Coefficient 240
Coefficient of Determination 245
Spearman Rank-Order Correlation 245
Chi-Square and Contingency Coefficient 246
Simple Regression and Multiple Regression 247
Testing for Differences Between Two Samples 250
Independent and Paired *t*-Tests 251
Confidence Intervals 254

Mann-Whitney *U* 256
Sign Test and Wilcoxon Matched-Pairs Signed-Ranks Test 257
Testing for Differences Among Three or More Samples 258
Statistical Analysis for Factorial Designs 262
Additional Tools for Analyzing Clinical Data 265
Caution in the Use and Reporting of Statistics 267
Summary 268
Review Questions 269
Learning Activities 270
References 271
Appendix 11–1. Examples of Data Analysis Procedures 274

Chapter 12. Research Outcomes: Clinical Guidance, Research Reports **277**
Main Points 277
Knowledge Base for Evaluating Clinical Research 278
Critical Appraisal 278
How Applicable Are the Findings? 284
Reporting Research Findings 285
Components of a Research Report 286
Writing Guidelines and Writing Style 288
Disseminating Research Findings 289
Summary 291
Review Questions 291
Learning Activities 292
References 293

Index *297*

PREFACE

When Dr. Lauren Nelson finished the first edition of this textbook in 2010, evidence-based practice, the use of research to inform clinical decision-making, was an emerging concept in the field of communication sciences and disorders. Currently, the situation is much different with widespread recognition of the importance of evidence to support clinical practice. Students and professionals benefit from consistent discussion of research evidence throughout the fields of audiology and speech-language pathology. If you browse current books on nearly any communication disorders topic, such as child language disorders, articulation and phonological disorders, adult neurogenic disorders, aural rehabilitation, and hearing aids, you will find a major section or chapter on research evidence. The topic of research evidence has become pervasive throughout our field of study and is a subject in many courses.

Both Dr. Nelson and Dr. Gilbert have experience teaching a research course for graduate students in communication sciences and disorders. Only a few of these students plan to pursue a career in research and/or higher education. The majority anticipate working in a clinical setting as an audiologist or speech-language pathologist, yet they nearly all express an appreciation of the role of research in the field of communication sciences and disorders. Occasionally students still worry about their motivation, expecting the topics of a research course to be less than exciting. But more often, they have already discovered that research is essential for high-quality clinical practice and that audiologists and speech-language pathologists need skills to investigate the existing research base and even to conduct their own original research. Our goal in writing this textbook is to help students and professionals develop knowledge and skills in research that will serve them throughout their professional careers.

Students frequently express concerns about the topics they expect to cover in a research methods course. Many of their concerns are similar from year to year and may be concerns you share. Students worry that they would have difficulty understanding the content of research articles, particularly the statistical information. Others describe prior frustration with their attempts to read research reports because they spent considerable time rereading material that was difficult to understand. They think that time management could be an issue, both in "keeping up" with their assigned readings and working on their own research projects. Many students are uneasy about finding a "good" topic for their own graduate research project.

If you have similar concerns, ideally this textbook will offer you some strategies for tackling those concerns. Recognizing that the way one approaches scientific inquiry is similar to the way audiologists and speech-language pathologists think about assessment and treatment of persons with communication disorders is an important

first step. Our students have identified ideas for research projects by understanding that high-quality research stems from genuine curiosity and interest about a topic and that research in the field of communication sciences and disorders takes many forms. In their personal reflections, students report that repeated practice in reading research articles and a better understanding of the content and structure of those articles helped them use their study time more efficiently and effectively. The concerns our students express about research and the strategies we developed to address those concerns are the basis for this text.

This fifth edition adds a chapter on research investigating or developing assessments or diagnostic approaches. Specifically, this chapter addresses questions regarding validity and reliability. The fifth edition also updates the resources and tools available to assist us in finding and evaluating research evidence. The knowledge and skills needed to engage in empirical research and to use research in clinical practice are comparable, and that is how these topics are presented in this text. Rather than treating empirical research and searching for clinical evidence as separate topics, this text presents both as different applications of a process of scientific inquiry. The order of the chapters reflects the steps a researcher or clinician might complete when conducting an investigation. We recognize, however, that research is not a linear process and sometimes requires revisiting or revising your prior work.

Chapter 1 introduces the topic of scientific inquiry and its different applications in the field of communication sciences and disorders. Because ethical practice is a primary concern for both clinicians and researchers, Chapter 2 covers responsible conduct of research and ethical issues that affect the design and utilization of research, as well as the challenges associated with securing and using electronic records. Chapter 3 describes how researchers and clinicians might formulate questions as the starting point for their investigations. Some of these questions might be answered in the existing literature and others might be refined based on that literature. Thus, Chapter 4 addresses the information you might need to conduct a good-quality literature search. Chapter 5 provides guidance organizing and writing a literature review, and describes different types of literature reviews. Chapter 6, Chapter 7, and Chapter 8 cover the different types of research that are common in the field of communication sciences and disorders and the relationship between these types of research and the evidence audiologists and speech-language pathologists need to support their clinical endeavors. Chapter 7 is the new chapter focusing on research of assessments and diagnostic approaches. Chapter 9 reviews how researchers select persons to participate in research and issues associated with that process. Chapter 10 and Chapter 11 describe the analysis of research data using various statistical procedures. The final chapter, Chapter 12, covers how researchers and clinicians use the information gathered through their investigations. For researchers, this often involves preparation of a research report to disseminate to other professionals, and for clinicians, it usually leads to a decision about the most appropriate assessment and treatment approaches for their clients. For both clinicians and researchers, criteria for evaluating the quality of evidence are important.

Each chapter includes examples from the field of communication sciences and disorders to illustrate important concepts. New to this edition, each chapter begins with main points that the reader can use to guide their reading of the chapter. Similar to recommendations for how to read

journal articles, this text and the individual chapters do not need to be read "in order." A suggestion is to first read the main points and then read the summary at the end of the chapter that often expands on the brief main points. Next, read the chapter introduction, which presents necessary background information. Finally, read the main body of the chapter, or the sections of particular interest to you. The review questions and learning activities at the end of each chapter can be used individually or in a classroom for discussion or small group activities. Two research scenarios or case studies are included in Chapter 2 and Chapter 8 to illustrate a practical application of concepts and to facilitate discussion. The online resources provide opportunities to work with examples and figures in a more dynamic way. Where appropriate, the learning activities include a list of research articles from journals in communication sciences and disorders that illustrate topics covered in the chapter. The learning activities could serve as homework assignments or, in some cases, as the focus of in-class discussions. In our own courses, we use the review questions in small group activities. Students benefit from explaining difficult questions to each other and doing so in a way that illustrates their own mastery of the concepts.

1

Empirical and Nonempirical Research: An Overview

Main Points

- Research is systematic inquiry that can be applied in scientific, academic, and clinical settings.
- Examples of roles for research include:
  - Gather information to answer scientific or clinical questions
  - Guide evidence-based practice
  - Evaluate programs for funding or resource allocation
- There are different categories of research relating to:
  - "Old"/new observations
  - Form of observations
  - Manipulation of variables
  - Random assignment to experimental variables
  - Manner of reporting results
- Research categories are to be used as guidelines. Research may include multiple categories/multiple methods (mixed methods).
- Research involves variables.
  - Independent ~ input
  - Dependent ~ output
- When reading research reports, you do not have to read it in order. Identify the research question and the authors' answer before reading the specific details and taking notes in your own words.

For many students, learning that they need to complete a research course is a cause of considerable anxiety. Audiologists and speech-language pathologists who are already engaged in their professional practice often recognize the importance of a strong research base in communication sciences and disorders but may view research as an activity unique to those who hold research-oriented doctoral degrees. Perhaps you are someone who views research as a requirement to endure rather than as a topic to embrace, or perhaps you acknowledge the importance of research in communication sciences and disorders but consider it something that others with unique talents undertake. One aim of this introductory chapter is to establish the fact that research encompasses many different kinds of activities, and professionals in clinical settings already engage in some

of these. Furthermore, the knowledge and skills we need to be effective researchers are not necessarily unique talents but often parallel the processes and procedures employed by audiologists and speech-language pathologists.

Systematic Inquiry

One way to view research is as a process of systematic inquiry. Making an inquiry involves asking a question and then engaging in a process to determine the answer to that question. Asking and answering questions is at the heart of research endeavors. Research is systematic because the approach you use to find answers has predetermined procedures, and these procedures are carried out in a regular, orderly manner. Usually, the questions that researchers investigate are ones that are recognized as important to a field of study, such as communication sciences and disorders, and to persons in society, such as children and adults with communication disorders.

The *scientific method* is an approach to systematic inquiry. This method involves a series of steps that lead from identifying a problem and formulating a question to discovering possible answers to that question.

The generally accepted steps include the following: (1) Identify a problem and further define that problem through background research, (2) develop a specific hypothesis or question to investigate, (3) plan a set of procedures for testing the hypothesis or answering the question, (4) collect data using those procedures, (5) analyze the data, and (6) make a decision about the viability of the hypothesis or answer to the question.

You would expect to find the steps of the scientific method in a research text. However, Pindzola et al. (2016) included similar steps in their diagnosis and evaluation textbook when discussing the "science and art" of diagnosis (p. 19). These authors observed that clinicians engage in a way of thinking that parallels the method scientists employ in their experimental research. When faced with a clinical problem, such as a person referred for an evaluation, audiologists and speech-language pathologists gather and analyze data to test a hypothesis. In the case of a speech, language, or hearing evaluation, the hypotheses relate to whether or not someone has a disorder, the nature of that disorder, and how to best treat that disorder. Although the types of questions or hypotheses differ, both clinical practice and research involve ways of thinking and problem solving that are systematic in nature. When the process of inquiry is systematic, both clinicians and scientists have greater confidence that the information they provide is accurate and trustworthy, whether providing that information to individual clients and their families or to the scientific community.

Some Roles for Research

Scientific research has many roles in the fields of audiology and speech-language pathology. Perhaps the most basic role is to satisfy scientific curiosity. Researchers in communication sciences and disorders regularly participate in a process of identifying unanswered questions and designing information-gathering procedures to answer those questions. Researchers focus on questions they regard as important for understanding the nature of human communication; the underlying physiology of speaking and hearing; the causes of speech, language, and hearing disorders; and so

forth. Researchers who are motivated primarily by scientific curiosity might still include persons with speech, language, or hearing disorders in their studies and conduct research that has implications for assessing and treating communication disorders. For example, researchers gained new evidence about the neurological bases of speech and language by including persons with aphasia in their studies. These types of studies provided information about the effects of brain lesions on speech and language use but did not necessarily lead directly to specific assessment or treatment recommendations.

Research is also valuable in guiding clinical practice in audiology and speech-language pathology. Scientific and clinical research follow similar processes (Figure 1–1). The two paths differ mainly in the order of gaining knowledge and identifying questions. In scientific research, knowledge is first gained in order to develop a question, with a refining process of learning more about specific topics to narrow down the research question. In clinical research, the question is often the first step, identified through a clinical concern. After identifying the question, then knowledge is gathered, again with a refining process.

Sometimes audiologists and speech-language pathologists are motivated to conduct research because of unanswered questions they encounter in their clinical practice. The term *clinician-scientist* is a way to refer to health care professionals, including audiologists and speech-language pathologists, whose primary responsibility is providing clinical services but who also engage in research in their profession (Chute, 2013). Sometime clinicians are the lead researchers on a project, but many

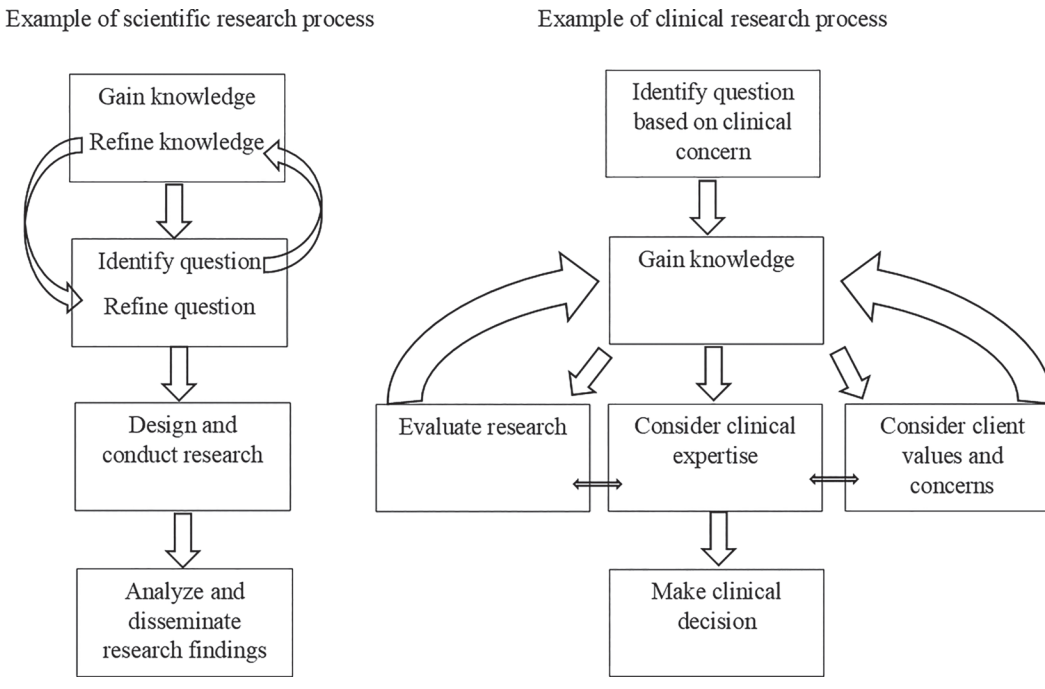

Figure 1–1. Examples of research processes.

times clinicians collaborate with a research team. Clinician-scientists are ideally positioned to conduct research that guides the way audiologists and speech-language pathologists diagnose and treat communication disorders. Clinician-scientists have firsthand knowledge regarding information that is lacking, as well as work with clients in their professional practice who would be most representative of children and adults with speech, language, and hearing disorders.

The notion of using research to guide clinical practice is important even for audiologists and speech-language pathologists who do not participate in conducting original research. A strong emphasis on using scientific evidence to guide decisions has emerged in both the fields of medicine and education. Because audiologists and speech-language pathologists are employed in medical and educational settings, this movement has encompassed those fields as well. The term *evidence-based practice* refers to an approach in which clinicians use the best available scientific evidence to guide their decisions about how to evaluate and treat persons with communication disorders. When clinicians engage in evidence-based practice, they are making decisions about how to serve their clients effectively based on multiple sources of information: (1) the best available evidence from systematic research, (2) their own professional experience and expertise, and (3) client and/or family considerations (American Speech-Language-Hearing Association [ASHA], 2004; Schmitt et al., 2021).[1] Many clinician-scientists also highlight practice-based evidence as a meaningful source of data (Dollaghan, 2007; Fissel Brannick et al., 2022).

When audiologists and speech-language pathologists participate in evidence-based practice, they might do so by consulting an existing evidence review. Usually, a panel of experts prepares such reviews. They are published in professional journals or perhaps published in electronic format on a website. When the authors of the reviews conduct a well-defined, qualitative critique of the existing research, the review is a systematic review. When the authors apply both qualitative and quantitative analysis in their review, it may be a meta-analysis. Some examples include a meta-analysis of the use of hearing aids for individuals with tinnitus (Waechter & Jönsson, 2022), a systematic review and meta-analysis of the use of nonword repetition in assessing the language of bilingual and monolingual children (Schwob et al., 2021), meta-analyses of word-finding treatment for persons with aphasia (Wisenburn & Mahoney, 2009), and parent-implemented intervention for child language delays (Roberts & Kaiser, 2011). The American Speech-Language-Hearing Association (ASHA) has documented many examples of evidence reviews published through 2024 (ASHA, 2024). Recommendations for systematic reviews and/or meta-analyses, which may be useful for speech-language pathology and audiology, have been developed in the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) (Liberati et al., 2009; Moher et al., 2009).

Sometimes audiologists and speech-language pathologists conduct individual evidence searches on behalf of a particu-

[1]The American Speech-Language-Hearing Association (2005) position statement on evidence-based practice can be found in the document *Evidence-Based Practice in Communication Disorders* [Position Statement], available from http://www.asha.org/policy. In this document, ASHA established the position that audiologists and speech-language pathologists should engage in evidence-based practice to ensure provision of the highest quality clinical services.

lar client (Gallagher, 2002). Such searches begin with a client-specific question and culminate with review, evaluation, and application of existing research. Clinicians might use existing research literature when answering questions such as which of two treatment approaches produced the most improvement in the shortest time, whether a particular diagnostic procedure yields results that are accurate and reliable, or what the most effective treatment for a client with a specific diagnosis is. Evidence-based practice reflects a movement away from sole reliance on expert opinion and toward an approach that relies on careful consideration of research evidence in conjunction with clinical expertise and client/family considerations (Gallagher, 2002).

Another reason audiologists and speech-language pathologists engage in research is for program evaluation and support. This type of research is conducted at a local level sometimes in response to external requirements and sometimes due to local initiatives. For example, a medical center might evaluate the quality of its programs and services by comparing them to a set of nationally recognized standards. Professionals employed in educational settings are very much aware of the use of student achievement testing to evaluate school programs. Again, such evaluation involves comparisons to state and national standards purported to reflect the quality of school programs. At other times, program evaluation questions emerge from local rather than state or national initiatives. For example, a medical center might conduct consumer satisfaction research with the goal of improving its programs and services and increasing the likelihood that consumers choose that medical center as their health care provider. A school district might conduct program evaluation research after making changes to curriculum or teaching practices to determine if these changes led to improvements in student learning and achievement. Although professionals such as audiologists, speech-language pathologists, nurses, physicians, and teachers often debate the best approaches for program evaluation, nearly all agree that research of this type plays an important role in their professions.

Scientific research also may influence public policy, particularly policy regarding the allocation of resources. When research evidence is particularly strong, legislators and policy makers may consider this evidence in making decisions about spending public funds. An example of this is the growth of publicly funded early childhood education for all 3- and 4-year-olds. One reason for the increase in public funding is research that consistently demonstrated that children who attended good-quality preschool programs performed better in school and were more successful in their later lives. The research actually demonstrated that the funds spent early in childhood were offset by savings that occurred later through reduced educational spending on special services and reduced need for public assistance in adulthood (Barnett, 2000).

Research that demonstrates how a service or program impacts society is sometimes referred to as cost-effectiveness or cost-benefit research. Cost-effectiveness research looks at the cost of a program or service relative to the outcomes produced (Barnett, 2000). For example, if different treatment programs or different technologies varied in cost, an audiologist or speech-language pathologist would probably want confirmation that the more expensive approach produced better outcomes for their clients. Cost-benefit research looks at the cost of a program or service relative to its impact on costs that occur later in

life. For preschool education, the analysis included documentation of the cost of the educational program and long-term follow-up of the children who participated. The long-term follow-up revealed actual cost benefits to society in several different ways. For example, children who received early childhood education were less likely to need special education services during the school years, were less likely to need other public services such as juvenile detention, were less likely to participate in public assistance programs as adults, and typically earned more income per year as adults (Barnett, 2000). Thus, individuals who advocated for public funding of early childhood education could point to a body of research that suggested such programs produced a net financial benefit to society that greatly offset the initial cost. Audiologists and speech-language pathologists would profit from a body of research demonstrating the benefits of our programs.

Types of Research

Taking some time to peruse published research in audiology and speech-language pathology, such as that found in our professional journals, reveals many forms of research. Generally, research studies share at least one similarity: a question that needs an answer or problem that needs a solution. How researchers formulate their questions or how they plan and conduct their studies, however, can be quite different. In this section, we consider some of the terminology researchers use to characterize these differences (Figure 1–2).

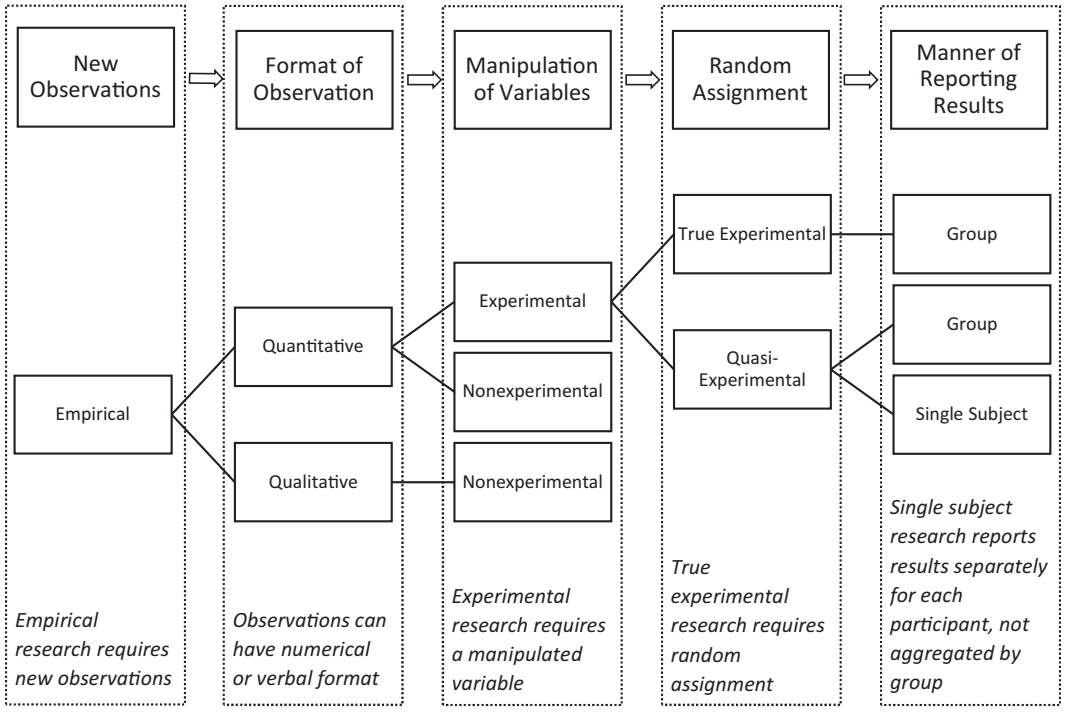

Figure 1–2. Types of research.

Most of the time when professionals in the fields of audiology and speech-language pathology use the term *research*, they are referring to *empirical* research. Empirical research involves the collection of new information or data through observation and measurement of behavior and/or physical properties (Trochim et al., 2016). Review of recent issues of professional journals in communication sciences and disorders reveals several ways that human behavior was observed as language samples (Spencer et al., 2023), survey responses (Ebert & Williams, 2023; Oliva et al., 2023), ratings of perceived effort (Cortez-Aoyagi et al., 2023), and test scores (Mues et al., 2023), as well as several ways of measuring physical properties, such as auditory brainstem response waveforms (Porter et al., 2022), tongue pressure measurements (Szynkiewicz et al., 2023), otoacoustic emissions (Pacheco et al., 2022), and acoustic measures of voice (Dahl & Stepp, 2023), or measuring both behaviors (speech recognition, effort ratings) and physical properties (pupillometry) to assess listening effort (Lau et al., 2019).

Researchers conducting nonempirical investigations make use of existing information instead of gathering new data. Nonempirical research ranges from loosely structured term papers and literature reviews to carefully constructed theoretical analyses or systematic reviews of a body of research. Another way to characterize different forms of research is the distinction between *qualitative* and *quantitative* research. Qualitative research and quantitative research differ with regard to the way questions or problems are formulated and investigated. A commonly identified difference, however, is in the type of information or data a researcher gathers. Qualitative research data often include verbal information. This might take the form of highly detailed descriptions of a person's behavior or perhaps direct quotes of a person's statements. Quantitative research, as you might expect, relates to numerical information such as frequency counts and measures of size or other physical properties. Sometimes researchers gather both types of data and report both numerical and verbal information.

Within the category of quantitative research, we often make a distinction between studies that are experimental and those that are nonexperimental. In experimental research, researchers identify one or more factors that they will manipulate or control during the experiment. For example, a researcher might compare different approaches for improving a person's communication abilities and could manipulate how much or what type of approach participants experience. The researcher manipulates or controls the conditions so that some participants have a different experience during the experiment than others. According to Newhart and Patten (2023), a true experiment meets two criteria. The first is the researcher's creation of different conditions or experiences by manipulating one or more factors during the experiment, and the second is that the conditions participants experience are determined randomly. A true experiment has random assignment of the participants to different experimental groups. Experimental research that lacks random assignment to groups is sometimes referred to as quasi-experimental research. Generally speaking, a study that meets both standards, experimental manipulation and random assignment, provides stronger evidence than a quasi-experimental study.

One of the most common kinds of experiments is one in which a researcher compares the performance of two groups, each experiencing a different experimental manipulation or treatment. In audiology and speech-language pathology, such