“Excellent introductory text that takes the students from the beginning review of literature, through the research design and analysis, all the way through to the final presentation of their results.”

— Daniel L. Carl, PhD, University of Cincinnati
Designing and Conducting Research in Health and Human Performance

Designing and Conducting Research in Health and Human Performance, 2nd edition shows students how to become effective producers and consumers of health and human performance research. Like the first edition, this edition provides comprehensive coverage of both quantitative and qualitative research methods and includes step-by-step guidance for writing effective research proposals and theses. In addition, the authors show how to read, assess, interpret, and apply published research and how to conduct basic studies in health, physical education, exercise science, athletic training, and recreation. In this edition, the authors have also expanded areas of research design to include the PICO (patient problem or population, intervention, comparison, and outcomes) technique.

Designing and Conducting Research in Health and Human Performance, 2nd edition is filled with more up-to-date illustrative examples that emphasize the real-world applications of research methods. Throughout, the authors draw on a variety of examples that were selected because they provide a context to further the understanding of health and human performance research.

Research to Practice examples and Tips are included by the authors to help students better appreciate the book’s content. Additionally, new to this edition, is Pulse Check, which provides an opportunity for students to engage in critical thinking in all things research. These study aids provide suggestions and additional resources to assist students in understanding the research process. Key terms, defined and highlighted, enrich each chapter. The end of each chapter includes Applying What You Learned sections designed to help students comprehend and follow best practices in research methods. Online resources and guides developed by the authors to support and enhance students’ learning of important research concepts are available.

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DESIGNING AND CONDUCTING RESEARCH IN HEALTH AND HUMAN PERFORMANCE

Second Edition

Tracey D. Matthews and Kimberly T. Kostelis
We dedicate this text to our students—you have been with us at every stage of our writing. Thank you for the privilege of working with you!
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The inspiration for this textbook began when I first started teaching at a small liberal arts college in Vermont, Castleton University. The Physical Education Department included a Senior Thesis class designed to introduce undergraduates to research methods in physical education and exercise science. As I searched for textbooks to use, I realized that most of the research methods texts in exercise science and physical education were written with the graduate student in mind. At that time, I realized there was a need for such a textbook for undergraduate students. Later, after moving on to Springfield College in Springfield, Massachusetts, I had the privilege of having Dr. Kimberly T. Kostelis as my graduate assistant. I knew that if we partnered, we could write an effective and informative research methods textbook for undergraduates in health and human performance.

We have many years of experience presenting research methods to both graduate and undergraduate students, and we hope you agree that we have been able to gear this textbook for the particular needs of the undergraduate student. We emphasize real-world applications of research methods throughout the text. We draw on many different, current examples from the areas of health and human performance, with the hope that these examples will provide you with a context in which to understand research. We are now in our second edition in which we have made some additions and updated research examples in the areas of health and human performance.

We also designed the textbook in a very specific sequence. In Part I, “Understanding Important Research Concepts,” we provide the reader with a holistic picture of research in process. Recognizing that at this beginning point students may know very little about the research process, and it may seem overwhelming, we took great care to continually reemphasize these concepts throughout the text. In this edition, we have added concepts on evidence-based practice and the PICO technique (patient problem or population, intervention, comparison, and outcomes).

After providing the foundational concepts to ensure that you have a basic understanding of the important concepts of research in Part I, we begin to present how to go about writing a review of literature in Part II, “Reviewing the Literature.” Within the chapters of Part II, we provide you with the necessary tools to identify your topic, search for related articles on your topic, and write a review of literature. Throughout you will notice practical, real-world examples—Research to Practice—so you can see how research is applied to our fields in health and human performance.

In Part III, we take the research process to the next level and discuss issues related to “Understanding and Developing Research Designs.” Not only do we present information on how you can develop your own research design, but we present important concepts and also research examples in the health and human performance area. We cover qualitative, quantitative, and mixed-methods research designs in these chapters.

Part IV presents measurement and analysis issues related to research. These often can be the most difficult concepts to grasp; however, our intent is to make the information applicable to your content areas. Once more, examples and applications are provided throughout each chapter. We discuss measurement issues for both qualitative and quantitative research designs. We hope you will gain awareness and understanding of not only quantitative research analyses, but also qualitative data reporting. As is emphasized throughout the text, we offer analyses that will best answer your research
question. We believe that to do this you need to have an understanding of and exposure to both types of research designs.

The final section, Part V, is entitled “Putting it All Together.” In this section, we teach you how to write your results and discussion. If you do decide to collect data, you will have the resources and ability to do so. Additionally, we have found that there are many other ways of presenting your research including posters and oral presentations. The last chapter provides detailed descriptions of how best to effectively present your information in both forms.

Throughout, you will notice not only the Research to Practice examples, but also Tips, which provide suggestions and additional resources to assist you in understanding the research process. Within the text, we also offer key terms that are defined and highlighted throughout each chapter. At the end of each chapter, chapter review questions will help you to understand and follow “best practices” in research methods. In this new edition, we have also added Pulse Checks within each chapter. These can be used to check for understanding about the topics presented. In addition to the text itself, we offer online resources and guides to help you understand important research concepts. We hope that these application pieces will provide a context in which to better understand research methods.

After you have used this book, we hope you have a better appreciation of and excitement for research methods. We believe this text can provide a context for you to comprehend the research process and how it can be implemented in our fields of health and human performance. We want you to be able to understand and perform research, but also to become excellent consumers of research. We want you to become the source that your fellow students will go to for answers to research questions related to health and human performance. We hope our text will provide you with the necessary tools to achieve these goals!
Acknowledgments

We thank the following individuals who have assisted with this textbook. First, we thank Shrikrishna Singh, David Varley, and Megan Smith of Routledge. Krish was instrumental in getting us connected to David and Megan. Thank you Krish for your encouragement and support. David and Megan have been supportive throughout the entire process, offering words of encouragement and feedback through our journey. Thank you both. The reviewers and editors who took the time to review our manuscript and provided us with valuable suggestions and constructive criticism. We thank you for your time and feedback.

We also acknowledge our mentor, who has guided us along the way. Dr. Barbara Jensen served as a role model for both of us during our graduate programs. We are indebted to her for her time and leadership.

We would also like to acknowledge our students. You are the reason we decided to write this text. With each class we have taught, we learned from you and were inspired by you to produce a text that would make research applicable to your discipline instead of something too abstract and overwhelming. Our goal was to make research fun (or, at the very least a bit more enjoyable)!

Finally, we must acknowledge our biggest fans, our families. First, to our husbands, Lee Matthews and George Kostelis who have been our biggest cheerleaders during this journey. They have been a constant source of support and understanding throughout our writing. Thank you for your constant love and continued encouragement in our professional lives. We are stronger women with your support. Our children are our pride and joy. To Emma, you are now an adult, but you have always been understanding and encouraging of your mom’s work. Thank you for your patience when your mom needed extra time to write. To Demitri and Xander, my beacons of light, your energy, love and support have allowed me to strive to be my best and attain professional goals. I love you both very much.
WHAT IS THE PURPOSE of understanding research? Why do I need to understand the research process? When will I use research concepts in my profession? Perhaps these are questions that you are asking yourself as you begin your quest into understanding research concepts. We hope that by the end of this section and more so, after reading this book, you will have a greater appreciation for research in general. Research is a challenging topic; we ask you to keep an open mind throughout and experience the research process at least once. Our goal is not to make you a scientific researcher but rather a good consumer of research. We also encourage you to make applications to your area of study, and we hope that through this textbook you gain a better appreciation of why research is important. Consider some of the following scenarios.

You are a health educator and a parent asks you about a recent health topic, such as a salmonella outbreak in food. As a health educator, you need to convey the most accurate and correct information to the parents. You may not know all the answers so what will you do? Yes, research the topic!

You are a health promotion/wellness coordinator in a corporate setting. Your supervisor has asked you to create a survey regarding client satisfaction with the fitness facility you are managing. How will you create a survey? This book can help you to understand the steps that go into questionnaire development, but you also need to know the content of appropriate items, which involves a review of literature.

You are a personal fitness trainer at a local fitness facility. Many clients have asked you about the latest diets and their credibility. How will you respond to help them make an informed decision?

Finally, you are an athletic trainer and an athlete has asked you about a new supplement on the market and its effects when training. To provide an informed decision, you need to research the new supplement and provide the athlete with the most accurate and up-to-date information. Yes, research the topic!

We hope that these scenarios have provided you with a basis of why research is important. In Chapter 1, you will learn some of the basic concepts of research. We also emphasize the importance of being a good consumer of research, which is relevant to each of these scenarios. Chapter 2 continues to cover research concepts by providing an overview of research designs as well as to introduce the nature of research variables and measurement issues. Both of these chapters provide a strong base for understanding research concepts.

Good luck!
WHAT YOU’LL LEARN

■ How to define research and begin to explore the nature of research
■ How the scientific method helps guide the research process
■ How evidence-based practice guides a clinician in answering a clinical question
■ How the research continuum ranges from applied research in field settings to basic research in laboratory settings

As stated in the Introduction, research is part of our everyday lives. We use research in our personal lives to enhance our decision making and problem solving. For instance, when we are considering purchasing a new car, many of us will take the time to research and define specific criteria we are looking for in our car purchase. Through the information that is gathered, we are able to make an informed decision. Using data from current research to support the situation at hand will enhance our decision-making process. Next time you are having a debate with a friend, add a research claim or identify data to augment your position. Do not worry if you cannot cite the source; most likely your friend will not ask, because it is hard to argue with research claims and data!

Using research within your career is critical to your professional development. The research examples used in the Introduction for the health and human performance fields are good examples of how you may use research methods in your career. If you plan to participate in conducting research or plan to be a consumer of research through reading and attending professional development seminars to advance yourself professionally, it is imperative to understand the concepts and designs of research. We hope that you will be able to experience the research process so that you will be able to directly apply the experience with the sometimes difficult and complex nature of research. Through this textbook, we will guide you through the research process. To begin, we must define research and examine the research continuum.

Defining the Research Process

How do we go about defining research? Think about research as a process that starts with a question and ends with a conclusion. To arrive at the end and have the ability to
make a knowledgeable conclusion requires a systematic approach to answering your research question.

Consider the health educator scenario again from the Introduction. The salmonella outbreak may have been covered extensively in the media. As a health educator, it is your professional responsibility to recognize that the reported information may be compelling, yet not always totally accurate or complete. Relying solely on mass media information is not recommended, especially those convincing and persuasive headlines. Furthermore, it is your responsibility to determine what information is truthful and how you will present and inform parents in your school system about this outbreak. As a health educator, you should use more accurate resources, such as the Centers for Disease Control and Prevention (CDC). When turning to more scientific resources in an attempt to provide accurate information, you need to remember that you are presenting this information to individuals without your content knowledge base. Therefore, you must be able to communicate clearly in such a manner that your audience will understand the information. With your education and training thus far, combined with the help of this textbook, you will know where to look for reliable resources, how to interpret information, and how best to communicate that information to others. With practice, sorting and filtering mass media information and reviewing scientific research will become easier, and you will be able to carefully and systematically report the needed information accurately to your audience.

Because the health and human performance fields are science-based professions, we need to stay current with new developments in our disciplines. It is our professional responsibility to stay current and be able to communicate ongoing changes within our fields to our clients. For example, in 2007 the American College of Sports Medicine (ACSM) and American Heart Association (AHA) announced recommendations on physical activity and public health (Haskell et al., 2007). Updates are continually being made with regard to dosage, intensity, frequency, and duration of physical activity. In 2008, the United States Department of Health and Human Services (HHS) issued the 2008 Physical Activity Guidelines for Americans (www.health.gov/paguidelines). In 2010, then First Lady Michelle Obama introduced the Let’s Move initiative and renamed the President’s Council on Fitness and Sports to the President’s Council on Fitness, Sports, and Nutrition to provide a broader perspective of health initiatives for Americans. More recently, the President’s Council was renamed to Sports, Fitness, and Nutrition. Additionally, Physical Activity Guidelines Advisory Committee Scientific Report of 2018 was submitted to Health and Human Services. The committee’s charge was to examine scientific literature published since the 2008 guidelines. Staying informed and being a good consumer of research will assist you in informing students and clients while keeping you up to date on current trends. Continuing to read, interpret, and communicate scientific information will become easier with practice, as will further understanding of the research process.

PULSE CHECK

How would you define research?

Scientific Method

Remember, research is a purposeful and systematic process to problem solving. Understanding how to communicate research findings to individuals is only one aspect of research. Being able to develop a sound research design and execute the research
methods is equally important. Personally, experiencing the research process will allow you to apply your experience to the concepts of research and its designs. The scientific method is used to answer your research question.

The scientific method is a way to ask and answer specific questions by making observations and performing experiments. See Table 1.1 for an overview of the steps in the scientific method.

**Step One: Identify the Problem**
The first step in the scientific method is to select/define a general problem or a question of interest to you. Ask yourself what you are interested in and want to know more about in your profession. Identify the problem you would like to solve. We cannot stress enough that this topic area must be of interest to you. You will be spending much time working with this topic area, and your choice of topic will impact the approach and execution of the remaining steps of the scientific process. This is like the foundation of a house; you need to have a solid underpinning to build the framework for a well-built house that will withstand the test of time. At this point, you should be able to brainstorm some areas of interest to you; however, further refining your topic area is discussed in Chapter 3.

**Table 1.1 Steps in the Scientific Method**

<table>
<thead>
<tr>
<th>Step</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Identify the problem</td>
<td>→ What is your area of interest? → What questions are you curious about in your profession? → What do you want to know more about in your professional field?</td>
</tr>
<tr>
<td>2. Research the area (Review of literature)</td>
<td>→ How will you get a better picture of your research topic area?</td>
</tr>
<tr>
<td>3. Identify a hypothesis or research question</td>
<td>→ What are your initial predictions or questions based on the research that has been conducted in the field to date?</td>
</tr>
<tr>
<td>4. Design an appropriate research design (Research methods)</td>
<td>→ How will you solve your research problem or question?</td>
</tr>
<tr>
<td>5. Collect data</td>
<td>→ How will you execute your research methods and what will you do with all your data?</td>
</tr>
<tr>
<td>6. Analyze data (Results)</td>
<td>→ How will you analyze your data and what will you find?</td>
</tr>
<tr>
<td>7. Formulate findings and conclusions</td>
<td>→ How will you make sense of your results and what does it all mean?</td>
</tr>
</tbody>
</table>

**Step Two: Research the Area**
Next, you need to begin researching your topic area of interest. What do you need to know to understand the topic? Where do you need to go to understand more? Secondary sources and browsing through government and professional organization websites may be useful to gain a broad sense of your topic area; see Tip for more information.
Secondary Sources
Include resources, such as textbooks, reviews of literature, and position papers that present research, but not the author(s)’ own research.

Primary Sources
Are resources in which the author(s) actually performed the research presented and include Methods, Results, and Discussion sections.

Quantitative Research Approach
Research that relies on numerical data to reach results and conclusions.

Step Three: Identify a Hypothesis and/or Research Question
A thorough review of the literature will help you understand the problem and allow you to successfully lead to the next step in the scientific method of identifying a hypothesis or research question. A hypothesis is an educated guess: What do you think will happen? This is not just a guess; it comes from the research you have performed in Step 2. Based on past research, you will be able to develop a best guess (research hypothesis) as to what will happen. Another approach is to develop a research question. Sometimes it may be difficult to come up with an educated guess, especially when you are using the qualitative research approach. We will discuss much more on specific research designs; however, overall, research is divided into two approaches: quantitative and qualitative.

Further discussion on quantitative research designs is discussed in Chapter 5.
Qualitative research designs are discussed in Chapter 6. The decision to formulate a research hypothesis or use a research question is sometimes up to the researcher or the type of research design. Not to complicate things more for you, but these two approaches could also be combined that is known as mixed-methods research (discussed in Chapter 7).
Step Four: Construct an Appropriate Research Design

Once the research hypothesis or question is developed, the researcher will determine the most appropriate research design. The design and methodology are always driven by the research hypothesis or question. Going back to building a house, the framework that is set will dictate the design of the house. This is true here in our example; the research that was conducted that led us to developing our research hypothesis or question (framework) will dictate the research design. Your review of the literature will help to guide you in appropriately developing your own research design. As you begin reading past research, you will find that often researchers identify future research considerations or suggestions for future research designs. These can be very helpful as you begin to develop your own design. At the same time, you must keep in mind ethics in research (Chapter 8) and ensure that the benefits of the research outweigh the risks involved with conducting the research. Chapter 9 further discusses developing research designs and methodology considerations. At this point of refining the design and developing the methodology, you will define the research variables you can measure and the ways in which you can measure those variables. Further discussion and considerations of ways of measuring your research variables include considering validity, reliability, and objectivity, which are presented in Chapter 10. In short, you want to make sure you will be measuring what you want to be measured (validity), and you want to be consistently (reliability and objectivity) measuring your research variable.

Steps Five and Six: Collect and Analyze Data

The next two steps in the scientific method include collecting and analyzing your data, which again are dependent on the research design that was selected based on the research hypothesis or question. This is the final finishing stage of building a house. All the finish work is dependent on the framework and type of design. The finish work of a house is contingent on its style and design. Likewise, in research, if you are using a quantitative research approach, you will be using inferential statistics to either accept or reject the statistical (null) hypothesis. Chapters 11 and 12 will provide you with more in-depth coverage of hypothesis testing and specific statistical procedures to test research hypotheses. Conversely, if the researcher will be using qualitative methods, Chapter 13 details how to interpret the data and answer research questions. If you are using a mixed-methods approach or combining qualitative and quantitative data analysis, you will be using statistical procedures and qualitative data analysis procedures to answer your research question.

Step Seven: Formulate Findings and Conclusions

The final step, formulating findings and conclusions, occurs when the researcher is ready to make connections between his or her research findings and the literature. At this point, the house is built, and the owner needs to determine how to decorate the house in accordance with the house’s style. In other words, based on the analysis of the data from the previous step, it is now time to interpret the results and make conclusions. The researcher will ask (1) How are the findings from the current study similar to or different from past findings? and (2) How do the findings contribute to the existing body of research? The researcher also considers the implications and meaning of
Introduction to Research in Health and Human Performance

FORMULATE FINDINGS AND CONCLUSIONS

IDENTIFY THE PROBLEM

ANALYZE DATA

RESEARCH THE AREA

COLLECT DATA

IDENTIFY A HYPOTHESIS AND/OR RESEARCH QUESTION

DESIGN AN APPROPRIATE RESEARCH DESIGN

Figure 1.1 Scientific Method

his or her findings. A term we often use in our research courses is the “so what” factor. Once you have answered the research question or supported your research hypothesis, so what? What does it mean? How can the information be used by practitioners? These are very important questions, and you want to be sure that these are answered at the conclusion of the research. Chapters 14 and 15 cover the final steps of the research process that include preparing your Results and Discussion sections, as well as ways of professionally presenting your research. Figure 1.1 provides a visual representation of the steps of the scientific method, as well as the continual flow of the research process.

PULSE CHECK

What are the steps in the scientific method?

Evidence-Based Practice

Evidence-based practice (EBP) is a widely used research method in the health professions including all areas of health and human performance. EBP is a method in which you systematically review past research to inform how you will make decisions about patient care. In order to effectively use EBP, the clinician uses his/her expertise to make the most appropriate choices to improve the patients’ well-being or health. The term evidence-based medicine was coined in the 1990s. Sackett, Rosenberg, Muir, Haynes, and Richardson (1996) defined evidence-based medicine as “the conscientious, explicit and judicious use of current best evidence in making decisions about the care of individual patients” (p. 71). Health professions ranging from nursing to social work to athletic training utilize the EBP. In these fields the desire is to create the link between theory and practice. EBP provides the ways in which this link can occur. The main priority to focus on the overall outcomes of the patient.
Similar to the scientific method, there are specific steps to EBP. Raab and Craig (2016) described the steps from an athletic training approach. The first step is to identify a clinically appropriate and searchable research question related to the athlete. This is very similar to the first step in the scientific research process of identifying a problem. In EBP, the problem will be specific to the athlete and not a specific interest of yours. Steps two and three of EBP are incorporated in Step two of the scientific method—research the area. Step two of EBP involves a review of databases to identify evidence related to the specific question about the athlete. Step three is to critically evaluate the evidence you find in your search. Step four of EBP includes integrating the evidence to make the appropriate choice of the best treatment option. This step could be comparable to designing an appropriate research design. Here, the researcher is utilizing the information from the review of literature to develop a design that will best answer the research question. The final step in EBP is evaluate the outcomes and monitor the athlete based on the treatment outcome that was decided. This step is comparable to Steps five through seven of the scientific method. In these steps the research is analyzing the data and making decisions about the outcome based on the analysis. In the EBP approach, the clinician is analyzing and monitoring the patient outcomes. In this step, the clinician will utilize the information from Steps one to four to continually assess patient outcomes and make adjustments when needed. Like the scientific method, EBP has a continual flow to this process. In Chapter 3, we will further discuss the PICO format (Patient Problem or Population, Intervention, Comparison, and Outcome) that will assist you in developing your EBP question.

RESEARCH TO PRACTICE: EVIDENCE-BASED PRACTICE EXAMPLES

Miller, Di Mango, and Katt (2018) examined responses to high school football players when they experienced cooling delays in a lab setting. The researchers wanted to answer if a delay of cold-water immersions (CWIs) by 5 or 30 minutes would impact core temperature cooling rates and the players' perceived thermal sensation. The researchers concluded that
treatment delays and football equipment did not impair CWI’s effectiveness. Because participants felt cooler and better after the 30-min delay despite still having elevated core temperature, clinicians should use objective measurements (core temp) to guide their decision making for patients with possible exertional heat stroke (p. 1200).

Turner (2019) examined a rotator cuff treatment on a national-level synchronized ice skater. Turner concluded
a best practice approach for the conservative treatment of rotator cuff tears is yet to be identified in the current literature. The present case suggests that conservative treatment designed to correct scapular dyskinesis can be effective in alleviating pain and dysfunction associated with the injury, as well as reducing the time to return to full level of sport when compared to surgical interventions (p. 64).
PULSE CHECK

What are the steps in evidence-based practice?

TIP

Examining some of the current research programs at the Mayo Clinic can assist with providing further context to research being conducted and research being utilized to enhance health care. One example is the sports medicine research being conducted at the Mayo Clinic (www.mayo.edu/research/centers-programs/sports-medicine/overview), in comparison to how research results are being synthesized in the Evidence-Based Practice Research program at the Mayo Clinic (www.mayo.edu/research/centers-programs/evidence-based-practice-research-program).

Research Continuum: Applied to Basic Research

From a very global perspective, many researchers will identify two forms of research: applied and basic research. For purposes of defining the two, we can assume that they are dichotomous. Applied research attempts to address a specific question and is more concerned with the application of findings. Applied research usually uses a bottom-up approach or inductive reasoning to solve problems. Research questions are generated through individual observations or experiences in an effort to solve actual problems in the field. The foundation of applied research is based on developing new theories as opposed to testing existing theories. Thus, conclusions are based on information generated from individual and direct observations.

For examples of applied research, please refer to Research to Practice.

Research to Practice: Applied Research Examples

Shih and Wand (2019) examined spiking kinematics of injured volleyball players. Research indicated “Alterations occurred in glenohumeral, scapular, and trunk kinematics when volleyball players with shoulder pain performed the cross-body spike, particularly at the instant of ball contact. These biomechanical changes might be linked to the overuse shoulder injuries seen in volleyball players and should be noted when managing players with shoulder pain” (p. 97).

Reichert et al. (2019) examined water-based training models on muscular function of older women. Researchers concluded that “Water-based resistance training using simple or multiple sets promotes the same gains in rapid strength, however only multiple sets induced improvement on functional capacity” (p. 46).

Conversely, basic research is usually considered to be more laboratory research that may or may not have immediate or direct implications. Applied research uses more inductive reasoning; whereas, basic research uses a more top-down approach or deductive reasoning. Research questions are generated based on a theoretical underpinning that will drive research to develop new hypotheses based on the results of the
research. Basic research addresses the researcher’s curiosity and is driven by a quest for knowledge, not necessarily to answer a specific question.

Essentially, applied research is thought to be more practical, and basic research is considered more theoretical. For examples of basic research, please refer to Research to Practice.

**RESEARCH TO PRACTICE: BASIC RESEARCH EXAMPLES**

Robison, Swenson, Hamilton, and Thanos (2018) examined how exercise may reduce dopamine response in rats. Possible exercise-induced changes in dopamine signaling were examined among male and female Lewis rats. Rats who were 8 weeks old were split into exercise and sedentary groups. Exercise rats were run on a treadmill for 10 minutes, 5 days per week, for 6 weeks; whereas, sedentary rats remained in their home cage. “Rats were killed after 6 weeks of treatment, and their brains were used for in vitro autoradiography using [established] ligands to quantify dopamine type 1-like receptor (D1R)-like, dopamine type 2-like receptor (D2R)-like, and dopamine transporter binding, respectively” (p. 1596).

Higuchi et al. (2019) examined prostaglandin E2 receptor 4-associated protein (ERAP) in diabetic mice and concluded “that ERAP regulates gluconeogenesis in hepatocytes and is associated with hyperglycemia in diabetic mice. Our data suggest that suppression of ERAP could be a novel strategy for the treatment of diabetes” (p. E410).

Although we clearly define these two forms of research, one can argue that there is no clear dichotomy but rather a continuum that exists between the two forms. If we consider a continuum, applied research that answers more immediate questions and occurs in a real-world setting would be on one end, and basic research that addresses more theoretical issues and has more strict scientific controls would be at the other end. Consider research in exercise physiology. Often as researchers we attempt to control specific parameters during exercise, such as time of exercise, fluid intake, temperature, and diet. We also may have the subjects tested in a laboratory setting where scientific controls are in place versus a real-life setting, yet still attempt to apply the findings to a real-world setting. In the fields of health and human performance, applied research is more common; however, basic research is still very important and essential to many professionals. Specifically, medical professionals conduct basic research in various areas to better understand infectious diseases and discover treatments and cures for developmental diseases and cancer. These are only a few examples, and there are many aspects or lines of research, such as biomedical and genetic research, that are being conducted to better understand the human organism and how we function. As we consider applied and basic research along the continuum, a balance of both may be the most appropriate research design, as illustrated in Figure 1.2. We also encourage you to review the online student resources for more information on these cited articles, as well as web page links to various organizations conducting research.

**PULSE CHECK**

What is the difference between applied and basic research?
Newton et al. (2019) conducted research using controlled parameters in a laboratory setting yet applied findings to a real-world setting. Researchers examined patients with prostate cancer and the influences of exercise on bone mineral density. Specifically, Newton et al. (2019) “combined impact loading and resistance exercise attenuates bone loss at the spine and enhances overall musculoskeletal function in prostate cancer patients undergoing androgen deprivation therapy” (p. 607).

SUMMARY

Research can provide us with knowledge and the ability to better solve problems. Staying current in your career is imperative to your professional development. At the same time, research can lead to misleading findings and conclusions and the need to dig deeper and examine the research methodology. Catchy or misleading research findings may not be unfounded but rather misinterpreted by readers who simply read the mass media headlines. Thus, you need to be good consumers of research. Through this textbook, you will learn to review and interpret information and systematically report accurate and relative findings within your profession.

Research is very systematic in nature, and understanding the scientific method will assist with you developing an overall command of the research process. Beginning with identifying a research problem that is of interest to you is imperative. You will be spending a great amount of time researching this area and must be invested in what you are doing. Much of your time will be spent on preparing a review of literature, which provides a foundation for the remaining steps in the scientific method. Based on the research, you can make an educated guess or hypothesis as to what you think would happen. However, if your topic area warrants more investigation that explores the how and why, then you would develop research questions. These two examples help differentiate the quantitative and qualitative research approaches. Evidence-based practice (EBP) is a method in which you systematically review past research to inform how you will make decisions about patient care. In order to effectively use EBP, the clinician uses his/her expertise to make the most appropriate choices to improve the patients’ well-being or health. While EBP has unique characteristics, there is much similarity in EBP steps to the scientific method.
Research design and methodology are based on research hypotheses or questions. Many considerations need to be addressed at this step that are discussed in later chapters. Not only is learning about the various quantitative and qualitative research designs in Chapters 5 through 7 important, but also discussing ethics (Chapter 8) is crucial in developing your research proposal (Chapter 9). Finally, analyzing and formulating findings will allow you to make conclusions based on the research conducted. Through this process, we hope you will have a greater understanding and appreciation for the research process.

Applying What You Learned

1. Provide an example of how understanding the research process will benefit you professionally.
2. Why is being a good consumer of research important to understanding and interpreting findings and conclusions? Provide an example of a catchy claim in the headlines that should be further questioned or critically evaluated before using the results.
3. In reference to the scientific method, why is Step 2 (Review of the Literature) a critical step in the subsequent steps of the scientific method? Specifically think about the information you will you garner from this step and how this will impact the decision-making process for the research design.
4. Let’s compare the scientific method and evidence-based practice. Provide an example of how the scientific method is used as a framework to conduct research to enhance decision making, whereas, evidence-based practice is focused on using the research to enhance decision making.
5. Provide an example for both applied and basic research that is in your area of interest. For each, indicate what characteristics within the research allow the example to be categorized as applied or basic research.

Key Terms

Applied Research
Basic Research
Evidence-Based Practice
Primary Sources
Qualitative Research Approach
Quantitative Research Approach
Research
Secondary Sources
Scientific Method

References


WHAT YOU’LL LEARN

- How the different types of research designs relate to quantitative, qualitative, and mixed-methods approaches
- How research variables differ among various research designs
- How measuring research variables are important to research and influence the overall quality of the research design
- How threats to internal and external validity can affect the quality of research

Now that you have been introduced to the basic concepts of research from Chapter 1, we want to provide you with an overview of different research designs that are common in health and human performance. Because the primary purpose of the first section of this text is to introduce you to important concepts, we will not spend a lot of time covering all of the research designs. As you move through the text, you will see that we commit entire chapters to quantitative, qualitative, and mixed-methods designs (Chapters 5 through 7). For now, we want to provide you with just an overview, so you can begin to develop your research topic. As we learned from the steps in the scientific method, the research design is based on the research problem and aligned with the proposed hypothesis or research question. Understanding the various research designs will assist you with better understanding your research variables.

When thinking about developing your research design, you need to understand the nature and measurement of research variables. Research variables are better understood when examining them in relation to the various available research designs. When thinking about how you will measure research variables, considerations need to be discussed to ensure that you are designing quality research methodology, including the concepts of validity, reliability, and objectivity. These measurement issues are introduced here, and Chapter 10 will provide more explanations surrounding them. The last section of this chapter discusses how the measurement of research variables and overall research designs affect the quality of research.
Overview of Research Designs

Now that you have a general overview of some basic research concepts from Chapter 1, let us highlight some of the different types of research. We introduced the forms of research as applied and basic and discussed how research forms a continuum. Various research designs can fall along the continuum, depending on how you design the methodology. First, quantitative and qualitative research designs are both covered in this text. So, what is the difference? Quantitative research answers research questions using quantifiable variables, or variables that can be assigned a number.

Qualitative research uses text and descriptions to answer the research questions. Words such as how and why are often used within the context of answering a research question. These types of questions are more open-ended in nature and are not easily answered by obtaining a numerical value. Researchers evaluate the findings by reviewing records, texts, and other artifacts to answer the research question. Quantitative research examines research from a statistical perspective; whereas, qualitative research explores research from a conceptual perspective. The question that may arise is: Is one better than the other? Of course, the answer is no; the research design you use should be driven solely by the research question and not by the type of research. Focus on what you want to find out. This should always drive your methodology. Your design and methods should not be developed based on the fact that you want to use a survey, or you want to interview participants. Let the research question guide your methodology. This is the reason for the research question being the first step in the scientific method.

Different types of research are used in both qualitative and quantitative research design. Many times, these types overlap and may involve a qualitative or quantitative approach, so no clear demarcation exists as to a type of researching being “more” qualitative or “more” quantitative. Additionally, part of the research design may be quantitative and an additional component may be qualitative in nature. This is known as a mixed-methods approach.

PULSE CHECK

What are the differences between quantitative and qualitative research approaches?

Table 2.1 provides an overview of the research designs that we will be presenting throughout the text.

Understanding Research Variables

Having knowledge of the different types of research designs allows you to better understand the research variables involved in the various designs. Based on your research question, you will be able to identify the research variables that you are most interested in learning more about in your topic area of interest.

For example, if you were interested in how exercise affects cognitive functioning among elderly adults, your two research variables would be exercise and cognitive functioning. The aspect of elderly adults is not measured; it is rather a descriptor of who your sample would include for your study. Age would be a research variable if the question were rephrased to include how age influences cognitive functioning. We
Table 2.1 Overview of Research Designs

<table>
<thead>
<tr>
<th>Research Types</th>
<th>Description</th>
<th>Quantitative, Qualitative, Both</th>
</tr>
</thead>
<tbody>
<tr>
<td>Descriptive research</td>
<td>1. Attempting to describe a current state of affairs (see Chapter 5)</td>
<td>1. Both</td>
</tr>
<tr>
<td></td>
<td>2. Observing individuals in some sort of environment (see Chapters 5 and 6)</td>
<td>2. Both</td>
</tr>
<tr>
<td>Experimental</td>
<td>1. Examining differences of an attribute variable on a dependent variable (see Chapter 5)</td>
<td>1. Quantitative</td>
</tr>
<tr>
<td></td>
<td>2. Examining the effects of a treatment on a dependent variable (see Chapter 5)</td>
<td>2. Quantitative</td>
</tr>
<tr>
<td>Correlation</td>
<td>Attempting to make relationships on two variables on the same subject (see Chapter 5)</td>
<td>Quantitative</td>
</tr>
<tr>
<td>Ethnographic</td>
<td>Describing the cultural characteristics of a group of people (see Chapter 6)</td>
<td>Qualitative</td>
</tr>
<tr>
<td>Phenomenological</td>
<td>Describing one or more individuals’ experiences of a phenomenon (see Chapter 6)</td>
<td>Qualitative</td>
</tr>
<tr>
<td>Case Study</td>
<td>Thoroughly investigating one individual or organization (see Chapters 5 and 6)</td>
<td>Both</td>
</tr>
<tr>
<td>Narrative Inquiry</td>
<td>Storytelling through collection of anecdotal information (see Chapter 6)</td>
<td>Qualitative</td>
</tr>
<tr>
<td>Action Research</td>
<td>Focusing on local problems that practitioners face (see Chapter 7)</td>
<td>Both</td>
</tr>
</tbody>
</table>

**Operational Definition**
Statement of how the research variable will be measured in the context of the specific research study.

**PULSE CHECK**
What are research variables?

The different ways in which research variables are operationally defined are important to understand and recognize. If exercise is to be measured using a questionnaire to determine the level of exercise, this would be a continuous variable, because it would produce a range of scores based on the items on the questionnaire.
Independent and Dependent Variables

The ways in which research variables are defined are aligned with the type of research design. Table 2.1 shows experimental designs divided into either quasi-experimental or true experimental. Experimental research designs include independent and dependent variables. The way in which these research variables are operationally defined will determine whether the experimental design is quasi-experimental or true experimental. The example of exercise among elderly adults illustrates how a research design can be either quasi-experimental or true experimental.

If exercise is measured by taking a group of elderly adults who regularly exercise and another group who is sedentary, then this would be known as a grouping variable or independent variable.

Another way to use exercise as a grouping variable or independent variable would be to take one group of elderly adults and have them attend group exercise sessions for eight weeks, while the other (control) group would continue their sedentary lifestyle as normal. The way in which the grouping or independent variable is operationally defined will determine whether the research design will be quasi-experimental or true experimental.

In either type of experimental research design, the second research variable we mentioned was a dependent variable. In the same example, we can examine how cognitive functioning is considered the measured variable or dependent variable.

When examining the research question of exercise and cognitive functioning among elderly adults, the outcome of cognitive functioning is dependent on the other research variable of exercise (group exercise or control). Cognitive functioning is what is being measured as the outcome of the experimental research design.

Predictor and Criterion Variables

As shown in Table 2.1, correlation attempts to make a relationship based on two research variables. In other words, how much does exercise relate to cognitive functioning? Correlation examines relationships and how much one research variable influences or relates to the other research variable.
In the same example, exercise would be considered a predictor variable, or X variable, in a correlation research design.

Often the X variable is considered the independent variable. The X variables within correlation designs are continuous in nature, and thus we will be using the terms predictor or X variable when discussing correlation research designs.

When examining the research question of how exercise influences cognitive functioning, the second research variable is cognitive functioning. This would be considered the criterion variable, or Y variable, that we are trying to better understand among elderly adults.

Often the Y variable is considered the dependent variable. The Y variables within correlation designs are also continuous in nature and a measured variable. The Y variables are dependent on the X variable, but correlation research designs are examining the relationship of the variables across distributions, and thus we will use the terms criterion or Y variable when discussing correlation research designs. See Table 2.2 for a summary of the definitions of the research variables.

If you refer back to Table 2.1, you will see that research designs that are quantitative have distinct research variables associated with their design. Quasi-experimental, true experimental, and correlation research design are discussed in more detail within Chapter 5. Additionally, the other qualitative, as well as mixed-methods designs are further explored throughout Chapters 5 through 7. Nevertheless, based on the research question that you develop, you will need to begin to think about the research variables

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**Table 2.2** Summary of Research Variables

<table>
<thead>
<tr>
<th>Independent Variable</th>
<th>Grouping variable in experimental research designs: Students who received sex education and students who did not receive sex education in their health class</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dependent Variable</td>
<td>Measured variable or outcome in experimental research designs: Number of sexually transmitted diseases among students</td>
</tr>
<tr>
<td>Predictor variable or X variable</td>
<td>Variable used to explain the criterion or outcome variable in correlation research designs, otherwise known as the X variable: Amount of support provided throughout labor and childbirth</td>
</tr>
<tr>
<td>Criterion variable or Y variable</td>
<td>Variable that is being explained by the predictor variable in correlation research designs, otherwise known as the Y variable: Number of hours women were in labor</td>
</tr>
</tbody>
</table>
and design. Additionally, we will explore some measurement issues when thinking about operationally defining your research variables. We encourage you to keep these aspects in mind when reading other research and writing a review of the literature, which is the second step of the scientific method. Being mindful of operational definitions used in the research will also assist with developing a quality research methodology.

Measuring Research Variables

When you are thinking about making research variables operational, you also need to think about how you will measure them. How you propose to measure your research variables is critical. How you decide to measure your research variables will affect the quality of your research design. How valid and reliable are the measurements? Measurements must have some level of validity and reliability evidence so that the collected data when analyzed produces quality research results. Validity, reliability, and objectivity concepts are discussed in greater detail in Chapter 10; however, an overview is provided here to introduce you to these concepts in research designs.

Validity

Validity of a measurement indicates that the research variable is measuring what it is supposed to be measuring.

Many ways exist to provide support for validity that are discussed in Chapter 10. When you are reading and reviewing the literature, be aware of how the research variables were measured. For example, if you wanted to examine the differences in cognitive impairment among patients who were taking medications for mild to moderate Alzheimer disease, such as Aricept, Exelon, or Razadyne, you would use some test for cognitive impairment. The way in which you choose to use and measure cognitive impairment is critical in determining the quality of your research. You want to make sure that the test you choose is truly measuring what it purports to measure. At this point, you may think that you could come up with your own cognitive testing; however, how will you ensure that the test is valid? Once you conduct a review of the literature, you will read about how others have measured cognitive impairment. You will see different ways of measuring cognitive impairment based on the characteristics of the participants. One example of a valid and reliable measurement that you would see is the Mini-Mental State Examination-2 (MMSE-2; Folstein & Psychological Assessment Resources, Inc, 2010).

Reliability and Objectivity

Not only is it important to ensure that valid measurements are used within the research design, but you should also examine the reliability of the measurements. You must examine validity first; you cannot have validity without reliability, yet you can have reliability without validity. Reliability of a measurement refers to its consistency.

You can be consistently measuring the wrong research variable, which is why validity needs to be considered before reliability. One common way for providing support for reliability is to administer a test, such as the MMSE-2 (Folstein & Psychological Assessment Resources, Inc, 2010), on one day and then again on another day. If the MMSE-2 is measuring cognitive impairment, then the results from day 1 to another day should be similar. Many different ways to provide support for reliability are discussed in Chapter 10.
Interpreting Research Designs

Measuring research variables is directly related to the overall quality of the research designs. No research is conducted without flaws or some disadvantage; however, because research is defined as a careful, systematic way of problem solving, one must be mindful of balancing positive aspects as well as drawbacks of the proposed research. A balance needs to be maintained between the amount of control and practicality when developing research methodology. Quality research results allow you to draw conclusions and allow practitioners to use the research in their profession. With that said, we now introduce two major issues to consider: internal and external validity.

The internal validity of the research methodology has to do with control of the study. How you develop and execute your research design will play a role in the internal validity of your study. Basic research, which is typically in a laboratory or controlled setting, will have higher internal validity. Essentially, it is the amount of control within the study. The more control, the higher the internal validity.

The external validity of the research methodology has to do with the practicality of the study. Can the research findings from the study be generalized to a larger population? If the research sample is a good representation of the population, then external validity will be higher. External validity will also be higher among applied research designs, because the design is more practical, and the results can be more readily transferred to the general population (generalizable). For additional characteristics of internal and external validity, please refer to Table 2.3.

Many factors can influence the internal and external validity of a research study. Chapter 9 provides more insight on threats to internal and external validity, as well as how to address and balance threats when developing your research design. Nevertheless, it is important to introduce some of the threats to internal and external validity. These research concepts are difficult to understand and warrant additional discussion. Also, these research concepts should be learned before you start reading and...
**Table 2.3** Characteristics of Internal and External Validity

<table>
<thead>
<tr>
<th>Internal Validity</th>
<th>External Validity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Good scientific control</td>
<td>Ability to generalize back to larger population</td>
</tr>
<tr>
<td>Extraneous variables have been controlled</td>
<td>Applied research design</td>
</tr>
<tr>
<td>Results can be attributed to the research design</td>
<td>Results can be applied to the field</td>
</tr>
</tbody>
</table>

interpreting research journal articles. As previously mentioned, reading past research can help guide your research design by considering some of the proposed research considerations or suggestions for future research design. Often these future research directions are based on internal and external validity threats. Threats to internal validity include selection bias, maturation, history, testing effects, instrumentation, and experimental mortality. Threats to external validity are dependent on the degree of internal validity and often are known as the interaction effect. The impact of the internal validity must be taken into account to determine its impact or interaction on the generalizability of the results. Consequently, the focus is on internal validity threats.

**Threats to Internal Validity**

When research is designed and executed, threats to internal validity should be considered to ensure quality research. Typically, the steps in the research process of developing a research design and collecting data are the points in which threats to internal validity should be considered. You should not only think about such threats when you are developing research proposals, but you should also examine such threats when you are reading journal articles about the research that has been conducted in your area of interest. Thus, when you are reading research journal articles for your review of literature, be aware whether any threats may have affected the results of the study.

**Selection Bias**

Determine first how participants were selected, because selection bias is one threat to internal validity. When selecting participants, the researcher should randomly select participants.

If the selection involves a bias, the results could be attributed to that bias and not to the actual findings. In the same vein, the researcher needs to ensure that selection among groups is similar. For example, if a researcher is examining motor development patterns of kindergartners and uses a number of different schools to collect data, the researcher must ensure that the children are of the same maturational level. If one school takes children at 4.5 years and another has strict guidelines for only accepting children 5 and older, some clear maturational and development issues could exist between the two groups. These issues could influence the findings for the motor development patterns.

**Maturation**

Maturation itself is a threat to internal validity. Maturation issues affect selection of participants as illustrated in the previous example, but also the passage of time during the research study is a threat. Aging, fatigue, and hunger are also concerns that should
be taken into consideration during methodology development. For most studies, the researcher will identify expectations of the participants before the study begins. Does the researcher want the participants to come in fasted? Well-rested? Hydrated? These are all issues that need to be addressed before the study begins. You need to be consistent with all participants, because you will be making comparisons perhaps among groups. If one participant comes in fatigued, and all others come in well rested, the results of that one participant could influence the results of the study.

**History**
The most common and typically uncontrollable threat is history. History deals with events that occur during or before the experiment that are not part of the treatment. Say you were attempting to examine flexibility and range of motion (ROM) during an exercise treatment. You want to ensure that individuals who have a high degree of flexibility (such as dancers or gymnasts) were not included in the study. These individuals could influence the results of the tests. In addition, if you were examining a relaxation program on stress reduction for employees during their work week and during the experiment participants watched a program on stress reduction on television, this could very much influence how they may respond to the relaxation program. The program on television is a confounding or extraneous variable to the study. The big issue here is to attempt to minimize these issues before the research study begins.

**Testing Effects**
Depending on the design of the research study, you may need to take a testing effect into account before you begin the study. Testing effect is an internal validity problem if the research design warrants a pretest and posttest. If you desire baseline levels before the experiment begins, you may pretest the participants on the specific variable. Then the participants may participate in a specific protocol and be posttested. Just the shear exposure to the test once may influence how the participants perform on the test the second time. There are ways to reduce this threat through your methodology by using alternative tests that measure the same specific variable in your research study.

**Instrumentation**
In addition to testing effects, proper calibration of the instrumentation is essential to the internal validity of the study. This is important not only with mechanical instrumentation but also with observational administrations of a test. You will want the test administrators or raters to agree on what they are observing and ensure that they are in fact looking for the same things. If raters are looking for different expectations, the results of the study can be compromised.

**Experiment Mortality**
Other types of internal validity threats that should be taken into consideration during the study include experiment mortality. Here, loss of participants from the study is a concern. This is very common in studies in which participants must return a number of times before the study is complete. Many times, participants may lose interest or do not enjoy the testing procedures. If this occurs, participants are more than likely to drop out of the study. We discuss these in more detail in Chapter 9; at this time, we want you to understand the importance of these issues as you begin reading research in your interest areas.
External Validity
As with internal validity, external validity plays an important role in your research. Here, we are concerned with how we can generalize our results to a larger population. External validity is also very dependent on internal validity. If we go back to the example involving motor development patterns in kindergartners, and we do not consider a sample that can be generalized to a larger group, then we will not have very good external validity. For the most part, external validity is directly related to how you have attained your sample. In Chapter 9, we discuss sampling procedures that will better assist the researcher in ensuring appropriate external validity.

SUMMARY
In the first part of the chapter, an overview is provided of the various types of research that are used frequently in health and human performance. The different research designs included quantitative, qualitative, and mixed-methods approaches. In general, qualitative research allows researchers to make conclusions based on statistical significance; whereas, conclusions from qualitative research are drawn from a conceptual perspective. Some research designs can employ both quantitative and qualitative approaches, known as a mixed-methods approach. No one single design is better than another. What is really important is that you use the method that best answers your research question.

Understanding research designs allow you to better understand research variables. Research variables include those aspects that are measured within your study. The operational definition of a research variable is also critical to understand, as well as how your definition of the research variable will affect the research design. For example, examining the differences among students who received sex education and students who did not receive sex education in their health class could be a quasi-experimental or potentially a true experimental design if the sex education curriculum was implemented in a health class. This same example could be a correlation research design if the operational definition were changed to the amount of sex education that was taught in different health classes across districts and states. The difference between the operational definitions is whether the independent variable is categorical in nature or whether the definition allowed for a range of scores. The amount of sex education among health classes across various districts and states would be on a continuum.

Finally, examining the measurement of research variables affects the overall quality of research designs. When discussing measurement of research variables, think about validity, reliability, and objectivity. You must examine validity first; you cannot have validity without reliability, but you can have reliability without validity. You have to ensure that you are measuring what you are supposed to be measuring, but also must be consistently measuring what you are supposed to be measuring. These concepts contribute to the overall quality and control of a research study. The amount of control within a study is its internal validity. Many threats can affect the control of the study; however, the more you control and increase internal validity, the lower the external validity. External validity refers to the generalizability of the study. The results of your sample should be applicable to the target population. The key point to remember is that no research will be without flaws, but you should recognize potential threats to internal and external validity; that is being a good consumer of research.
Applying What You Learned

1. Provide your own Research to Practice example and indicate what aspects within the research design that categorize it as either quantitative, qualitative, or a mixed-method research approach.

2. How does the operational definition of research variables potentially change the type of research design? Let’s use the research variable example in the text of cognitive functioning, and operationalizing this variable as scores on the Mini-Mental State Exam (MMSE) would be considered a quantitative research approach. How could cognitive functioning be operationally defined that would then be considered a qualitative research approach?

3. If an assessment is consistently measuring what it purports to measure, the instrument has both acceptable validity and reliability. Yet how can an assessment not have validity, but still have reliability? Provide an example to illustrate your understanding.

4. Why is it important to control for internal validity threats? When controlling for internal validity threats, what effect does this have on external validity?

Key Terms

- Categorical Data
- Continuous Data
- Correlation Research Designs
- Criterion Variable
- Dependent Variable
- External Validity
- Independent Variable
- Internal Validity
- Mixed-Method Research Approach
- Objectivity
- Operational Definition
- Predictor Variable
- Quantitative Research Approach
- Qualitative Research Approach
- Quasi-Experimental Designs
- Random Sampling
- Reliability
- Research Variables
- True Experimental Designs
- Validity

Reference

WHAT IS THE FIRST STEP in the research process? Identifying the problem that is of most interest to you is the first step in the scientific method.

In this section this first step will be discussed, and you will be provided with guidance for reviewing literature in your area of interest. Chapter 3 presents key concepts about how you can identify your research problem and delineate secondary sources from primary research journal articles. As you begin researching your topic area, you need to gain access to the research, which is where the library will play an important role. As you begin collecting resources and journal articles, you need to understand how to read and interpret the research journal articles. The PICO format (Patient Problem or Population, Intervention, Comparison, and Outcome) that will assist you in developing your evidence-based practice question will also be presented. Additionally, you will begin to organize your research in a way that will make it understandable to a reader.

Chapter 4 continues the discussion of how to organize your research, develop an outline, and identify sections before you begin to write the review of literature. Writing your review of the literature is the second step in the scientific method. The concept of funneling your research will assist in organizing and writing your review of the literature. These chapters are designed to assist you in getting your ideas and words down on paper. We can help direct you and provide advice; however, it is up to you to research your topic and write about the related research that currently exists. Good luck!
WHAT YOU’LL LEARN

- How to develop your area of interest and identify the research problem
- How to select a research topic area of interest
- How to use the library and access secondary and primary sources
- How to read and interpret research journal articles

Now that you have an understanding of the scientific method, as well as important research concepts, it is time to begin developing your own research topic. Criteria for selecting your topic area are discussed, including choosing a topic for which you have a passion, that has practical value, and that is feasible and considering critical mass. Tools and activities will help shape your topic ideas. Selecting a topic area that you are passionate about and is of great interest to you is critical, because the remaining steps in the scientific method are contingent on your research question. Once you select your topic area, you will conduct a literature search and begin to read and interpret the body of research that exists in your area of interest. Advice is provided to help you effectively navigate and read through research journal articles.

Identifying the Problem

Identifying the problem is a challenging part of the research process, but also the most important step of the scientific method. Where to begin? You may be overwhelmed by selecting or identifying a research problem. Keep in mind that you do not have to do this alone! You have access to many resources to help you identify a problem to research. We start by providing you with some questions and recommendations to assist with developing your problem.

First ask yourself the question, Why am I here? This may seem too philosophical; however, start with questions such as: Why did you select your major? Why were you interested in this field of study? Typically, answers address career choice, but think more deeply. What is it about the major that really interests you? If you are a health educator, what areas of health education really seem to spark your interest? As an exercise science major, what content of exercise science would you like to know more
about? Were there courses in your major that you found more interesting than others? What were they? Was it the course on health promotion and disease prevention? Or was it your clinical exercise physiology course? Answering these questions will not specifically identify the problem, but it will move you closer to a topic idea. Using courses or an interest area in your major as a beginning point may help you to identify a topic idea.

Depending on your major, you can also consult the professional associations within your field of study. At this point in your academic career, you have probably been encouraged to become affiliated with a professional association. The following list identifies related professional organizations in health and human performance. We suggest that you become familiar with your affiliated organization to stay current in your career, to learn about professional development opportunities, as well as to find topic ideas for your research proposal. You can browse through the web pages of professional organizations for ideas; for example, the American College of Sports Medicine (ACSM) has a section on research. You may get a few ideas, or something may spark your interest when you browse through past research grants or roundtables and conferences supported by ACSM. The ACSM also has a health and physical activity reference database that may be helpful to you as you develop your topic idea. We encourage you to review the online student resources for more information and web links for the professional organizations in the following Tip.

TIP: PROFESSIONAL ASSOCIATIONS IN HEALTH AND HUMAN PERFORMANCE

- American College Health Association
- American College of Sports Medicine
- American Kinesiology Association
- American Physical Therapy Association
- American Public Health Association
- American Therapeutic Recreation Association
- Association for Applied Sport Psychology
- National Association for Health and Fitness
- National Athletic Trainers’ Association
- National Education Association
- National Recreation and Park Association
- Society for Public Health Education
- Society of Health and Physical Educators

Professional organizations can be educational and provide valuable information and ideas, yet another excellent resource right under your fingertips are the faculty in your program. Faculty are the experts in your field of study. Start with your faculty advisor, or another faculty mentor within your program. Get to know faculty and their area of expertise; what kind of research interests them? If you have identified a specific area within your major, consider meeting with the faculty member who teaches that course.
But remember, have a plan about what your potential areas of interest include when you meet with them. You should not expect them to provide your research topic for you, rather they can help you focus as you begin researching a topic area.

At this point, you should have a topic area of interest and may be ready to start reading some research to gain a better sense of your topic. We first encourage you to see whether the professional association within your field of study has an official publication. For example, Medicine and Science in Sport and Exercise is sponsored by the ACSM. Many of these organizations have professional peer-reviewed journals that publish related research within that field of study.

Such journals will have current up-to-date topics on research in your field of study. Examples of peer-reviewed journals in the health and human performance area are included in the following Tip. One exploratory method of developing your topic is to refer to a recent copy of a professional journal and begin by reviewing the research that was published in the journal to get a better sense of what the hot topics are in your field of study. If a particular research study sounds interesting, read it, study it, and delve deeper! As we discuss later, the published research will offer suggestions for future research that will help shape your topic idea.

### TIP: RESEARCH JOURNALS IN HEALTH AND HUMAN PERFORMANCE

- American Journal of Health Behavior
- American Journal of Health Education
- American Journal of Health Promotion
- American Journal of Health Studies
- American Journal of Public Health
- American Journal of Recreation Therapy
- British Journal of Sports Medicine
- British Medical Journal
- European Journal of Applied Physiology
- Exercise and Sports Sciences Reviews
- Health Communication
- Health Education and Behavior
- Health Education Journal
- Health Promotion Practice Journal
- Health Psychology
- International Electronic Journal of Health Education
- International Journal of Athletic Therapy and Training
- International Journal of Sports Nutrition
- Journal of Adolescent Health
Criteria for Selecting a Research Topic
As you begin developing your idea, you should also consider the criteria in selecting a research topic. These criteria include passion for the subject matter, practical value, feasibility, and critical mass. These are all factors that are important to the success of the research process.

Passion
First and foremost, you must select a topic that you are passionate about and that will keep your attention throughout the research process. If you do not have the passion or interest to see the project through, the research process can be an unfulfilling
IDENTIFYING THE PROBLEM

experience. Again, this goes back to the questions asked earlier: Why are you here, and why did you select this major? Be sure to take the time to select a topic that can hold your interest and that you want to know more about in your area of interest. Being intellectually curious is a major advantage when conducting research.

**Practical Value**

Next, ensuring that the topic has some practical value to your field is also important. Recall in Chapter 1 when we discussed the research continuum of applied to basic research. We noted that in the health and human performance areas, applied research is probably used more often, although basic research does have its place. The question you should ask yourself as you begin to develop your topic is: Is my research idea practical? Can the results be immediately used by practitioners? Answering these questions now will help you later as you begin to focus on your study ideas.

The last two criteria, feasibility and critical mass, are equally important when selecting your topic idea, because they relate to the ability to carry out your proposed research topic.

**Feasibility**

Feasibility refers to the limitations of resources and time constraints associated with the research study. Do you have the adequate resources to conduct the research? Do you have the expertise to administer the specific treatments or tests? How much time do you have to collect data? These are very specific but important questions that need to be answered. Again, this is where your faculty advisor can play an important role. Discussing your topic idea and the resources and time constraints with your advisor can help answer these questions.

**Critical Mass**

Finally, considering critical mass is directly related to feasibility. Here, you need to consider whether your research idea is warranted or acceptable as a research project. Many students begin with some very specific research ideas that are similar to current research that is being performed in peer-reviewed journals. Is additional research in this area warranted? You may want to think about a different approach to your research idea. Also, depending on your institution’s resources, your initial research idea may be too large given the available resources or time constraints. Additionally, you need to consider the type of research project you are performing.

**PULSE CHECK**

What considerations should be taken into account when selecting a research topic?

**Concept Mapping**

For a supplementary way of developing your topic, consider using concept mapping. Concept Mapping: a way to diagram relationships among ideas; Visuals for Phase I and Phase II of concept mapping are illustrated in Figures 3.1 and 3.2. Please refer to the Tip on Using Concept Mapping to Streamline Research Topics in this section to assist you with using concept mapping to refine your topic area. Finally, be mindful that the research process takes time. Your topic selection will not happen overnight and will take much thought and careful consideration.
TIP: USING CONCEPT MAPPING TO STREAMLINE RESEARCH TOPICS

Concept mapping illustrates the relationships among your topic ideas. The visual depiction will connect your topic ideas, which is sometimes referred to as “webbing” or “linking.” Through this process, you can visually see your ideas and how they relate to each other, but it also allows you to adjust and modify your approach to your topic area. Begin by brainstorming and then edit or refocus to develop your research problem.
Phase I: Brainstorming

Before you begin, set your mind frame to “free-think” and grab a piece of paper.

- First, draw a circle in the center and inside that circle write the main focus area of interest, which could be a word or short phrase related to your topic idea.
- Pause for moment and reflect on what you just wrote.
- Next, brainstorm key words and concepts that are related to what you wrote inside your circle. Remember, “free-think,” so write any words or concepts that come to your mind when thinking about your topic idea.
- Draw squares around single ideas.
- Draw circles around groups of ideas.
- Finally, draw lines with arrows appropriately connecting the squares and circles back to the main circle, as well as any subgroups of ideas that may have resulted from the groups of ideas.

Do not fret over what your circles, squares, or lines look like; just make sure you leave room to allow your concept map to continue to expand and develop your idea. One suggested strategy is to write your key words and concepts on sticky notes so when you proceed to phase II you can easily reorganize your ideas. Software programs are available for free and for purchase that also assist with your brainstorming process. We encourage you to consult the online resources for more information on such software programs.

Phase II: Editing or Refocusing

At this point, reflect on the circles and squares outside the main circle. In other words, think “outside-the-circle.”

- Remove, reword, or rework your brainstorming as needed.
- Move circles and squares so ideas are appropriately organized.

Through this visual reorganization, you are developing your idea, and you can now analyze your visual concept map and more clearly identify your research problem or question.


Evidence-Based Practice and PICO

In Chapter 1, we introduced you to the concept of evidence-based practice (EBP) as a research method that used in the clinical healthcare field. Recall, there were five steps to the EBP process: (1) identifying a clinically appropriate and searchable research questions, (2) review of databases, (3) critically evaluating the evidence of
the question, (4) integrating the evidence and making the appropriate decision, and (5) evaluate the outcome. In order to develop your EBP research question, the PICO (Patient Problem or Population, Intervention, Comparison, and Outcome) format is used. This format helps the individual to organize information in order to answer a well-built clinical question that is directed to the problem at hand. Table 3.1 provides a listing of the PICO elements along with a brief description of the elements. When considering applying the PICO format to the EBP process, it is important to note that there are varying levels of quality of evidence. Referring to the Evidence-Based Pyramid in Figure 3.3, it is clear to see that systematic reviews are considered to highest degree of quality. Your EBP question will determine the types of EBP evidence produced during the process. When examining the pyramid from the base to the top, the quantity of information is greater at the bottom and decreases toward the top of the pyramid; however, there is an inverse relationship to the quality of information. At the top of the pyramid, systematic reviews, are considered to be the highest quality of EBP information, but the quantity of these reviews is small.

Background information and expert opinions are essential yet lacks corresponding objective research support. Nevertheless, such expert opinions can lead to exploring topic areas of interest to your field of study. Case-controlled studies provide more research support but are usually unique events and are not considered experiments. Moving to randomized control trials, these are experiments in which subjects are assigned to either an experimental group or a control or placebo group. These types of studies attempt to control extraneous or confounding variables that may influence the treatment that is being evaluated or assessed. Cohort studies are longitudinal studies that examine an issue over time. The next level of the pyramid focuses on critically appraised individual articles. These are articles that evaluate and synopsizes individual research studies. Whereas, critically appraised topics evaluates and synopsizes multiple research studies. Finally, systematic reviews answer specific clinical questions by performing a comprehensive review of literature and systematically provide recommendations on the specific studies that have met the threshold of criteria for the review. Typically, only quantitative studies and more specifically, randomized control trials are included in the review. Finally, you will note the pyramid is divided into unfiltered and filtered sources. Filtered sources are making recommendations and are evaluating the research. Unfiltered sources are the actual studies that have been performed, such as randomized control studies, cohort studies, and/or case studies.

<table>
<thead>
<tr>
<th><strong>Table 3.1 PICO Elements</strong></th>
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<tbody>
<tr>
<td><strong>PICO Element</strong></td>
</tr>
<tr>
<td>Patient Problem/Population</td>
</tr>
<tr>
<td>Intervention</td>
</tr>
<tr>
<td>Comparison</td>
</tr>
<tr>
<td>Outcome</td>
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</tbody>
</table>
Finalizing Research Questions
Regardless of whether the activity of concept mapping worked for you, we suggest you map out your broad topic area and see how you can or how you did narrow your idea down to a research question. This process will assist you in obtaining adequate and appropriate sources. Not only should you start looking for articles on your research question, but it is also imperative that you read and explore the research variables as they relate to your topic area. This breakdown will also help with creating an outline for your review of the literature. Please refer to Table 3.2 for questions to answer and examples of taking your broad topic area down to a potential and realistic research question. As we mentioned, your topic selection will not happen overnight. Be patient and let the process take shape. Another great place to gather information to help in selecting your topic is the library.

Accessing Sources
The library is a place where you will be spending a lot of time, whether physically or virtually from your computer. Here is where you will be able to really define your research topic and begin to read the related research on your topic. As you gather the related research, you then begin to write your review of the literature on your topic, which we discuss in greater detail in Chapter 4. Let us begin by discussing how to perform the literature search. The following list presents an outline of what is needed to start the literature search process.
### Table 3.2 Finalizing Your Research Question

<table>
<thead>
<tr>
<th>What is your topic area of interest?</th>
<th>Cardiac Rehabilitation</th>
<th>Older Adults</th>
<th>Bone Health</th>
</tr>
</thead>
<tbody>
<tr>
<td>Based on your response above, what aspect are you interested in examining?</td>
<td>Different rehabilitation programs</td>
<td>Memory and exercise</td>
<td>Osteoporosis</td>
</tr>
<tr>
<td>Based on your response above, what will you concentrate on and direct your research focus toward?</td>
<td>Rehabilitation programs in clinical settings versus rehabilitation programs in home settings</td>
<td>Short-term cognition memory and aerobic exercise</td>
<td>Bone health among adolescent girls</td>
</tr>
<tr>
<td>Based on your response above, what is a potential and realistic research question?</td>
<td>Are there differences among patients who choose to participate in a clinical rehabilitation setting or stay at home to complete a rehabilitation program in regard to exercise adherence?</td>
<td>Is there a relationship between the amount of aerobic exercise participation and cognitive memory among older adults?</td>
<td>What bone health interventions are effective for adolescent girls?</td>
</tr>
</tbody>
</table>

### Outline for a Literature Search

1. Identify the problem.
2. Consult secondary sources.
3. Brainstorm search words and key terms.
4. Search for primary research journal articles via databases.
5. Read, evaluate, and interpret primary research journal articles.

### Conducting Literature Searches

Identifying the problem is the first step in the scientific method. This step is necessary to know where to start your literature search and move to the second step of the scientific method, which is writing the review of the literature. We have discussed some strategies to help you identify and develop the topic or research problem. As we emphasized before, do not think that this process has to be done in a bubble. Use the resources around you to help determine your topic selections, such as your professional associations, faculty in your program, and professional research journals. You also may want to brainstorm out your topic area by using concept mapping. Through the brainstorming process and then taking a step back to look at your
If at this point in your literature search you are not satisfied with the quality or quantity of your research journal articles, we have a few more strategies and points to consider. If you are just plain frustrated, you are not alone; we suggest discussing with other students your literature search process using databases. Another common obstacle is that although you may think you have identified common search words and key terms, this is not always the case. Refer to the scenario presented in the Research to Practice: Example of Varying Search Words and Key Terms.
<table>
<thead>
<tr>
<th><strong>Title</strong></th>
<th><strong>Description</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Sport Discus</td>
<td>Provides full text for sports and sports medicine journals</td>
</tr>
<tr>
<td>Sport Discus Education Resources Information Center (ERIC)</td>
<td>Provides educational research and information to improve practice in learning, teaching, educational decision-making, and research</td>
</tr>
<tr>
<td>Medline</td>
<td>Provides information to help answer health questions, also provides extensive information from the National Institutes of Health (NIH) and other governmental agencies</td>
</tr>
<tr>
<td>PsychINFOR</td>
<td>Provides information on psychology and related disciplines, including journal articles and book chapters</td>
</tr>
<tr>
<td>Cumulative Index to Nursing and Allied Health Literature (CINHAL)</td>
<td>Provides the most comprehensive resource for nursing and allied health literature</td>
</tr>
<tr>
<td>Dynamed</td>
<td>Provides an evidence-based medical information database with nearly 3,000 summaries of clinical topics</td>
</tr>
<tr>
<td>Health Reference Center</td>
<td>Provides information on subjects of health and health care delivery issues, fitness, nutrition, medicine, safety, alcohol and drug abuse</td>
</tr>
<tr>
<td>Physical Education Index</td>
<td>Provides detailed research in sport and exercise sciences, however it has both popular and research materials in it</td>
</tr>
<tr>
<td>PubMed</td>
<td>Provides a service of the U.S. National Library of Medicine that includes over 18 million citations from MEDLINE and other life science journals for biomedical articles back to 1948</td>
</tr>
<tr>
<td>Centre for Reviews and Dissemination (CRD)</td>
<td>This center focuses solely on evidence synthesis in the health care field</td>
</tr>
<tr>
<td>Database of Abstracts of Reviews of Effects (DARE)</td>
<td>Includes systematic reviews by CRD researchers that evaluate healthcare interventions.</td>
</tr>
<tr>
<td>Cochrane Library</td>
<td>Includes systematic reviews and other types of medical information that can guide clinical decision making.</td>
</tr>
</tbody>
</table>
Ella was interested in examining cryotherapy treatment for exercise-induced muscle damage (EIMD), which is commonly associated with repeated eccentric movements. Cryotherapy is a common term that has been used for cold-water therapy. As a result, Ella began using this key term when she began searching for research journal articles. What she found was that the term cryotherapy is no longer used as a descriptor, but cold-water immersion (CWI) is a more common descriptor, especially in exercise science. Using this descriptor, Ella was able to find more research related to her topic area.

Not only can consulting reviews of literature assist with search words and key terms, but also accessing the bibliography of the review can help in identifying primary research journal articles in your topic area. If, for example, you are reading about posttraumatic stress disorder and its impact on the work environment, as you are reading about how the authors summarized the research findings, look at the corresponding citation(s) in the References. You should consult these references directly and read more about the primary research that was conducted among elderly adults. Some review papers summarize research in a table that can be very beneficial to you. For additional information, see Research to Practice; we encourage you to obtain the sample review papers cited here.

Using the Internet

Students often wonder, Can I use web-based search engines to also identify possible references? This question is not easy to answer. Yet it is asked by most students. The Internet is what students are familiar with and comfortable using. Not to mention it is easy to access, and a large amount of search results are produced instantaneously. As discussed in Chapter 1, not only do you need to understand how to perform research, but you also need to be a good consumer of research. If you wish to use Google to search for primary research, we emphasize that you should proceed with caution. Be sure to access articles that are coming from peer-reviewed journals. Although articles found from a web-based search may sound very interesting, a researcher should question whether the article comes from a valid and reliable source.

We recommend for web-based searches, a more advanced and accurate search engine called Google Scholar.

Google Scholar searches across disciplines and produces results from multiple sources. For more information, check it out online. Google Scholar also offers the ability to select many different “advanced scholar searches” that limit date range, author, publication, or subject areas. “Scholar preferences” are also available that allow you to select your preferences, such as linking to your library. Setting up your library link may require additional technical support from your librarian; however, for some material that is restricted on Google Scholar, your library may have access to the complete resource. Because of publication rights and copyright concerns, not all of the search results on Google Scholar are available in full text. Often only the abstract is available. Nevertheless, if you are going to use the Internet for any searches, we encourage you to try Google Scholar. Refer to Research to Practice for a good example of attempting to find research-related articles on exercise adherence. If you only used Google to search for this term, many different sources emerge. However, if you use Google
DEVELOPING YOUR RESEARCH TOPIC AND INTERPRETING RESEARCH REPORTS

Scholar, the information is limited to research-related material, which is the type of information needed for your research.

Remember, research is defined as a careful, systematic approach to problem solving. As a researcher, you need to identify the appropriate information for your topic. Much of the great information presented in Google may only be opinion and may not be based on careful research practices. Although web-based searches are used, still, the best place to research your topic area is through the library databases.

The major advantage of using your library databases is that these databases are designed specifically for researching and accessing articles. Because there is a level of scrutiny with regard to what is included in these databases, the information is more trustworthy than that from Internet searches. In addition to the library databases, do not forget the most important resource in the library, the reference librarian! We strongly encourage you to use them as a resource when you have questions or roadblocks while searching for research articles in your topic area. Reference librarians are invaluable resources during the search process. Again, this is just another reminder that you are not alone in the research process; many individuals will be happy to assist you with your research.

Now that you have obtained all this research on your topic, what is next? Well, the next step is to begin reading the research. This can sometimes be another overwhelming obstacle for students. Reading primary research can be daunting, even for experts. Therefore, we now discuss how to read and record the research articles efficiently and effortlessly.

RESEARCH TO PRACTICE: EXAMPLES OF USING A REVIEW OF THE LITERATURE TO FIND ADDITIONAL PRIMARY RESEARCH ARTICLES

Reviews exploring effects of exercise on cognition among elderly adults could be helpful in understanding the broad topic area and getting a sense of the direction of future research. The following seven reviews provide an example in this topic area of interest:

• The researchers provide a table of studies evaluating the impact of physical activity or exercise on the human gut microbiome


- This systematic review provides a detailed description on how the research articles were selected.


Seven tables are included that provide detailed information about specific studies based on a topic related hydration and performance.

The researchers also provided key words that were utilized to identify the studies they reviewed.

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**RESEARCH TO PRACTICE: EXAMPLE OF USING GOOGLE AND GOOGLE SCHOLAR**

Using Google to search for research on “exercise adherence”

- Just typing in “exercise adherence” in Google will result in a number of different results from a variety of sources. Search results can be seen in Figure 3.4.

Using Google Scholar to search for research on “exercise adherence”

- Just typing in “exercise adherence” in Google Scholar will result in more scientific research-related resources. In this example, no limitation or preferences were set. Advanced Scholar searches can be conducted, and Scholar preferences can be selected. Search results are shown in Figure 3.5.

![Figure 3.4 Example of Google Search Results](image-url)
Reading and Interpreting Research Reports

When reading the primary research articles you have obtained, it is important to realize that reading research is not like reading one of your favorite novels. Reading a journal article can take many reads before you understand the findings and their implications. At this point, you should have read the abstract once when determining whether the article was appropriate. You may want to read the abstract again to get an overall sense of the article. Yet we want to emphasize that just reading the abstract is not enough. Reading the abstract will provide you with a summary of the research study, but it will not provide details needed to accurately understand the research study and to be able to properly evaluate and interpret the research findings and conclusions. Thus, as you begin to read your research journal articles, you should consistently focus your attention on specific points in the article. The following list identifies the pieces of information you should be able to identify from the article.

Information Gathered From Research Journal Articles

- Statement of the problem, typically including the proposed hypothesis or research question of the study
- Participants or subjects used in the study, with any pertinent characteristics
- Research variables indicated with corresponding operational definitions of how each variable was measured in the study. Typically, these variables will include:
  - X and Y variables, or
  - Grouping and measured variables
- Procedures taken to measure research variables and ensure good scientific control
Components of a Research Journal Article

You need to identify and understand quite a bit of information when reading research articles. Again, we mention that you should read through the abstract to make sure the article is connected to your topic area. Only reading the abstract is not enough, valuable information is presented throughout the research journal article that is essential for further interpreting the results and becoming a good consumer of research. As you begin reading, you will understand that it may take two to three times reading to obtain all of the information. After you read through a few times, one strategy we suggest is to talk to someone about the research article. Having a discussion about the article may allow a greater understanding of the research study, as well as shed new critical interpretation and evaluation. You also should not fret over the fact that you may not understand one aspect of the study; you will still be able to get a sense of the research study as a whole.

Introduction

If you noticed in the previous list, the information you will gather from research journal articles is very sequential. Each piece of information can be found in specific sections of research journal articles. When you first begin reading a journal article, the statement of the problem, hypotheses, or research questions are found at the end of the introduction. In the introduction, the authors provide research evidence and a rationale for why the study is important and meaningful to consider. There is a connection between the cited research and the research study’s purpose. Typically, there is a proposed hypothesis in quantitative research designs or research questions in qualitative research designs.

Methods

After the introduction, a Methods section usually follows. Here, subsections may include participants or subjects, measuring instruments used to measure the research variables, procedures, and data analysis used to help answer the research problem. The Methods section provides an in-depth look at the nature of the study. After methods, the research findings are presented in the Results section. If the research is quantitative in nature, the author will present demographic information along with descriptive statistics to provide some general information about the participants. Inferential statistics are used to answer the hypotheses. Were there group differences among the measured dependent variables? Was a relationship found between the two (X and Y) variables? Were there differences in the frequency of scores across levels of data? In Chapters 10, 11, and 12 we discuss in greater detail how to analyze the data.

Results

In the Results section, you should notice not only text but tables and figures that help present the data. Whether qualitative or quantitative, tables and figures can help the reader understand the outcome of the study. When examining a table or figure, each
should stand alone. In other words, the reader should be able to understand the details of the table without referring to the text. To understand the results, we encourage you to take time to review the tables and figures in the Results section. Many times, tables and figures are more easily understood than the statistical jargon that may be presented in text format.

Discussion
After the results, the authors will present the implications of the results in a Discussion section. Here, the research findings from the Results section are restated without statistical terminology. Research findings will then be compared and contrasted with the results of previous research studies. Additionally, in many journals you will read how the current research findings can be applied and directly used in a real-life setting. We call this the “so what factor.” We challenge you to ask this question, so what now? For example, the results identified group differences—so what? What does this mean? What does this imply? This is an attempt to critically evaluate the research findings. Many times, this is where the practitioner is looking to determine how the study’s findings can best be used in practice.

Suggestions for Reading and Interpreting Research Journal Articles
At this point, we hope that you have read through and tried your hand at interpreting at least one research journal article. We assure you that as you read more, you will become more comfortable with the information in research journal articles. You will start to expect what information can be obtained in each section; you may even be able to skip around and still have an overall sense of the research study. However, before you continue to read through more research journal articles, we suggest you read through the articles titled “Reading Research 101” and “How to Understand and Interpret Food and Health-Related Scientific Studies.” These resources provide an excellent summary on the breakdown of research journal articles. Not only does it cover the breakdown, it also offers questions to ask to assist with your critical evaluation to becoming a good consumer of research.

TIP: READING AND INTERPRETING RESEARCH RESOURCES


Full articles are accessible using online resources.

As you continue to read through your research journal articles, we suggest that you summarize each article. This will assist when you begin writing. As you are probably aware by now, the research process takes time. You will want to have some type of
article summary to look back to, so you do not have to reread the full article from beginning to end! Table 3.4 presents specific pointed questions that the reader should respond to when reading research. We use a nine-step approach to reading research that was adapted from Locke, Silverman, and Spirduso (2017), who created a twelve-step process to research report reading.

**Table 3.4 Nine-Step Approach to Reading Research Journal Articles**

1. **What was the purpose of the study?**
   - This is typically found at the end of the introduction.

2. **Who did the author(s) utilize in the study?**
   - This is typically in the Participants subsection of the Methods.
   - Note how many participants or subjects and any important characteristics.

3. **How did the study produce data for the research variables?**
   - This is typically in the Measuring Instruments subsection of the Methods.
   - Indicate questionnaires, tests, ratings, interviews, etc. utilized to measure research variables.

4. **What were the major steps (sequential) in performing the study?**
   - This is typically in the Procedures subsection of the Methods.
   - May want to utilize either flow-chart or diagram for a clearer visual explanation of the procedures.

5. **What were the results?**
   - This is typically its own Results section.
   - Think about how the purpose of the study (#1) and indicate the data findings.

6. **What does the author conclude?**
   - This is typically its own Discussion section.
   - Often research findings from the results are summarized here without statistical terminology.
   - Again, think about the purpose of the study (#1) and interpret the results (#5).

7. **What cautions do you raise about the limits of this study?**
   - This is typically found in the Discussion section.
   - Think about internal validity threats and indicate aspects of the scientific control that may have been compromised in the research study.

8. **What cautions does the researcher(s) raise about interpreting the study?**
   - This is typically found in the Discussion section.
   - Think about external validity and the ability to generalize research findings.
   - If no cautions are directly noted, think about aspects that limit generalizability.

9. **What particularly interesting/valuable things could a reader learn from this study?**
   - This is found throughout the research journal article.
   - Think outside the box!
The nine steps to reading research shown in Table 3.4 can be very helpful, especially in the beginning stages of research. Using these nine steps for each article you read provides you with a synopsis of the research article. One point to emphasize here is to make sure you write the responses to the questions in your own words. Plagiarism is one ethical concern of research that is discussed further in Chapter 8. Using these nine steps helps avoid any issue of plagiarism that could occur if you are copying the information verbatim from the article. As you begin learning in Chapter 4, the review of literature that you will write is your interpretation of the literature. The best practice now is to write the summary or synopsis in your own words to avoid any risk of plagiarism. For each research article, you should have a synopsis, using the nine steps as your guide. Once you have read the articles, you are now ready to write your review of the literature. Chapter 4 will present tips on writing a review of the literature.

SUMMARY

The purpose of this chapter was to provide the reader with information for selecting a research topic and reading research reports. Identifying the research problem to narrow down a topic area of interest can be challenging. Questions you should ask yourself include: Why did I choose my major? What courses interest me the most? Is there a problem I want to know more about? In addition to these questions, students have many resources to assist them, including their faculty advisor or faculty mentors. Professional associations that sponsor peer-reviewed research journals are another excellent resource when deciding on a topic idea. Four criteria should be considered when selecting a research topic: passion for the subject matter, practical value, feasibility, and critical mass. When selecting a research topic, these criteria need to be carefully considered. One way to assist with topic selection is by using concept mapping or a diagram to help show the relationship among your ideas. There are two phases to concept mapping: brainstorming and editing or refocusing.

Key descriptors and identification of secondary sources can play a critical role in the success of your database searching. Key words are descriptors that are used in databases to help identify research about your topic. Secondary sources, such as textbooks and reviews of literature, are also good resources to help refine your topic idea and identify key words for your database search. In addition to the databases that are available through your library, many students will often use web-based searches for their research topic. Using a web-based search engine as the primary research tool is not always appropriate. Being a good consumer of research is an important component to searching; therefore, we caution the reader not to use a web-based search unless it is identified as an appropriate research search engine.

After gathering research journal articles, you have to begin reading and interpreting the articles. Key aspects of a research article were presented that are considered important for the reader to obtain. Some of these components include research questions, participants, procedures, research design, research findings, future research statements, and important references. We also included a nine-step approach to research writing and encourage you to use this when recording information about the research report. After reading and recording the research, the next step is to write the review of the literature.
Applying What You Learned

1. Identify two peer-reviewed journals in your content area. Obtain a recent issue of one journal and review the table of contents. What are the “hot” issues being researched in your area?
2. Provide an example of a primary and secondary source in your area of research and indicate how those resources would be valuable to a research topic area.
3. Use the steps for concept mapping to help develop your topic idea that is of interest to you.
4. Using your topic idea, run a search using Google and then with Google Scholar. What are the differences in the results from each search?
5. Explain how you go about deciding which results are reputable and which results should be further questioned or investigated before making claims.

Key Terms

Case-Controlled Studies
Cohort Studies
Concept Mapping
Critically Appraised Individual Articles
Critically Appraised Topics
Google Scholar
Peer-Reviewed Journals
PICO
Primary Sources
Randomized Control Trials
Secondary Sources
Systematic Reviews

References


WHAT YOU’LL LEARN

- How to take your research and develop an outline to guide your literature review
- How an outline continues to guide literature review development by “funneling”
- How funneling research creates major sections of the literature review
- How to write scientifically using different writing styles

By now you have identified a topic and started researching your topic area. Make sure you are still interested in your topic area. You will be spending a great deal of time reading articles, as well as developing and writing your review of the literature; thus, you must be invested in your topic. Reading articles and synthesizing your research should make you eager to unfold more about your topic area, and you also should begin to think of future research ideas. Use the tools and suggestions from Chapter 3 to help you continue to read articles and organize your research. Remember the differences between primary and secondary sources as you organize your research to begin writing your literature review. Primary sources contain original research that has been collected by the author(s) of the article. These articles contain methods, results, and discussions. Secondary sources discuss research conducted by others and provide more of an overview. Examples of secondary sources include literature reviews, textbooks, and position statements. Much of the advice provided in Chapter 3 will be crucial to your success as you begin writing your literature review.

As you begin to think about writing, the organization of your research is critical to the development of a well-written literature review. Think of the review of the literature as telling your story about your topic area. If a friend of yours who is majoring in engineering reads your review of the literature about bone health in adolescent girls, she should be able to clearly understand information not only about bone health in general, but also about the development of osteoporosis. As she continues to read the literature review, she should further understand bone health interventions among adolescent girls. Being able to write a comprehensive review may seem overwhelming; however, we will guide you. We begin by discussing how you can funnel your ideas. The concept of funneling will assist in developing your outline and identifying major sections of your literature review so you can begin writing. Although we mention
writing your research “story,” your writing style must be scientific. Scientific writing is clear, concise, and very different from writing a short story for your English class. Again, we will guide you through the complete process; let us start by developing an outline for your review of the literature.

Developing an Outline

As you sort through your research articles and continue to organize the research, think about your engineering friend, and how you will ensure that she will be able to understand your topic area of interest. This is where we use the concept of funneling. A funnel is very wide at the top and then narrows at the end. Similarly, start broadly by introducing your topic area, and funnel the research downward to where the research on bone health in adolescent girls is today. Before we continue, we suggest that you use past reviews as a guide for your own writing. Please see the Tip for more information as you begin the writing process.

To continue with the funneling concept, the purpose of the funnel is to provide a way to get large quantities of an item into a narrower place. For example, funnels can be used to transfer liquids, such as oil in your car. What does a funnel have to do with writing your review of the literature? When you write a complete and comprehensive literature review, you provide a large amount of information to the reader in a well-synthesized manner. You begin with more general information about the topic as a way to introduce the reader to the broad topic area of interest. The reader, such as your friend who is majoring in engineering, may have limited knowledge or understanding of the topic area. Your job is to provide an overview that gradually becomes more streamlined. By the end of the review, the reader should have a solid understanding of the topic and what you are attempting to study for your own research. Recognizing that the thought of writing a comprehensive literature review may seem overwhelming, we suggest that you to look and see whether there are published position statements in your topic area of interest. These will help guide and funnel your research approach. Please see the Tip for more information as you begin the writing process.

TIP: READ LITERATURE REVIEWS

One main purpose of a written review of the literature is that it should provide readers with an insight into the nature of the topic area of interest. Reading other reviews in your proposed topic area is also helpful in providing an example and guideline of the scope of a review of the literature. Below are some sample published review papers. We have also included examples of systematic reviews which are reviews of health-related studies. The purpose of these types of reviews are to examine a specific health-related question using the PICO format (Patient, Intervention, Comparison, and Outcome). We encourage you to find a published review or systematic review in your area of interest to gain a deeper insight into the nature of your topic, at the same time using it as a guideline for writing a literature review.

To provide a better understanding, think about the example of bone health among adolescent girls. Using the tools from Chapter 3, you have been able to identify specific databases and have accumulated secondary sources, as well as primary research journal articles on osteoporosis, bone health, and bone health in adolescent girls. Your secondary sources provide an overview of the topic area, and the primary sources provide the specific overview of the research conducted. Again, remember the concept of the funnel to help organize your information. This process will allow you to identify the sections of your review of literature. Figure 4.1 presents one way of visually organizing your information in the shape of a funnel.

### TIP: CONSULT POSITION STATEMENTS

Another main purpose of a written review of literature is that it should provide readers with an overview of specific research that has been conducted in the topic area of interest. Original research must be discussed, synthesized, and cited, but all information also must be current, up-to-date research. One strategy to ensure that your information is current is to look at position statements. Here are some example position statements related to health and human performance. We encourage you to investigate your topic area by starting with your appropriate professional organization, such as those listed in Chapter 3.


The concept of funneling, along with your responses to the four-step process of finalizing your research question in Chapter 3 (see Table 3.2), will continue to guide the development of an outline for your review of the literature. Make sure that at this point you have read and interpreted the research journal articles. We suggest using the nine steps to understanding a research journal article presented in Chapter 3 (see Table 3.4). A summary of each article will enhance your ability to develop your outline and understand the research content that is appropriate as you move down the funnel. Using the four-step process illustrated in Table 4.1 will assist with identifying sections of your literature review, which can be difficult to organize while being mindful of the big picture.

**Background Information Section**

As you think about your review of the literature as a whole, you need to start wide at the top of your funnel and present general information on your topic area of interest. At the top of the funnel in Figure 4.1, more general information is presented about bone health. Thus, the first section of your literature review should include a section on overall bone health. General information on the purpose of bones, how bones change over a lifetime, as well as how individuals can keep bones healthy, provides the reader with a first step to understanding your topic. This beginning section may include information from secondary sources to assist the reader with understanding the topic area, as well as theoretical information on the topic area. Depending on the nature of your topic area, you may need to present theories of the research area to assist the reader in understanding it. For example, if you were researching motivation, you may need to present various theories of achievement motivation.

**PULSE CHECK**

What information is provided at the beginning of a review of literature? Think about the top of the funnel example.
Allied Research Section

Background information will lead you into discussing the research. Now that the reader has the tools to understand your interpretation and synthesis of the research, you should begin presenting research on your variables. This section may include a small amount of information from secondary sources to continue to provide a knowledge base for understanding the research. The research presented in this section will come from primary research journal articles. You are moving down the funnel; you should be moving from a broad perspective to a narrower focus. Because you are only midway down the funnel, your research presented will be related to your research variables. This type of research is considered allied research.

Depending on the nature of your topic area and proposed research question, this may take on a different shape than other reviews of literature. Looking at our example,
Table 4.1 Funneling Your Research

<table>
<thead>
<tr>
<th>Question</th>
<th>Topic/Interest</th>
<th>Research Focus</th>
</tr>
</thead>
</table>
| **What is your topic area of interest?**                                 | Bone health                     | ■ Purpose of bones  
■ Bones change over life  
■ Keeping bones healthy  
(Top of the funnel in Figure 4.1) |
| **Based on your response above, what aspect are you interested in examining?** | Osteoporosis                    | ■ Causes/risk factors  
■ History  
■ Diagnosis  
■ Prevention & screening  
(Top and middle of the funnel in Figure 4.1) |
| **Based on your response above, what will you concentrate on and direct your research focus?** | Bone health among adolescent girls | ■ Importance of bone health during adolescence  
■ Role of Physical Activity, Calcium, and Vitamin D  
(Middle of the funnel in Figure 4.1) |
| **Based on your response above, what is a potential and realistic research question?** | What bone health interventions are effective for adolescent girls? | ■ Synopsis of research findings leading to future research directions of examining bone health interventions among adolescent girls  
(Bottom of the funnel in Figure 4.1) |

one must provide a little more background information before presenting some of the allied research. A section on the disease of osteoporosis is warranted. You may include the following information: causes and risk factors of osteoporosis, information on family history, how osteoporosis is diagnosed, and finally a section on summarizing allied research on prevention of and screening for osteoporosis. As you move through each section, you should provide connections to the next section. Transitions are important throughout your review of the literature. Figure 4.1 shows how you could connect bone health to osteoporosis.

**PULSE CHECK**

What is allied research?

Additionally, the next section on bone health and adolescents can segue nicely from osteoporosis. Here, you need to focus on the importance of bone health during adolescence. Physical activity and proper intake of calcium and vitamin D play crucial roles
Review of the Literature Summary Section

Although the background information, allied research, and critical research sections may take on a different shape for literature reviews, the summary for all reviews will include a synopsis of the research findings and suggest what future research is needed. The summary enables the reader to get a brief overview of the research that has been conducted to date while concluding with a paragraph that identifies what research is needed now in your area of interest. The future research that is suggested in the review of the literature is your proposed research question; here you attempt to connect the past research with what you are interested in studying. When writing, however, you simply state the future research; you are not presenting it in the form of a hypothesis or statement of the problem. Please see the Tip for more information as you finish writing the review of the literature.
TIP: SUMMARIZING THE RESEARCH

A third and final purpose of a written review of the literature is that it should provide readers with the rationale for the proposed research question. A rationale for research is vital. Think back to the criteria for selecting a research topic presented in Chapter 3. Not only do you need to have a passion for the subject matter, but it also needs to be practical, feasible, and warranted or acceptable (critical mass). At this point, step back and make sure you have a complete review of the literature that includes appropriate and adequate information and research that clearly leads to where the research is today and what is the future research direction. If your review of the literature is complete, this last summary section will enable all readers to get a synopsis of the research findings and recognize the rationale for what research is needed now in your area of study.

Table 4.2  Sections of a Review of Literature with Sample Headings

<table>
<thead>
<tr>
<th>Background Information: includes general information on topic to give a broad overview of the research area. May include presentation of theoretical constructs of the research area.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overview of Bone Health</td>
</tr>
<tr>
<td>Anatomy of the Knee</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Allied Research: includes research studies related to topic areas and research variables, but not exactly aligned with proposed research questions.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overview and Research on Osteoporosis</td>
</tr>
<tr>
<td>Bone Health among Adolescent Girls</td>
</tr>
<tr>
<td>Research Related to Knee Injuries</td>
</tr>
<tr>
<td>Measuring Incidences of Knee Injuries</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Critical Research: includes research studies aligned with proposed research questions.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bone Health Interventions among Adolescents</td>
</tr>
<tr>
<td>Gender Differences in Knee Injuries</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Summary: includes summary of the research findings which is concluded with what is now needed in the research area.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Summary of Research Literature</td>
</tr>
<tr>
<td>Summary of Research Literature</td>
</tr>
</tbody>
</table>

The concept of the funnel, as well as information that is included in the background information, allied research, critical research, and summary sections of a review of literature, is your outline to guide your writing. Additionally, this outline will provide you with your major sections of the literature review. Please note that the overall sections we presented are not the actual names of your sections in your review itself. These sections should have descriptive headings that relate to the information
presented in that section. Table 4.2 provides you with some examples of types of headings you may use within your review of the literature. Notice that the sections begin with more general information and move toward a narrower research focus, which is funneling your research.

**PULSE CHECK**

What is one purpose of writing a review of literature?

**Organizing Your Research Articles**

Now that you have developed the outline of your literature review, we offer one last suggestion to guide your writing. You may be thinking that this is a lot of work and time spent, so you just start writing. Yet, the more preparation time that is spent, the easier the writing will be for your review of literature. Just think about preparing a lesson plan to teach a health class; the more you have prepared, the better you are at being able to modify, adjust, and think on your feet during the lesson you are teaching. In other words, time spent on preparation pays off!

If you were to just start writing, you may feel overwhelmed because you are taking a great deal of information and attempting to synopsize the many research articles you have read.

At this point in the process, a good organizational method is essential. Begin grouping similar studies together and begin discussing their commonalities. Perhaps their methods were similar, yet results provided a different outcome. Linking studies together so you can present the findings in a clear, succinct manner is important. You should not discuss each research article separately. The purpose of the review is to present the research findings of past research and link the findings together. What was different about the findings? What was similar? What did the researchers suggest for future research? What were the practical applications that were suggested? What were the limitations they discussed? These are all questions that need to be answered when you are writing the review. If you summarized your articles using the Nine Steps to Understanding a Research Journal Article, then the answers to those questions can be found. Please also see the Tip for some strategies on organizing your research before you start writing.

**TIP: ORGANIZING YOUR RESEARCH**

Because of the overwhelming number of research journal articles and amount of information available, you must have some method of organization for your research. We direct you back to published review papers that have tables included with their summary of the research.


Writing Scientifically

Now that you have developed the outline of your literature review and organized your research articles, you are ready to start writing! In the next sections, we provide you with the tools to develop your scientific writing style in accordance with American Psychological Association (APA) format. Please see the Tip for some additional writing resources. We also remind you that although we described writing a review of literature as writing your research story, your writing style must be scientific in nature.

Scientific writing is very different than writing a creative short story for an English class. The best advice to help develop your writing style is to read research; not only other published review papers, but also primary research journal articles will assist with developing a scientific writing style.

TIP: WRITING RESOURCES

We encourage you to also refer to the APA Manual, 6th edition, or the writing style that is required at your institution, as well as Strunk and White (2000) for more specific detail on writing style and format. We use the APA writing style and format for this text, but you should understand that there are many different writing styles and formats that are used for publications in the areas of health and human performance. Another common writing style is the American Medical Association (AMA) writing style and format. We have identified resources that you can refer to for either AMA and APA below.


Websites for AMA and APA:

- [www.amamanualofstyle.com](http://www.amamanualofstyle.com)
- [www.apastyle.org](http://www.apastyle.org)

The Purdue Online Writing Lab (OWL) is an excellent resource to find information about correctly citing sources and general format considerations. We include the website here.

[https://owl.purdue.edu/owl/purdue_owl.html](https://owl.purdue.edu/owl/purdue_owl.html)

Lastly, another excellent resource for writing and resource support is your own library! Libraries have excellent online resources, as well as reference librarians who are ready to assist you with these types of questions, so, don’t be afraid to ask for help!

The fact that you have funneled your research is a key characteristic of scientific writing; presenting your research in an organized and logical order is also essential. You must ensure that your review is complete with respect to appropriate and adequate information and research, but your evaluation and synthesis of the research findings...
At this point, we hope you have a sense of what scientific writing style entails. Because you are writing about research that has already been conducted, you must write in past tense. Additionally, the third person must be used; avoid “I” or “you” throughout your review of the literature.

When writing about other research that has been conducted, you must paraphrase and give credit where credit is due. Use quotes only when you are defining terms or when you cannot think of any other way to present the information from the research journal article. Too many quotes correlate with poor writing style; use direct quotes sparingly. We recognize reading research and writing a review of literature are challenging; you must use your own words and learn to paraphrase appropriately. Writing from your article summaries, as well as your table or tables of organized research articles, will assist with the process of writing a synthesized review of literature. You cannot sit down and write directly from the articles, nor should you present one article and then another article. Research must be summarized.

To help with summarizing, think about the similarities and differences among the articles. Again, look at the tables of organized research articles. Also, look back at the answers to the questions we presented when you were organizing your research, such as what was similar or different about the findings. Think about the timeline of the research and how future research improved on the limitations of the previous study or studies in your review. Remember to use transitions within your writing to help present a synthesis of the research. Transitions also can help emphasize the logical flow, such as using a transition similar to “In a more recent study . . .” Good flow and synthesized research are important. Your writing must be concise and to the point while also keeping the reader in mind and trying to make it interesting. You may find it hard to believe that writing about research using the scientific writing style can be made interesting, but we challenge you to do your best!

**PULSE CHECK**

What is scientific writing?

At this point, we hope you have a sense of what scientific writing style entails. As you continue to read research and write your literature review, your own scientific writing style will emerge. Although you have probably taken at least one English class, we would like to go over some common errors as they relate to scientific writing and the format you are required to use. We encourage you to read carefully and make sure you are proofreading your drafts appropriately.

**Grammar**

Grammar refers to the rules for using the eight parts of speech: nouns, pronouns, verbs, adjectives, adverbs, prepositions, conjunctions, and interjections. Nouns include people, places, things, organizations, and events. Please be cautious about trying to make a noun work as a verb. Also try to avoid the use of possessives. Writing “Fogarty’s findings were” is preferably written as “Fogarty found,” which removes the possessive.

Pronouns replace nouns. Examples include his, everyone, it, this, there. To avoid confusion, avoid beginning sentences with pronouns and simply write what “it” is! You may use pronouns in the body of the sentence, however, to avoid repeating the
noun. When thinking about his or her as a pronoun, make sure you avoid sexist language. Using he or she pronouns is nonsexist but awkward. The use of neutral-gender third-person plural pronouns (they, them, people) is preferable. Do not mix singular nouns such as subject, athlete, or student with plural pronouns such as their, they, or them. If the noun is singular (the subject), the pronoun must be singular (he, she). If the noun is plural (subjects, athletes, students), the pronoun must be plural. Never state a singular subject as they. This is an example of mixing a singular noun with a plural pronoun. Rather, with the subjects use they and with the subject use she or he.

Verbs make a statement, ask a question, or give direction. Verbs have a person, voice, tense, and number. Again, keep in mind that scientific writing style is written in the third person. Talking about yourself in the first person is a big no-no in research writing. Also avoid using the second person you to talk to the reader. For example, writing about bone health interventions that you will read in this section should be replaced with directly writing the methodology including a two-year school-based exercise intervention.

Notice the correction that was made to third person, but also how direct the writing style is in the example. The tense is also written in the past tense. This is along the same lines as making sure your voice is active as opposed to passive. The active voice makes the noun the doer, and the noun is acted on in the passive voice. For example, “writing research by Tower and Kostelis” (passive) should be replaced with “Tower and Kostelis researched” (active). Notice that the active voice noun is at the beginning of the sentence.

Prepositions (to, of, for, at, by, as, on, before, after, and so forth) are used to show time and space relationships. Many prepositions are used frequently. Do not end any of your sentences with a preposition.

Diction
Diction refers to using the correct words to convey your meaning. A few common errors seen within literature reviews include “affect” versus “effect.” Affect is a verb meaning to influence, and effect is a verb or noun meaning to achieve or bring about results. Another common error is “farther” versus “further.” Farther refers to distance, whereas further represents additional research. The words “then” and “than” are commonly used interchangeably in writing. Remember that “then” refers to a time sequence, and “than” refers to making a comparison.

Punctuation
Punctuation is the use of special marks to group words, phrases, and clauses. Punctuation is used to support the message conveyed by the sentence and paragraph. The APA requires only one space after all punctuation. Commas are used frequently to indicate a pause and a variation in voice and pitch where required by the structure of the sentence. Pauses and variation in voice help to clarify the meaning of written sentences. Please refer to the following list for more information on the five principles to follow when using commas in writing your review of the literature:

Principles for Using Commas

- Commas precede conjunctions that join clauses. You can get the paper in late, but your grade will be lowered. Conjunctions (and, but, or, nor, for, so, yet) put closely related ideas together. In essence, you are putting two sentences into one.
Conjunctions help to avoid several short choppy sentences. To test whether a comma with a conjunction is used correctly, replace the conjunction with a period. If you have two complete sentences, the comma is used correctly. If you do not have two sentences, omit the comma, because the conjunction may be connecting words rather than clauses.

- Commas follow certain introductory elements. Introductory elements include modifying words, phrases, and subordinate/dependent clauses. Before leaving for the field, the coach gave the team a pep talk. You could omit the introductory phrase and have a sentence, but if you omit the clause you do not have a sentence. Notice that the subject (coach) appears in the clause. To test whether you have an introductory phrase, replace the comma with a period. If you do not have two complete sentences, the comma is correctly used. If you have two complete sentences, replace the comma with a semicolon or a period.

- Commas separate items in a series. A series is three or more consecutive words, phrases, or clauses in one sentence: Doctors Matthews, Kostelis, and Jensen teach research methods. With a series of one-word items, or short phrases and clauses, you can omit the comma before the word and, but it is never wrong to include it: Doctors Matthews, Kostelis and Jensen teach research methods. Whichever you choose, be sure to use it consistently.

- Commas set off nonrestrictive phrases and clauses (interrupters). Interrupters, or parenthetical elements, are words or phrases that are not essential to the grammar of the sentence even if they alter its meaning. Professor Fogarty, who earned her doctorate in physical education, teaches research methods. Notice that the subject (Fogarty) is separated from the predicate (teaches) in the preceding sentence. To test whether the commas are used correctly, cross out the information between the commas. If you have a sentence, the commas are correct. You could take out the modifying phrase about the degree and have a sentence, but not the beginning and ending parts of the sentence. Being able to eliminate the information makes it nonrestrictive. Be aware that commas do not set off restrictive phrases and clauses. Restrictive means it is important (or cannot be eliminated); therefore, do not set it off with commas.

- Commas are used to prevent misreading. Occasionally a comma, though not called for by the other principles just discussed, may be needed to prevent misreading. Do not write: To the young blood pudding may not be appealing food. Rather, write: To the young, blood pudding may not be appealing food. In a general sense, almost all commas are used to prevent misreading or to make reading easier. If you use the comma according to the other four principles, you can avoid, or at least minimize, using commas to simply prevent misreading.

Semicolons are often not used or are used inappropriately in writing literature reviews. Semicolons are used to connect two closely related clauses. The semicolon, rather than the comma followed by a conjunction, can be used to connect two sentences. Use a semicolon when the clauses are closely related but a conjunction does not seem appropriate, or when conjunctions make the sentence seem to ramble or to be choppy. To test whether you used the semicolon correctly in this case, make sure you have a complete sentence on both sides. If the semicolon does not connect two complete sentences, it is used incorrectly. When citing research, semicolons are used when a series has more than one part using commas. For example:

The studies by Fogarty and Tower (2019); Tower, Fogarty, and Kostelis (2017); and Matthews and Dexter (2016) supported the hypothesis.
Colons are used to point forward and indicate that the following material is closely related to the preceding material. There is only one solution: edit the paper carefully. Colons are commonly used to introduce a series. The teachers are as follows: Dexter; Matthews; and Fogarty. For APA format, use one space after the colon in the body of your text and in your bibliography. The colon is also used before a long quotation in which quotation marks are not used. Avoid overuse of the colon. Notice that semicolons are used to separate the items in a series after the colon.

Dashes are used to mark a sudden break in thought, before a summary statement to set it off, and after an introductory list. Research methods—as Dr. Fogarty said—is easy. Notice that you could also use commas or parentheses to set off the break in thought. Our suggestion is to avoid the use of dashes, because it does not represent good scientific writing style.

Parentheses are used to set off illustrative matter and to enclose figures or letters. In research, parentheses are used to set off references and numbers. Parentheses are used to indicate probability values \((p < .05)\) and sample size \((N = 50)\). In general writing, parentheses are also used to set off supplementary material; however, with research writing, avoid confusing the reader by using parentheses to set off supplementary material; use commas instead. Numbers, rather than words, are more commonly used in quantitative research. However, do not start a sentence with a number. Start with a word or write out the number: The sample included 73 people. Seventy-three people were in the sample. When you have two sets of numbers, you may want to mix figures and words: three 2-inch nails and seven 3-inch nails are needed. When listing numbers to set off a series, use either 1. 2. 3. etc. or (1) (2) (3) etc. When using inclusive numbers in the reference section, use the full beginning and ending numbers, such as 125–129. The same is true of inclusive dates: 2000–2015. Be sure to always include page numbers with quotations. Additional information on using numbers according to the required format can be found in the manual for that writing style.

Although we cannot go over every detail of scientific writing, we have tried to provide you an overview and some common writing components to keep in mind. We mentioned some great writing resources to assist you, but we also refer you to an article by Jensen, Martin, Mann, and Fogarty (2004). Even though Jensen et al. was written when the American Psychological Association 5th edition was still in use, it provides a great synopsis of common writing APA corrections. In addition, many of these corrections cross over writing styles, yet we do suggest you refer to the writing style manual for more detailed information about format and style mechanics.

As you begin writing, take time to review your work and refer the common corrections writing table in Jensen et al. (2004) to identify corrections; also ensure that you are paraphrasing appropriately. When in doubt, ask your professor to check the accuracy of your article summaries to ensure that you are adequately paraphrasing. Removing a few words from a sentence or reversing the sentence structure is not paraphrasing. Synthesizing information and comparing and contrasting research will assist in this process. Please also remember to not write directly from the articles; this is where and when misuse of paraphrasing is used in writing a review of the literature. The Tip will help conquer some style problems in the literature review.
TIP: CONQUERING STYLE PROBLEMS IN THE REVIEW OF THE LITERATURE

■ Have an outline, following a logical sequence.
■ Remember the concept of funnelling and organizing your research articles.
■ Utilize primary sources from research journal articles.
■ Secondary sources include information from textbooks, reviews of literature, and position papers that typically provide background information; whereas primary sources include research that the author(s) have presented in a journal article.
■ Review needs to be current, up-to-date research.
■ Review of the literature must be complete, with appropriate and adequate research journal articles that are up-to-date.
■ Minimize the use of direct quotes.
■ You must paraphrase and give credit where credit is due, as well as keep in mind you should be synthesizing research.
■ Edit, Edit, Edit!
■ Use the common corrections presented in the list in this chapter, and also have a friend read and revise your review of the literature.

SUMMARY

The goal of this chapter was to assist you in beginning to write a review of the literature for your topic area. We started with showing you how to develop an outline before you actually begin writing. The concept of funnelling your ideas was introduced. We provided examples of different health and human performance topics when using funnelling (Figure 4.1). Next, we presented various sections that you may consider when writing your review of the literature. Sections that are often included in a literature review include sections such as background information, allied literature, critical literature, and a summary. Keep in mind that you would not use these names to identify your sections; instead, title them in relation to your topic.

As you begin to outline your review, you also need to begin organizing your research articles. We discussed how you could link your articles, and we provided examples of this in the Tip: Organizing Your Research. Finally, we discussed how to write scientifically. This type of writing style is different from other writing styles to which you may have already been introduced. We hope this chapter will assist you in successfully writing your review of the literature.

Applying What You Learned

1. Develop an outline for your review of literature. Ask yourself the following questions: (1) Does it resemble a funnel? (2) Is the outline logical? and (3) Is your information complete, with appropriate and adequate up-to-date research?
2. Why is completing a review of the literature essential before moving on to the next step of the scientific method of developing a hypothesis? Can you provide a hypothesis based on your review?
3. How is writing scientifically different from writing creatively for an English class?
4. What are some key aspects to remember about writing scientifically?
Key Terms

Allied Research Section
Critical Research Section
Scientific Writing

References


WHAT IS THE NEXT STEP in the research process after the review of the literature? Because you have read about other research, you can now begin thinking about your own research study. You have developed and refined your topic area of interest and written your review of literature. Using the steps in the scientific method from Chapter 1, after you research your topic, you are ready to consider the research question or develop a hypothesis. The research question will drive the research methodology.

In this section, “Understanding and Developing Research Designs,” a variety of research designs are presented that are used in health and human performance. The next five chapters will enable you to identify the best research design that will answer your research question. Important concepts are discussed, and research examples are provided in the health and human performance area. Learning by example can be a powerful learning tool that can provide you with context regarding how the different research designs are used in our profession. The types of research methods discussed include: quantitative methods (Chapter 5), qualitative methods (Chapter 6), and mixed-methods research (Chapter 7). Chapter 8 introduces you to ethical issues related to health and human performance. Keeping in mind the risks you might place on human subjects is important as you develop your research proposal, which is covered in Chapter 9. Good luck!
What you’ll learn

- How descriptive research designs can be used in your area of interest
- How to apply two different types of descriptive research designs, which include survey and behavioral observation research
- How experimental research designs can be either true experimental or quasi-experimental
- How to use correlation research designs in your area of interest

Quantitative research designs answer research questions using quantifiable research variables, variables that are measured and can be assigned a numeric value. Comparisons or relationships are made based on the quantity of the variable. For instance, if we were comparing percent body fat among males and females, we would measure percent body fat using either skin fold calipers, bio-electrical impedance, or dual-energy X-ray absorptiometry (DEXA or DXA). Gender can be assigned a number, such as males equal 1 and females equal 2. In this way, we could analyze differences in body composition between the sexes by using quantitative data analysis procedures. Alternatively, given percent body fat, if we wanted to examine the relationship between percent body fat and the number of minutes per week a person engages in physical activity, both variables are continuous in nature, so a relationship between the variables would be a more appropriate analysis. Although many types of quantitative research designs are available, we present three common quantitative research designs that are used in health and human performance research: descriptive, experimental, and correlation research designs.

Descriptive research designs focus on understanding the current state of affairs in a specific setting. We discuss two types of descriptive research designs: survey and behavioral observation research. By comparison, experimental research designs attempt to identify group differences in an outcome or dependent variable. The example of comparing sex differences and percent body fat is a quasi-experimental design. A true experimental design would identify treatment and control groups to examine how a specific treatment may affect the outcome or dependent variable. Finally, we
present research that examines the relationship between measured variables or correlation research design. The example of determining the relationship of percent body fat and number of minutes per week of physical activity would be an example of a correlation research design. Each design is useful and important in its own way. You will select the design based on what you want to know, which is connected to and aligned with your research question.

**Descriptive Research Designs**

Descriptive research attempts to answer immediate questions about a current state of affairs. We are attempting to illustrate an interest or point about a specific state or condition.

Descriptive research is more exploratory in nature and typically does not determine the underlying causes of the variables being examined. Descriptive research can take many forms. The most popular descriptive research designs used in health and human performance include surveys and behavioral observation. Within each type of descriptive research design, we provide specific examples of how the design is applied in the context of health and human performance.

**Survey Research Design**

Surveys are a popular method of collecting a large amount of data across a wide variety of topic areas.

Can you think back to the last time you took a survey? What was it for? How was the information going to be used? How long was it? What did it look like? These questions may seem strange, but these are some of the same questions you will be asking yourself if you decide that a survey is the best research design to answer your research question. Most likely, the reason you filled out a survey was for market research. In the business world, surveys provide invaluable information about the consumer. A company may use surveys to learn about consumer spending behaviors and patterns, or to gather intelligence about how products are being used, or to try to figure out the next big trends in their industry. Surveys are an excellent business research tool. Survey research is used not only in business but also in education, sports marketing, or in the allied health professions. In these contexts, we will discuss survey research in terms of a questionnaire. Please see the Tip for more information and resources for survey research designs.

**TIP: SURVEY RESEARCH DESIGN RESOURCES**

Survey research design can take on many forms; we direct you here to some additional resources in the area of survey research:

Survey Research Design: Developing a Questionnaire

A questionnaire is a type of survey in which researchers ask questions about something. Say you want to get a better idea of your client’s perceptions of programming at your fitness facility. You may ask clients when they come in to take a minute to fill out a quick questionnaire about current programming. You also may consider emailing the clients, or you may ask trainers or staff to interview clients. These are some ways of accessing the information. You will need to decide a few things before you give out your questionnaire: what information you will ask and what is the best way of accessing these individuals. Developing a series of questions about client perceptions on programming may not seem that difficult; however, item development is a little more challenging than one may initially think. The overall process for questionnaire development includes identifying an objective, identifying the sample, determining questionnaire format and item development, accessing the sample, and collecting and analyzing responses.

Objective Alignment

This obviously seems like an easy step; however, the decisions you make concerning the objective of the questionnaire will greatly affect all your other decisions. This step is similar to developing the research question of your study. You need to ask yourself: What information do I want to get out of this questionnaire? To answer this question, you need to understand your setting and most importantly the demographics of your targeted sample. If you are working in a commercial-type setting, such as a fitness facility, what are you trying to find out? Is your overall objective to determine how the clients perceive the fitness facility? Aspects may include cleanliness, programs being offered, and staff knowledge and friendliness. You will discover as we move through the different issues that having a clear objective is critically important to developing an effective and useful questionnaire.

Sample Appropriateness

Once you have identified the purpose of the questionnaire, you need to consider to whom you will give the questionnaire. As we alluded to, this directly relates to the objective; you must know the demographics of the targeted sample. If you are interested in client satisfaction of a fitness facility, you will administer the questionnaire directly to your clients. On the other hand, you may be more interested in your employers’ perceptions about a new program or feedback on the programs currently offered. Thus, the questions you design will be directly geared to your specific demographic and your objectives.

Questionnaire Format and Item Development

Once you have determined the objective or purpose and demographic from which you will sample, you can begin to develop a format for the questionnaire. This may appear to be very simple; however, many factors must be considered when developing the questionnaire format, including question type, appearance, and length.
Two types of questions are normally used in questionnaire research: open-ended and close-ended questions. Open-ended questions are questions in which the respondent is free to answer the question in any way. Close-ended responses are developed to provide the respondent with a set of specific choices to questions. Examples of close-ended questions include categorical items, ranking items, and Likert items.

**PULSE CHECK**

What is the process for questionnaire development?

**RESEARCH TO PRACTICE: EXAMPLES**

**DEVELOPING CATEGORICAL ITEMS**

An athletics director (AD) is interested in the satisfaction level of his or her athletics program from the athletes’ perspective. The AD develops a questionnaire to identify the levels of satisfaction that the athletes have participating on their teams. As the AD begins to develop the questionnaire, a number of factors need to be identified during question development. First, for the categorical variables, the AD must make sure that the items are mutually exclusive and exhaustive.

**INAPPROPRIATE CATEGORICAL ITEM:**

Please select your level of participation:

- Freshmen team
- Junior Varsity
- Varsity

What if the respondent plays for more than one of the levels? The respondent could either select more than one choice or skip the question entirely. As a researcher, your goal is to ensure that the respondent be able to select a choice that best represents their level of participation. Therefore, the AD may need to go back and reword the question.

**APPROPRIATELY REWORDED CATEGORICAL ITEM:**

Please select the level of participation in which you compete more than 50 percent of the time.

- Freshmen team
- Junior Varsity
- Varsity

Creating questions is not so easy! In this case, the AD needs to consider the purpose of the questionnaire together with the intended sample pool. Options for the categorical variables need to be carefully considered.
Likert items are used to identify a level of agreement or disagreement to a response. Bipolar adjectives are placed on each end of a scale, and you are asked to identify your level of agreement based on those adjectives. Each choice would be coded on a scale of 1 to 5 to quantify the responses. Typically, Likert items range between 3-, 5-, and 7-point scales. Likert items are commonly odd numbered so that a neutral point can be provided in the middle of the scale. Yet, in some instances, a forced choice response may be more appropriate to identify a level of agreement for a question. For an example of developing categorical items, please see next Research to Practice.

Ranking items are questions in which the respondent is provided a list of items and then asked to rank them in order of importance. The ways rating scales are used differ depending on the objectives of the research. How the rating scale is used depends primarily on what information the researcher wants to learn from the scale. The Research to Practice presents examples of ranking items that differ with respect to how they are used within research. In the first example, the items are ranked, and each item receives a score. In the second example, only one response is provided, but it is based on the ranking or Rating of Perceived Exertion (RPE; Borg, 1998). The ways in which each rating scale is different are dependent on the purpose of the questionnaire.

RESEARCH TO PRACTICE: EXAMPLES OF RANKING ITEMS

- Rank in order from 1 (best) to 5 (least) the following aspects you like most about your fitness membership:
  - Cardio equipment workout area
  - Free weights workout area
  - Aquatics workout area
  - Group exercise programming
  - Opportunities to work with personal trainer

- Based on the Rating of Perceived Exertion (RPE; Borg, 1998), rate your level of perceived exercise exertion on a scale from 6 to 20.

Likert items are used to identify a level of agreement or disagreement to a response. Bipolar adjectives are placed on each end of a scale, and you are asked to identify your level of agreement based on those adjectives. Each choice would be coded on a scale of 1 to 5 to quantify the responses. Typically, Likert items range between 3-, 5-, and 7-point scales. Likert items are commonly odd numbered so that a neutral point can be provided in the middle of the scale. Yet, in some instances, a forced choice response may be more appropriate to identify a level of agreement for a question. For an example of a Likert item, please see Research to Practice.

When deciding the number of levels to include and how items are written for a Likert item, the best practice is to start by first considering the demographics of your targeted sample. For example, a 3-point Likert scale is often used with children. Developmentally, children struggle to differentiate between strongly agree and agree. Therefore, it is developmentally appropriate to have a 3-point system to eliminate confusion for the child. Similarly, using pictures to identify the levels of agreement can be helpful instead of using words. For example, having a smiley face (3), neutral face (2), or a sad face (1) is also useful when surveying children. The 5-point and 7-point Likert scales are the most commonly
QuanTiTaTiVE rESEarCh DESignS used levels for questionnaire research in health and human performance. The decision of whether to use a 5- or 7-point scale is left up to the developer of the questionnaire. As you begin to write questions for your own questionnaire, a number of rules for question development need to be considered; please see the Tip.

RESEARCH TO PRACTICE: EXAMPLE OF LIKERT ITEM

Take the questionnaire that assesses client satisfaction with recent programming at a facility. A sample Likert item might include:

**The group exercise programming meets my fitness level needs**

<table>
<thead>
<tr>
<th>Very satisfied</th>
<th>Satisfied</th>
<th>No preference</th>
<th>Unsatisfied</th>
<th>Very unsatisfied</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
</tbody>
</table>

used levels for questionnaire research in health and human performance. The decision of whether to use a 5- or 7-point scale is left up to the developer of the questionnaire. As you begin to write questions for your own questionnaire, a number of rules for question development need to be considered; please see the Tip.

TIP: DEVELOPING APPROPRIATE QUESTION TYPES

When you are developing questionnaire items, some important considerations include:

- **Keep your objective in mind.** This is the number one point and the first step in questionnaire development; you must make sure you do not lose sight of your objective.

- **Keep your writing scientific in nature.** Overall item structure needs to be clear and concise. Remember the definition of scientific writing style: clear and concise. Along the same scientific lines, be unambiguous; do not leave any room for interpretation; be clear and concise. Items should not be too wordy, but rather straightforward and to the point.

- **Keep in mind the desired response.** The desired response should be the highest rating on the Likert scale for purposes of the statistical analysis. This will also keep you on track and ensure that all your questions relate to the objective of the questionnaire.

- **Keep your items positively stated.** Typically, if you keep your desired response in mind, items will be positively stated and avoid using negative statements. Keeping items positive will assist with scoring; however, when negative items may be appropriate is when the desired response is negative or you as the researcher want to ensure the respondents are being honest and fully reading the items on the questionnaire as opposed to answering all “strongly agree.”

- **Keep your items to only one thought.** For example, do not ask about the group fitness programming of the fitness facility and the staff knowledge in the same item. Rather, satisfaction with group fitness programming would be one item, and perceptions of a knowledgeable staff would be another item.

- **Keep your demographics of your targeted population in mind.** Keep your demographics of your targeted population in mind for purposes of ensuring that the items are culturally sensitive and avoid technical language or jargon that may be unfamiliar to your sample. Piloting and requesting feedback to a small representative sample helps to ensure appropriately worded items.
In addition to item development, you need to consider the appearance and length of the questionnaire. Having the questionnaire be aesthetically pleasing is important. This is true whether the questionnaire is web-based or a paper version. Individuals will be more inclined to initiate taking the questionnaire if it “looks” attractive.

Determining the appropriate length of the questionnaire is also a crucial piece to ensure that the individuals complete it. This is quite a balancing act. You want to make sure that you are asking all the appropriate and important questions, but also you want to keep the survey simple and as short as possible. This does not mean, however, that you eliminate questions to keep the questionnaire short. It does mean is that you need to go back and focus on your objectives of the questionnaire. Ask only the questions that help find answers to your original objectives for administering the questionnaire. This may seem obvious, yet many times as you begin developing questions, one question may lead to you to think of another question to ask. Although the question might be interesting, you need to ask yourself, “Is this what I really need to know to answer my initial question?” If not, take it out! You can develop another questionnaire later for those issues. The demographics of the targeted sample, such as age, will help determine the appropriate length. You may be familiar with a version of “KISS,” Keep It Simple and Short, but we also added “LL,” Likeable and Learnable: “KISS-LL.”

**Collecting Data—Online versus Hard Copy Surveys**

Today, we do not have to rely solely on paper copies of a questionnaire. With electronic email and web-based survey options, questionnaires are easier to administer and access. In the example of surveying client satisfaction of a fitness facility, the manager of the facility may consider an internet-based or email questionnaire to fully access the clients. If you rely only on the clientele who are coming into the facility, you may not receive the feedback you need to consider programming changes. The reasons the clients are not coming in may be related to the facility programming. An email to all members may provide the manager with a better picture of programming issues. Please refer to the online resources for some examples of Web-based survey tools commonly used in research.

Although these mediums may seem easier, they may not always be appropriate. In fact, delivering a paper copy of your questionnaire may sometimes make accessing your sample easier. In the example of surveying client satisfaction of a fitness facility, the manager of the facility may consider an internet-based or email questionnaire to fully access the clients. If you rely only on the clientele who are coming into the facility, you may not receive the feedback you need to consider programming changes. The reasons the clients are not coming in may be related to the facility programming. An email to all members may provide the manager with a better picture of programming issues. Please refer to the online resources for some examples of Web-based survey tools commonly used in research.

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Not only is how you access the sample important, but when you access the sample is critical. Again, you need to go back to the demographics of your targeted sample and fully understand the needs of the sample. Knowing when to send out your questionnaire is just as critical as how you choose to distribute it. When using questionnaires, you want to maximize the number of respondents to provide the most accurate analysis.

If we go back to the example about programming at a fitness facility, you may want to consider the time of year and the demographic location of your facility. Consider asking yourself: When will I be able to receive maximum responses about programming? Will seasonal programming affect the number of responses? When are members most active at the facility? Answers to these questions will allow you to decide on best time to administer the questionnaire.
Another example that is directly related to the objective of your questionnaire includes surveying how athletes spent their off-season (training or not training). In this example, the timing of when to access your sample is a little easier. You would want to access the athletes at the time of their off-season training, or just before they return. Asking them about their off-season training during the competitive season may not be appropriate. You may not receive the most accurate responses, because individuals may not be able to be as specific because of the time that has passed.

**Analyzing Responses**

After deciding on how and when to access the sample, the fun begins! Now, you are ready to collect the responses. You should provide a deadline for individuals to respond. You also must decide whether the responses will be anonymous or confidential.

These decisions depend on the types of questions you are asking and the purpose of the questionnaire.

Anonymous questionnaires are more difficult to track, in terms of being able to generate response reminders, yet they can be more appropriate when dealing with more sensitive issues. An example in health education is probably most appropriate. If you are attempting to ask issues regarding teen pregnancy, alcohol/drug use, or sexual activity among teenagers, more than likely more honest responses will prevail with an anonymous questionnaire. If your objective or purpose is not so sensitive, a confidential-type questionnaire may be appropriate. This way you can send out a second round of questionnaires to individuals who did not respond initially. Ideally, for research purposes, a 40 percent return rate is ideal. Monitoring the response rate of your questionnaire can help you decide whether you need to send out the questionnaire again, whether electronically or through postal mail. After you have decided that you have attained the desired number of responses, you are ready to analyze the data. We discuss this portion in greater detail in Chapter 12, when we discuss statistical analysis procedures for quantitative data.

**PULSE CHECK**

When can you state the survey is anonymous and when do you say it is confidential?

**Summarizing Survey Research Design**

Although within survey research design we have discussed how to develop your own questionnaire, many questionnaires may already be developed that you could use within your research area. The biggest decision on whether you need to develop your own questionnaire or consider using an existing one will be based on your research question, as well as the objective of the survey. Using an existing survey may be beneficial in that the survey’s psychometric properties, such as the validity and reliability, have been previously researched. Not having to spend time developing a questionnaire can allow you more time to focus on the research and gain more insight into your research question. Conversely, a published questionnaire may not meet the needs of your research question or be appropriate for the demographics of your targeted sample. Going through the literature and writing your literature review is critical in determining the appropriateness of published questionnaires for your research or whether you need to develop your own questionnaire. For examples of survey research, please see Research to Practice.
Behavioral Observation Research Design

Behavioral observation research design deals with using direct observation of behaviors in a natural setting, rather than relying on self-report data such as questionnaires. It is also known as systematic observation and analysis, by which objective information is collected on the instructional process and analyzed in a meaningful way.

Behavioral observational design techniques are used most frequently in education, when researchers are attempting to understand defined characteristics within a classroom. Usually simple observation behaviors are identified that are easy to record, such as type of quality of teacher feedback, amount of instructional time spent organizing a class or how is it done, amount of practice time students actually get, progressive sequences of the teacher’s task, amount of decision making permitted, and student off-task behaviors. When deciding to use behavioral observation techniques as a research method, the researcher should consider the following steps:

1. Decide what to look for (what is important enough)
2. Choose an observation method or tool to collect the data
3. Learn how to use the tool or training method
4. Gather data
5. Analyze and interpret the meaning of the data
6. Make changes in the instructional process
7. Monitor the change in teaching

If you think back to the scientific method in research from Chapter 1, you should notice similarities to these steps. The biggest difference here is that, after the findings, the individual may be able to make immediate changes to his or her instructional or teaching processes. This is a type of research that is referred to as action research, and we will learn more about it in Chapter 7.
Duration Recording
Choosing an observation method or tool to collect the data within behavioral observation can take several forms. The quantitative forms include duration recording, frequency recording, and interval recording. Duration recording is used to record how students and teachers spend time (e.g., time on task), but this is not good for very short time segments such as instances of feedback.

With duration recording, the researcher needs to have a stopwatch to record the time spent with the defined behaviors. For duration recording to be successful, the target behavior should have a clear beginning and ending.

Frequency Recording
Another form of observational research includes frequency count. The frequency count or tally recording method refers to defining specific events or “target behaviors” and counting how many times the behavior occurs.

This type of recording is used when occurrence or lack of occurrence of a behavior is important to know or when knowledge of a frequency of a behavior is important.

Interval Recording
The last form of observational research is interval recording. Interval recording is used when more specific indicators of how time is spent are needed.

With this type of recording, the researcher will divide the class or time into set intervals. During the intervals, the researcher identifies the number of predetermined behaviors or target behaviors that occur during that interval. For an example using behavioral observation in physical activity, please refer to the Research to Practice.

RESEARCH TO PRACTICE: BEHAVIORAL OBSERVATION RESEARCH EXAMPLE
■ Chuang, Sharma, Perry, and Diamond (2018) used observational research techniques to determine if physical activity as part of an early childhood program increased the children’s physical activity. Physical activity was measured using the System for Observing Fitness Instruction Time—Preschool version (SOFIT-P, Sharma, Chuang, Skala, & Atteberry, 2011).

PULSE CHECK
What are the two types of descriptive research designs?

Experimental Research Designs
The next type of quantitative research design is experimental research. Experimental research designs attempt to identify group differences of an outcome or dependent variable. Two types of experimental research designs that are possible include quasi-experimental research and true experimental research. The difference between these two designs lies in how the groups are defined. In the example in the beginning of
the chapter, comparing sex differences and percent body fat is a quasi-experimental design because the groups were defined by sex and could not be manipulated. A true experimental design includes groups that have been manipulated within the research design, such as treatment and control groups. The number of levels that are being examined would not change the research design but rather would change the statistic used to analyze the data, which is further discussed in Chapter 12.

**Quasi-experimental Designs**

Quasi-experimental designs examine group differences among the desired research variable.

Here, the groups are intact or grouped based on some attribute and known as the independent variable.

The best example of a quasi-experimental independent variable is sex. It is impossible to randomly assign individuals into groups using sex; you cannot randomly assign an individual to a male or female category. The categories are defined by the specific attribute of the group and are examined to determine differences between the dependent variables.

With quasi-experimental designs, you still desire to control as many confounding or extraneous variables as you can in an effort to ensure that the measured differences in the dependent variable are a result of the group differences. Like any other research design, you attempt to design your research with as much control as possible and minimize the threats to internal validity. You cannot identify a cause-and-effect relationship between the independent and dependent variables in quasi-experimental designs. Because the independent variable cannot be randomly assigned based on an attribute, it is difficult to show that the independent variable is causing the effect on the dependent variable. Examples of quasi-experimental research designs are presented in the Research to Practice.

**RESEARCH TO PRACTICE: EXAMPLES OF QUASI-EXPERIMENTAL RESEARCH DESIGN**

- Bégin et al. (2019) compared women who took part in a weight-loss program and those women who were wait listed for the program.
- Tejani, Middleton, Huang, and Dimeff (2019) used a quasi-experimental design to examine if interventional exercises would improve scores on the Functional Movement Screen (FMS™) in Division III female athletes.

**True Experimental Research Design**

True experimental research or randomized experimental research designs also examine group differences among the desired research variable.

This type of research design is used when you are attempting to determine how a treatment may affect an outcome variable. With true experimental designs, we are hoping to find a “cause-and-effect” relationship between the independent variable and a dependent variable. Remember that the independent variable is the grouping variable; thus, this may be a group receiving a treatment and a control group receiving a placebo, for example. The dependent variable is the measured variable or outcome. In short, true experimental designs, attempt to determine whether the way in which the independent groups were manipulated had an effect on the dependent variable.
What is the difference between true and quasi experimental?

Although we desire a cause-and-effect relationship, this is very difficult to attain. When we consider a cause-and-effect relationship, several factors must hold true. First, the cause must come before the effect. For example, if you are examining some sort of supplementation on a physical performance variable, such as strength, the supplementation, which is the cause, must precede the actual performance to determine its effects on strength. The second factor that must be true includes that the cause and effect must be related to one another. If you want to determine whether a treatment is affecting or influencing an outcome, you would hope that the treatment and outcome are related! Third, the relationship between the two cannot be caused by another variable. This last factor is a little trickier and is where experimental control comes into place. We may assume we have a true experimental design; we have identified treatment and control groups, and we are going to attempt to determine whether the treatment has some effect on the performance being measured. Consider the example of nutritional supplementation and its effects on strength. Many confounding or extraneous variables could influence the results of the study. How well you can control those variables will allow you to have good scientific control of the design and be able to say whether a cause-and-effect relationship existed.

When we discuss confounding or extraneous variables and maintaining good scientific control, we hope that you are thinking that this sounds a bit familiar. In Chapter 2, we discussed issues of scientific control, which included internal and external validity. Remember that internal validity is the amount of control within your study. Minimizing threats to internal validity will ensure that you have quality research. At the same time, remember that you want to have the ability to generalize findings, which refers to external validity. Table 5.1 is a review of characteristics of internal and external validity that were presented in Table 2.3 in Chapter 2.

True experimental research designs include an independent variable that involves randomization of subjects into a treatment group and a control group. More specifically, two common types of true experimental designs include posttest–only design and a pretest and posttest design. A posttest–only design is used when you identify at least two groups, a treatment group and a control group, and test them after the treatment only. This is used when the administration of a pretest will influence or confound the outcome variable after treatment, and the researcher has a sufficient sample size that is more than thirty subjects.

A pretest and posttest design includes an initial baseline test of the outcome variable for all groups, then randomization into an experimental or control group, followed by a posttest after treatment. Here, baseline measures can be compared and considered when evaluating the effect of the treatment on the outcome measure. Two examples of pretest and posttest designs are presented in the Research to Practice.

Table 5.1 Characteristics of Internal and External Validity

<table>
<thead>
<tr>
<th>Internal Validity</th>
<th>External Validity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Good scientific control</td>
<td>Ability to generalize back to larger population</td>
</tr>
<tr>
<td>Extraneous variables have been controlled</td>
<td>Applied research design</td>
</tr>
<tr>
<td>Results can be attributed to the research design</td>
<td>Results can be applied to the field</td>
</tr>
</tbody>
</table>
Correlation Research Designs

With experimental research designs, we focus on examining group differences for a given dependent variable or outcome variable. The independent variable is categorical in nature (such as male/female; treatment/control). The dependent variable is the measured outcome and is continuous in nature (such as strength, knowledge, range of motion, anxiety level, or frequency of occurrence). Additionally, with experimental research, depending on whether you have a quasi-experimental design or a true experimental design, you are attempting to examine the differences or effects of the independent variable with regard to the dependent variable. Correlation research is different.

The relationship and influence between two continuous variables are critical points in understanding correlation research designs. The two research variables are continuous in nature and known as predictor and criterion variables.

In other words, correlation research designs are set up to determine the relationship between the X and Y variables or to determine how much the X variable influences or relates to the Y variable. Examples of correlation research designs are presented in the Research to Practice.

In correlation research, you cannot imply causation. Another example will help illustrate this point. If you are examining the correlation between percent body fat (X) and physical activity as measured by the number of minutes engaged in physical activity over the week (Y), you cannot state that a decrease in percent body fat would cause an individual to engage in more physical activity. If you think about that statement for a minute, you would see that many reasons may cause someone to engage in physical activity. Additional predictor variables (X) influence physical activity engagement, such as health status or socioeconomic status. Having a lower percent body fat may be one factor as to why someone would engage in physical activity, but it is definitely not the only reason. Sometimes the best way to understand the concepts of correlation research is to look at how it differs from experimental research. Table 5.2 presents the distinctions between correlation and experimental research.

Pulse Check

What is correlation research?
Table 5.2 Correlational Design versus Experimental Design

<table>
<thead>
<tr>
<th>Correlational Design</th>
<th>Experimental Design</th>
</tr>
</thead>
<tbody>
<tr>
<td>The relationship between two or more continuous research variables</td>
<td>The effects of or differences between means of the dependent variable for the independent groups</td>
</tr>
<tr>
<td>Variables are called predictor and criterion variables</td>
<td>Variables are referred to as independent variables and dependent variables</td>
</tr>
<tr>
<td>Sample size: a large N with a large range of scores is needed—usually 25 per predictor variable</td>
<td>Sample size: a smaller N can be used</td>
</tr>
<tr>
<td>Example of a results statement: As age increases from 20 to 60 years, the level of dental anxiety decreases.</td>
<td>Example of a results statement: Females have a higher percent body fat compared to males.</td>
</tr>
<tr>
<td>Example of a conclusion statement: The higher the level of actual skill ability, the higher the perceive competence.</td>
<td>Example of a conclusion statement: Salaries for assistant professors are lower than salaries for full professors in a college setting.</td>
</tr>
</tbody>
</table>

RESEARCH TO PRACTICE: EXAMPLES OF CORRELATIONAL DESIGNS

- Brandt, Razon, Blom, and Bolin (2019) used a correlational design to examine the relationship between affective responses and running performance.
- Cox, Martinez, Baker, and Warren (2018) examined the relationship between the range of motion measurements of a goniometer and a smartphone app to determine its validity.

SUMMARY

Quantitative research designs answer questions using quantifiable research variables. A number of types of quantitative research designs are discussed in this chapter, including different types of descriptive research, experimental research, and correlation research. Descriptive research included survey research designs and behavioral observation research designs. Survey research design uses either published questionnaires or questionnaires you develop to assess the perceptions or behaviors of individuals. If a questionnaire is developed specifically for the research, many key points must be kept in mind during its development. You must start with identifying your objective as well as your sample so that you can appropriately determine the format of the questionnaire, including item development. Accessing the sample includes knowing your sample and when and how to best survey your sample. Collecting and analyzing the data are discussed. Behavioral observation designs use direct observation of behaviors in a natural setting. Quantitative behavioral observation methods to record data include duration, frequency, and interval recording.

Additionally, experimental research design is discussed, differentiating between quasi-experimental and true experimental designs. The key point to distinguish the
difference between these two types of experimental designs is examining the characteristics of the independent or grouping variable. If the independent variable was not manipulated, you know that a quasi-experimental research design was used; an independent variable that was manipulated by the researcher indicates that a true experimental research design was employed. Finally, correlation research design was presented, which examines the relationship between two continuous research variables. The key point to remember is its continuous nature. Think about how one variable (X) influences or relates to another variable (Y). Other forms of quantitative research are possible; however, these are probably the most popular in the area of health and human performance.

**Applying What You Learned**

1. Based on the two types of descriptive research designs, survey and behavioral observation, provide an example in your area of interest for each of these research designs.
2. Create a list for do’s and don’ts for developing a questionnaire.
3. Provide an example for each research design to illustrate the difference between a true experimental and quasi-experimental.
4. Provide an example of a correlation design in your area of interest. Indicate the predictor and criterion variable based on your example.

**Key Terms**

Anonymous  
Behavioral Observation  
Confidential  
Correlation Research Design  
Criterion Variable  
Dependent Variable  
Descriptive Research Design  
Duration Recording  
Frequency Recording  
Independent Variable  
Interval Recording  
Predictor Variable  
Quasi-Experimental Design  
Survey Research Design  
True Experimental Design

**References**


Qualitative Research

WHAT YOU’LL LEARN

- How to define the characteristics of qualitative research designs
- How to use the procedures in qualitative research designs, including: interviews, focus groups, observation, and stimulated recall
- How to define types of qualitative research designs, including: ethnographic research, phenomenological research, case study, and narrative inquiries

In Chapter 5, we discussed many different types of quantitative research methodologies. In this chapter, we present the counterpart, qualitative research methods, and its characteristics, procedures, and types. No one type of research methodology is better than another; the design that is selected is related to the research question. If you find that qualitative research design is the best way to answer your research questions, then that is the type of method you should employ.

The information in these chapters related to research designs is a mere overview of the types of methods. For more information, please refer to the online resources.

Characteristics of Qualitative Research

Qualitative research is characterized by intensive, long-term observation or participation in a real-world setting. Marshall and Rossman (2015) defined qualitative research as a broad approach to describing a social phenomenon.

As opposed to using the strict scientific controls in a laboratory setting in quantitative research, qualitative research attempts to understand the world through the eyes of the participants whose world it is. Therefore, qualitative research takes place in a natural, real-world setting where the individuals live work, play, or interact with others.

Within qualitative research, a question is usually presented instead of a research hypothesis. With qualitative research, we are not looking for a “yes” or “no” answer, but a more detailed, deliberate, meaningful answer. Qualitative research begins with “how” or “why” research questions.
Research Questions
Include descriptive and exploratory "how" and "why" questions when using the qualitative research approach.

Inductive Reasoning
A bottom-up form of problem solving in which new conclusions are based on information generated from individuals observations or experiences.

Deductive Reasoning
A top-down form of problem solving in which new conclusions are based on theory.

Here the researcher is attempting to dig deeper versus merely taking the “face” value of numerical data within the quantitative research approach. The researcher wants to go the next step and ask “how” or “why.”

Overall, the qualitative research approach takes on a more inductive approach to problem solving. As discussed in Chapter 1, the inductive approach is typically taken in applied research settings.

Within the qualitative approach, the researcher is the research instrument and will gather descriptive observations or evidence to answer the research questions and determine a new theoretical research foundation from the bottom up. Deductive reasoning works from the top down and is typically used in basic research within the quantitative research approach.

The difference in how conclusions are based is only one of the differences among quantitative and qualitative research approaches.

Although qualitative research may not appear to follow the strict scientific controls that quantitative research does, the standards and expectations of the researcher remain very high. Taking a closer look at the differences between qualitative and quantitative research may provide a better understanding of the uniqueness of each design. Table 6.1 gives a comparison of qualitative and quantitative research approaches.

Again, we emphasize that no research method is better than another; it is all about the nature of your research question.

The purpose of qualitative research is to understand, explain, and analyze in depth a particular phenomenon or event. The researcher is not interested in quantifying variables but rather in understanding why or how something happened. To get at this in-depth analysis, the researcher uses specific techniques that are unique to qualitative research. These techniques include interviews, direct observation, focus groups, and stimulated recall. The techniques that are used may be similar for qualitative or quantitative methodology; however, how the techniques are used and the tools that are used for each type of methodology are different. The tools used in qualitative research are more process-driven, whereas quantitative research is more product-driven. Process-driven means the focus is mainly on how you are getting there, as opposed to product-driven focusing on the end result.

As a result of qualitative research focusing on the process and using all descriptive data that are gathered by the researcher, biases are inherent. The researcher must identify potential biases present when performing the interviews or observing the participants. Because the researcher has a set of research questions to ask, the researcher will be inherently biased in anticipating answers to the research questions and in phrasing the questions themselves. However, the qualitative researcher will identify these upfront, and, through the data collection and analysis phase, minimize the biases. With quantitative research, the researcher controls the biases at the outset of the study. For example, this is done by randomly selecting participants; random assignment; using a blind or double-blind approach; or adhering to specific treatments for the subjects. Aspects within quantitative research are carefully thought out, and the researcher considers how the study design will affect the outcome of the study. In qualitative research, the researcher is not concerned with controlling the environment in which the participants are engaged. Rather, the researcher is concerned with what is happening in the environment and why it is happening. Again, qualitative researchers are more concerned with the process and what and how it is unfolding.

Because the researcher is asking a specific research question about a certain group of individuals or one person, the sample is purposefully derived. In quantitative research, we desire to have a random sample and infer back to a larger population. This is not the case in qualitative research. We are only interested in answering the
Table 6.1 Qualitative and Quantitative Research Characteristics

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Qualitative Research</th>
<th>Quantitative Research</th>
</tr>
</thead>
<tbody>
<tr>
<td>Purpose</td>
<td>Understand and explain in depth analysis of particular event or phenomenon</td>
<td>Describes, attempts to quantify, desire to make inferential conclusions</td>
</tr>
<tr>
<td>Technique</td>
<td>Interviews, observation, case studies, participant observer, or ethnography</td>
<td>Descriptive, correlation, or experimental</td>
</tr>
<tr>
<td>Tools used</td>
<td>Process driven, categories are defined by the process</td>
<td>Standardized measurements, product driven, categories are predefined</td>
</tr>
<tr>
<td>Role of researcher</td>
<td>Participant–observer, attempts to identify bias and let critic determine the role of his/her bias to the results</td>
<td>Objective, controls research design, and removal of bias</td>
</tr>
<tr>
<td>Interpretation of Results</td>
<td>Examine the findings for trends and relationships</td>
<td>Desire to make inferences, generalize back to a larger population</td>
</tr>
<tr>
<td>Type of reasoning</td>
<td>Inductive, begins with observations</td>
<td>Deductive, begins with theory</td>
</tr>
<tr>
<td>Participants/Subjects</td>
<td>Randomization is not an issue, purposeful selection of subjects</td>
<td>Randomization is desired to increase external validity (i.e., generalizability)</td>
</tr>
</tbody>
</table>

research question that is related to the specific group or person we are investigating. There is no assumption that the results will be generalized to a large population as in quantitative research. In fact, a qualitative researcher is not interested in generalizability; answering questions regarding the individuals in that specific social context is the main focus and purpose of qualitative research.

How the research question is answered is very different in qualitative research versus quantitative research. In quantitative research, we use inventories, quantifiable performance variables, or predefined categories to measure the variables. In this way, we are able to quantify or assign a numerical value to the variables that are being assessed. Conversely, within qualitative research, we use open-ended interviews, journaling, notes based on observations, and collecting documents. Data are not quantified but analyzed as text. The researcher spends a great amount of time reading and rereading interview transcripts, field notes, and other documents such as biographies to find common themes in the data. The researcher clusters similar topics together and reduces the topics into categories, showing the interrelationships among the data. This process is repeated until the researcher believes the data are saturated, or that the data have been exhaustively reviewed. Researchers often review the data numerous times to ensure that the data have been accurately represented. We discuss the data analysis for qualitative research designs in more detail in Chapter 11.
PULSE CHECK

What are the differences between qualitative and quantitative research approaches?

**Trustworthiness**

At this point, a question you may be asking is: How can the researcher assure the audience that the findings of the study are accurate and believable? Just as in quantitative research, qualitative research has ways of ensuring that the findings are accurate and reliable. Within quantitative research, the focus is on the internal and external validity of a research study. Internal validity is examined to ensure that the research study itself has a level of control and the results can be attributed back to the variables of the research. Other extraneous or confounding variables that are not part of the research study should be controlled as much as possible so appropriate conclusions can be made and considered reliable. Qualitative research has the same expectations; however, the term *trustworthiness* is employed instead of *internal and external validity*.

To maintain integrity of the data, the qualitative researcher uses different techniques to ensure trustworthiness. These techniques include prolonged engagement, peer debriefing, member checking, and triangulation.

**Prolonged Engagement**

Prolonged engagement refers to the length of time the researcher is immersed in the setting of the research design. The presumption is that the longer the researcher is engaged, the more trustworthy the data.

The more comfortable the participants are with responding to the researcher, the greater degree of trust is developed. This is the case with either interviewing or observation. Qualitative researchers often interview participants many times rather than once. As the participants gain comfort and trust with the interviewer, the more trusting they will feel when responding to questions. Similarly, in observational settings, a number of sessions may be required during which the researcher observes the setting for the participants to feel comfortable. Therefore, the longer the researcher can be involved in the setting, the more trustworthy or accurate the data.

**Peer Debriefing**

Peer debriefing is another resource to ensure trustworthiness of the data. The researcher will identify one or two peers or colleagues to discuss the data.

The peer debriefer can offer another perspective or play “devil’s advocate,” helping to keep the inquirer honest. The debriefer searches questions by the peer to help clarify interpretations, test the meanings that were identified by the researcher, and provide the researcher an opportunity for catharsis or cleansing. The debriefer helps to clear the mind of emotions and feelings that may cloud judgment.

**Member Checking**

Member checking provides the participants with the chance to review their transcripts before the researcher begins analysis.

If the participants review the transcripts and do not want to include a response or want to change how they responded, the researcher is expected to honor their request. Allowing the respondents to review their transcripts will help strengthen the trustworthiness of the data. These methods of trustworthiness would be reported in the data analysis section of the manuscript.
Procedures in Qualitative Research

Now that we have a good basis for what qualitative research is, let us take a look at some of the procedures used in qualitative research. Although many different methods may be used to collect qualitative data, we review four common types used in health and human performance: interviews, focus groups, direct observation, and stimulated recall.

Interviews

Interviewing is one of the most popular procedures to collect qualitative data. Although interviewing is the most popular procedure, it is also very difficult to execute. Although sitting down and asking a participant questions may seem very easy, in fact, this procedure can prove to be very complicated! We first discuss the different types of interviews and then how to prepare for the interview process.

Triangulation

Another way for the researcher to provide trustworthiness of the data is through triangulation. Collecting data multiple ways allows the researcher to verify the accuracy of the data.

For example, the researcher may collect data through interviews, journals, and observations. Providing multiple ways of accessing the data establishes the trustworthiness of the data. Data from different sources can be used to corroborate, elaborate, or illuminate the research question. We are referring not only to multiple sources but also to multiple cases or multiple informants. Sometimes researchers may use quantitative data as a triangulation method. For examples of triangulation used among published research journal articles, see Research to Practice. In Chapter 7, we discuss mixed-methods research, which incorporates both approaches, qualitative and quantitative.

PULSE CHECK

What is trustworthiness?

RESEARCH TO PRACTICE: EXAMPLES OF TRIANGULATION IN QUALITATIVE RESEARCH

- Welch Bacon, Kasamatsu, Lam, and Nottingham (2018) used the following triangulation methods in their research on patient care documentation in athletic training: multiple researchers analyzing the data and participant member checking.
- Perlman and Forrest (2018) identified member checking and peer debriefing as triangulation methods in their research on the sport education model in physical education. They examined how student coaches influenced the perceptions and experiences of their players.

PULSE CHECK

What does triangulation mean in qualitative research?

Procedures in Qualitative Research

Now that we have a good basis for what qualitative research is, let us take a look at some of the procedures used in qualitative research. Although many different methods may be used to collect qualitative data, we review four common types used in health and human performance: interviews, focus groups, direct observation, and stimulated recall.

Interviews

Interviewing is one of the most popular procedures to collect qualitative data. Although interviewing is the most popular procedure, it is also very difficult to execute. Although sitting down and asking a participant questions may seem very easy, in fact, this procedure can prove to be very complicated! We first discuss the different types of interviews and then how to prepare for the interview process.
Preparing for the Interview Process

Whether you use a structured, semistructured, or unstructured interview format, you must be well prepared for the interview process. If you have a script, you should review your questions so you feel comfortable asking the questions. If you have a limited script or no script, you should be prepared to direct the interview. When you are thinking about preparing for the interview, you need to consider the location and environment of the interview itself. The location and environment of the interview should be convenient and in a location where the participant is comfortable. Convenience should be considered a priority for the participant. You as the researcher may need to travel to make this happen, yet it is important to have the participant in an environment in which he or she is comfortable.

You should be prepared to audio or video-record the interview, as well as have a notebook to record any observations during the interview itself. You will not be able to remember everything that was said during the interview, so an audio recording will be necessary; then you can go back and listen and transcribe the interview for data.
analysis. If you also can video record the interview, you will get not only participants’ interview responses but also the physical communications that can go along with the responses. Nervous quirks and facial expressions can be used in interpretation of the data. As the interviewer, you should bring along a notebook to write down any comments during the interview, yet taking notes should be minimized to remain focused and attentive. Your focus needs to be on the participant, and often the action of you writing notes may make the participant uncomfortable. During the interview, the participant should get the sense that you are listening to his or her responses. Multitasking will limit your ability to take in the participants’ responses and or to follow up with other questions. While audio or video recording is ideal, keep in mind that some participants may be uncomfortable with it. Make sure you communicate about the recording before the interview. If the participants are uncomfortable, assure them that the recordings will be used only for research purposes.

Depending on the nature of the interview, you may want to set a time limit. This is especially true with initial interviews. If you know that you will be interviewing the participant a number of times, you can limit the amount of time you will interview. This can help to ensure the participant’s attention. Also, including follow-up interviews in your study helps you to establish a relationship with the participant, which is prolonged engagement. The biggest point to emphasize here is that the interview process is a skill. Whether you use a structured, semistructured, or unstructured interview in your research methodology, you must practice your interviewing skills and techniques. Practice is a must. For additional points to consider before conducting interviews, see the Tip checklist to consider.

**TIP: INTERVIEW CHECKLIST**

Here are some points to keep in mind during the interview process:

- Select a familiar, comfortable place for participant
- Bring audio or video recording equipment to session
- Test recording equipment at each session
- Have available backup of all technology in case of equipment failure
- Bring notebook or set of questions to interview
- Request that all electronic devices be turned off during the interview (include yourself!)
- Provide clear expectations in the beginning of the interview for the participant
  - Purpose of interview
  - Estimated length
  - Consent to make audio or video recording
  - Type of questions to be asked
  - Any questions from the participant
- Listen intently to the participant throughout the interview
  - Concluding remarks
  - Overview of interview
  - Estimated time in which participant will be able to review transcript
- Schedule a follow-up interview if necessary
- Any questions/concerns from the participant
Focus Groups

Interviews are beneficial especially when you know you can perform follow-up interviews with participants. If, however, you will have only one chance to interview several individuals, a focus group may be a better procedure to use.

Usually the best size for focus groups is between six and ten people (Johnson & VanderStoep, 2013). Much of the same preparation and detail that goes into an interview needs to be considered with a focus group.

There are advantages and challenges to conducting focus groups. Focus groups allow all participants to be interviewed together, which can save time as opposed to interviewing all participants separately. Allowing participants to hear the responses of others can be very beneficial and assist with determining themes within the research questions. Conversely, as a result of hearing responses, some participants may not feel comfortable sharing their thoughts. The difficulty with a focus group is ensuring that all participants get to express their views.

The moderator plays a vital role in making certain that everyone’s voice is heard. At the beginning of the focus group, the moderator should identify the purpose of the focus group and ask all individuals to introduce themselves.

Clear guidelines should be identified up front with all participants. Examples of these include: respect for others’ viewpoints, order of speaking, and respect for privacy. In addition to the moderator, another person may need to assist the moderator.

Another challenge of focus groups lies within the data collection logistics. If videotaping is not available, a recorder should assist the moderator or researcher by identifying the individuals who are responding to the questions. From the audiotape, which person was responding to the question may not be evident. As the researcher returns to transcribe the focus group, the notes from the assistant can help to identify the individuals who responded to the questions. For an example of a focus group design, see Research to Practice. Focus group interviewing is also a learned skill. Individuals who are interested in using focus groups as a way to collect data are referred to Krueger and Casey (2015).

RESEARCH TO PRACTICE: EXAMPLE OF FOCUS GROUP DESIGN

Satija et al. (2018) examined the barriers and enablers of physical activity of adolescents in India. In this qualitative study, the researchers used focus groups to interview boys and girls separately as well as grade level and private versus government schools. A total of two sessions per group was conducted in order to ensure all data were obtained.

TIP: RESOURCES FOR CONDUCTING FOCUS GROUPS

We encourage you to refer to the following resources for more details on focus groups:


Types of Qualitative Research Designs

Now that you have a basic understanding of the four common ways to collect data in qualitative research, let us discuss types of qualitative research designs. Many different types of qualitative research designs exist; we discuss four types that are used in the health and human performance area. With each description, an example of how the type of qualitative research design has been used in health and human performance is provided to better illustrate how the research is used in practice. The four types of qualitative research designs presented include: ethnographic research, phenomenological research, case study research, and narrative inquiry research.

Direct Observation
Data collected during interviews and focus groups result from the participants responding to a series of questions; data collected with direct observation are a result of the researcher’s perception of the participants’ actions. Rather than relying on the participants’ perceptions, the researcher is relying on his or her own perceptions of the research question.

In direct observation, the researcher can take on different roles: participant observer or observer only. What the researcher needs or wants to know will dictate the most appropriate method of observation. In both instances, the researcher takes narrative notes or field notes that describe what he or she observes. These notes are very detailed and attempt to provide a description of the setting and the interrelationships within the setting. To provide a more accurate description, the researcher may use an audio recorder to record all the observations. These field notes and audio recordings are used as data to help assist in answering the research question.

Stimulated Recall
Stimulated recall was developed by Benjamin Bloom in 1963 at the University of Chicago. Used in the educational forum, Bloom audiotaped lectures to help students recall different points within his lectures. Bloom found that 95 percent of students were able to recall points made within the lectures two days later.

This type of procedure can be very helpful especially when attempting to have a participant recall a performance. For examples of stimulated recall used in a research study, please see Research to Practice.

RESEARCH TO PRACTICE: EXAMPLE OF STIMULATED RECALL

Allain, Bloom, and Gilbert (2018) used stimulated recall when they examined intermission routines of NCAA ice hockey coaches. Coaches watched game footage and were asked to describe provided detailed explanations of their behaviors during game intermissions.

PULSE CHECK

What are the four common types of data collection in qualitative research?
**Ethnographic Research**

Ethnographic research focuses on the sociological meaning through close field observation of sociocultural phenomena. A popular definition of ethnography is found in Hammersley and Atkinson (2007):

> We see the term as referring primarily to a particular method or sets of methods. In its most characteristic form it involves the ethnographer participating, overtly or covertly, in people’s lives for an extended period of time, watching what happens, listening to what is said, asking questions—in fact, collecting whatever data are available to throw light on the issues that are the focus of the research (p. 1).

Johnson (2000) defined ethnography as “a descriptive account of social life and culture in a particular social system based on detailed observations of what people actually do” (p. 111).

Ethnography research occurs in a natural setting with a cultural group over a specific period. A cultural group can be any group that is defined by a common social experience. For examples of ethnography research please see Research to Practice.

**RESEARCH TO PRACTICE: ETHNOGRAPHY RESEARCH EXAMPLES**


**PULSE CHECK**

What is ethnographic research?

**Phenomenological Research**

Phenomenological research deals with how individuals experience a phenomenon or the subjective reality of an event.

The goal in phenomenological research is to understand the lived experience of the individuals being studied. Further understanding the feelings and emotions of the individuals is imperative and sets phenomenological research apart from other types of qualitative research.

The emphasis is placed on understanding the phenomenon from the eyes of the participants. Remember that qualitative research involves descriptive evaluations to understand the how and why. What better way to understand the situation then to ask those who lived through the phenomenon or event? Phenomenological research is also a perfect example of inductive reasoning, in which individual experiences from the participants...
Types of Qualitative Research Designs

Case Study Research

Case studies are used when the researcher wants to examine a single phenomenon bound by time or activity. The single phenomenon or case need not be a person; it also could be an organization, incident, or community.

The reason a case study may be used is because the situation is unique, and it would be impossible to acquire enough subjects. This type of research is used in law, business, medicine, and the social sciences. Within health and human performance, sport marketing, athletic training, and sport psychology use this form of research. Allied health professionals commonly use a case study format to describe a unique case. The purpose of case studies includes the ability to understand the research question and not focus on the generalizability of the findings. For examples of research using case studies, please see Research to Practice.

Case Study

An in-depth examination of a “case”—such as a person, organization, incident, or community—employing a wide variety of data collection methodology to understand the case.

Research to Practice: Examples of Phenomenological Research


Pulse Check

What is phenomenological research?

Research to Practice: Example of Research Using a Case Study

- Hoffmann, Loughead, and Caron (2019) examined an outstanding peer athletic mentor using a case study approach. Since the researchers were interested in understanding the specific mentoring identity and what motivated the mentor in this specific situation, a case study was appropriate.

Pulse Check

How would you describe the case study approach?
Qualitative research is characterized by intensive, long-term observation or participation in a real-world setting. Although very different from quantitative research, qualitative research still upholds rigorous methodology to ensure that the data are trustworthy and reliable. The best way to describe qualitative research may be to compare and contrast it with its counterpart, quantitative research. There are unique differences such as purpose, technique, tools used, role of the researcher, interpretation of the results, type of reasoning, and selection of participants. Although vast differences exist between the two types of research, both designs are concerned with providing a sound research design to answer research questions. Quantitative research addresses these issues through internal and external validity issues; within qualitative research, the term trustworthiness is employed to ensure accuracy and research rigor. Techniques to ensure trustworthiness of the qualitative data include peer debriefing, member checking, and prolonged engagement. Lastly, triangulation refers to collecting data through multiple research methodologies that all assess the same research variable. Techniques that were discussed in this chapter include interviews, focus groups, stimulated recall, and direct observation.

Numerous types of qualitative research exist, including ethnographic research, phenomenological research, case study research, and narrative inquiry research. Each type of qualitative research is selected by the researcher based on the research question. Ethnography refers to research that focuses on the sociological meaning through close field observation of a social phenomenon. Phenomenological research addresses how individuals experience a phenomenon or the subjective reality of an event. Case study research is used when the researcher wants to examine a single phenomenon bound by time or activity. Finally, narrative inquiries attempt to understand behavior through

**Narrative Inquiry Research**

Narrative inquiry research attempts to understand behavior through large anecdotal material. Another term used for narrative inquiry is storytelling.

This research approach can take many forms; the researcher can analyze the narratives, or the narrative is provided by the participants telling their side of the story. Qualitative research focuses on the descriptive nature of understanding the how and why; thus, through narrative inquiry, the context and meaning is told from those who experienced and lived it.

**RESEARCH TO PRACTICE: EXAMPLE OF NARRATIVE INQUIRY RESEARCH**

Fisher, Berbary, and Misener (2018) used narrative inquiry as a qualitative research method to examine women’s experiences in a mixed-gendered gym. Researchers “sought to illuminate women’s gendered experiences within a for-profit mixed-gendered gym space” (p. 477).

**PULSE CHECK**

What is narrative inquiry research?

**SUMMARY**

Qualitative research is characterized by intensive, long-term observation or participation in a real-world setting. Although very different from quantitative research, qualitative research still upholds rigorous methodology to ensure that the data are trustworthy and reliable. The best way to describe qualitative research may be to compare and contrast it with its counterpart, quantitative research. There are unique differences such as purpose, technique, tools used, role of the researcher, interpretation of the results, type of reasoning, and selection of participants. Although vast differences exist between the two types of research, both designs are concerned with providing a sound research design to answer research questions. Quantitative research addresses these issues through internal and external validity issues; within qualitative research, the term trustworthiness is employed to ensure accuracy and research rigor. Techniques to ensure trustworthiness of the qualitative data include peer debriefing, member checking, and prolonged engagement. Lastly, triangulation refers to collecting data through multiple research methodologies that all assess the same research variable. Techniques that were discussed in this chapter include interviews, focus groups, stimulated recall, and direct observation.

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large anecdotal material or storytelling. The area of qualitative research is very extensive. For a deeper understanding of this type of research, the reader is encouraged to refer to the additional resources online.

**Applying What You Learned**

1. Provide an example (research journal article) of qualitative research and indicate what makes it qualitative, vs a quantitative research approach.
2. How is the term *trustworthiness* in qualitative research equivalent to internal validity in quantitative research?
3. How might you provide support for trustworthiness to enhance the quality of qualitative research?
4. Indicate how you could use each type of data collection procedure (interviews, focus groups, observation, and stimulated recall) for a qualitative research design. Do you think there is a “better” procedure for answering your research question? Explain.
5. Provide a potential research question that would warrant ethnographic research. Additional research questions can be devised for phenomenological research, case study research, and narrative inquiry research.

**Key Terms**

Case Study  
Deductive Reasoning  
Direct Observation  
Ethnographic Research  
Focus Groups  
Inductive Reasoning  
Member Checking  
Narrative Inquiry Research  
Peer Debriefing  
Phenomenological Research  
Prolonged Engagement  
Qualitative Research Approach  
Research Questions  
Semi Structured Interview  
Stimulated Recall  
Structured Interview  
Triangulation  
Trustworthiness  
Unstructured Interview

**References**


WHAT YOU’LL LEARN

- How to identify mixed-methods research designs
- How to identify features of qualitative and quantitative methodology
- How to define the six types of mixed-methods research designs
- How to explain the advantages and challenges to mixed-methods research
- How to define and identify action research concepts and designs
- How to explain action research examples

In the last two chapters we presented quantitative and qualitative research designs (Chapters 5 and 6, respectively). In this chapter, we discuss how combining quantitative and qualitative research designs can be beneficial to your research. We also present information on another commonly used research design, especially in education, called action research. We hope that these three chapters will provide you with a flavor of the types of designs that are used within your content area; however, when deciding on research methodology, it is all about the research question! We begin by introducing you to mixed-methods research designs, and then we discuss action research.

Overview of Mixed- Methods Research Designs

As indicated by Creswell, Tashakkori, Jensen, and Shapley (2003), the popularity of and interest in a mixed-methods paradigm has increased over the past few years. Both qualitative and quantitative research have many critics. Researchers often espouse either one or the other paradigm; however, you must be able to identify what it is that you are interested in and what question you are trying to answer. If answering this question is indeed the most important issue, then the argument should not be which research orientation, qualitative or quantitative, but rather how and what is the most appropriate research design to answer your research questions.

The model for the scientific process of problem solving is similar for any type of research design. According to the scientific process that we discussed in Chapter 1, the
researcher must identify a topic area of interest and develop a research question; research the current research; identify a research hypothesis; design an appropriate research design; collect and analyze the data; and finally formulate findings and conclusions. Regardless of the type of data collected, the steps in this model are always the same. Please refer again to the following list and Figure 1.1 for a review of the scientific method.

**Steps in the Scientific Method**

1. Identify the problem
2. Research the area (review of literature)
3. Identify a hypothesis or research question
4. Design an appropriate research design (research methods)
5. Collect data
6. Analyze data (results)
7. Formulate findings and conclusions

Regardless of the type of data collected, the steps in the scientific method stay the same. This is where mixed-methods research can really apply. Mixed-methods research is not the only way to answer a research question; it is another way of looking at a question, and if that question calls for it, mixed-methods research design should be considered. Before we discuss the methodology of mixed-methods research, let us review the features of qualitative and quantitative research.

**Features of Qualitative and Quantitative Methodology**

Researchers know that qualitative and quantitative research have discernible characteristics. These characteristics include not only differences in each part of the scientific process from the research question to the data collection method and analysis and interpretation of the data, but in the distinct world view of the researcher.

In Chapter 6, we presented the characteristics of both research approaches; refer back to Table 6.1 for an outline of these characteristics.

With qualitative research, the process is as important as the product; we do not randomly select our subjects, and the researcher takes a more active role within the research environment. In fact, the researcher is considered the research instrument. With quantitative research, we strive to control the research design, use more standardized measurements, and attempt to generalize back to a larger population. Data collection for both types of research is vastly different as well. With quantitative research, we use quantifiable variables usually obtained from some sort of performance test or paper and pencil inventory that have evidence of validity and reliability. With qualitative research, we gather notes from observations as an observer or a participant, using journaling techniques, critical incident reports, or interviewing (one-on-one or focus groups).

Qualitative research involves analyzing and collecting data at the same time. Information is presented in the form of matrices, and categories and themes are created. Many rounds may be needed to review the data. Useful quotes are used to support themes or categories that help to answer the research question. With quantitative analysis, statistical procedures are used, and inferential statistics are applied to test the hypothesis. Chapters 11, 12, and 13 explain how to analyze and interpret data, regardless of methodology.

One common denominator of both qualitative and quantitative research is that the researcher attempts to assure the audience that the findings of the study are accurate and believable. The difference between the two methodologies lies in how that
is accomplished. Quantitative research addresses these concerns through internal and external validity of the research design. Can the researcher randomly select? Randomly assign? Have extraneous variables been controlled? Qualitative research assures this through the aspect of trustworthiness. How can the researcher persuade the audience that the findings are worthy of attention? Qualitative research uses tools such as triangulation, prolonged engagement, peer debriefing, and member checking as ways to provide trustworthiness. Although the two types of designs may handle the question differently with regard to accuracy and credibility, they both address these issues and strive to ensure that the results are authentic. Either type of research design may not work perfectly to answer your research question. Thus, another way to answer a research question is through the mixed-methods research design.

Framework for Mixed-Methods Research Designs

Creswell and Plano Clark (2011) presented a framework for research designs. With any research design, three areas need to be addressed. The first area is knowledge claims that are made by the researcher. The second area is strategies of inquiry, which include the approach to the research methodology. The third area is the methods of data collection. Although the framework is related to all types of methodology, we address this from a mixed-methods perspective.

Theoretical Perspectives for Mixed-Methods Research

The first area of a research design framework is the knowledge claims in which the researcher will approach the research. Knowledge claims refer to the theoretical perspective that lies behind the research design. Creswell and Plano Clark (2011) identified four theoretical perspectives: postpositivism, constructivism, advocacy/participatory, and pragmatism. The first perspective, postpositivism, underlies most quantitative research. This type of knowledge claim addresses scientific method in that it uses deductive reasoning, careful observation, and measurement. The second perspective, constructivism, relies on the participant’s views and attempts to understand the world in which they live. This type of knowledge claim is more closely aligned with qualitative research and uses open-ended questioning and inductive reasoning. The third perspective, advocacy/participatory, is usually intertwined with an agenda for reform that could be political or social. The researcher is usually attempting to change the lives of participants. Similar to constructivism, a qualitative approach is used with open-ended questioning and inductive reasoning within the advocacy/participatory knowledge claim. The fourth perspective, pragmatism, involves primarily application. The researcher is concerned more with what works and what approach will best suit the situation or solve the problem. Mixed-methods research works well with this knowledge claim, because the researcher is not committed to one system or philosophy but rather to what tools will work best to discover the underlying answers to the research question.

PULSE CHECK

What is a mixed-methods research approach?
Types of Methods and Data Collection for Mixed-Methods Research

The second and third areas of a research design framework are strategies of inquiry and data collection. Strategies of inquiry include the approach to the research methodology. The approach to the research methodology will dictate the methods for data collection. The strategies of inquiry, from a mixed-methods perspective, involve six types of designs: convergent parallel, explanatory sequential, exploratory sequential, embedded, transformative, and multiphase (Creswell & Plano Clark, 2011). We focus on the basic forms of these designs. We encourage you to refer to Creswell and Plano Clark (2011) for a further understanding of more detailed approaches of these mixed-methods designs. Additionally, specific qualitative and quantitative methods of data collection and analysis can be found in Chapters 6 and 7.

The quantitative data is the priority way in which the research question is answered. The quantitative data is used build on the qualitative analysis.

Figure 7.1 shows graphical examples of the six different types of mixed method designs. For the purposes of this chapter on mixed methods, we will not provide specific examples of all the types of mixed method research. We focus on a few that we think would be most related to research topics at the introductory level.

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**Figure 7.1 Six Major Mixed-Methods Research Designs**

Advantages of Mixed-Methods Research
Using mixed-methods research designs has advantages and challenges. One of the most important advantages involves creating partnerships, more specifically, with your professors and community. You may be working with two professors as you develop your research proposal. Qualitative and quantitative researchers may have never considered the benefits of working together. Instead of settling in to one research “camp,” a more constructive approach may be to work together with regard to research questions that may call for both types of methodologies. This leads to the second advantage: mixed-methods designs may answer research questions that other methodologies alone cannot. Mixed-methods research can allow the researcher to possibly confirm a quantitative hypothesis while exploring in greater depth the processes by which the relationship occurred. A good example of this is the research by Renehan et al. (2019) who used qualitative research to get to a deep understanding of the quantitative research. Mixed-methods research may help to offset the disadvantages of one method over another. Moreover, combining methods allows maximizing strengths and minimizing weaknesses of the methodologies.

Finally, mixed-methods research can help to provide the opportunity for representing a greater diversity of divergent views. One question that always comes up when discussing mixed-methods research is “What if the qualitative and quantitative results lead to different findings?” The answer may be that these divergent findings may lead to re-examining the theory or framework (Tashakkori & Teddlie, 2003). The research
 Challenges of Mixed-Methods Research

As with any research method, mixed-methods research comes with its challenges. The time that it takes to develop and implement the design can be tedious and long. Additionally, funding structures are sometimes more equipped to fund for a mono-method design. Few funding structures allow researchers the flexibility in timelines and project length needed to truly facilitate the expansion of mixed-methods approaches. Another important challenge is that professors must have an open mind with regard to mixed-methods research. Although mixed-methods research can create great collaboration, the desire to collaborate needs to be fostered and encouraged. Therefore, we emphasize the need for encouragement and support for mixed-methods research designs, as well as collaboration among students and faculty to have a successful research process. Researchers need to balance understanding the breadth of the research with appreciating that their expertise, whether quantitative or qualitative, is important. Now that you have a better understanding of mixed-methods research, we will shift gears and discuss action research.

PULSE CHECK

What is one advantage and one challenge of mixed-methods research?

Action Research

Action research is a type of research that is usually used in the educational arena. Action research can be defined as a process in which individuals collectively work together to solve a problem.

Action research is performed by a teacher or practitioner with the intent to inform or change his or her practices. Although action research is used mainly in education, it can be used in health promotion and sport management. Like mixed-methods research, action research is much more expansive than what we will provide in this chapter. The reader is encouraged to review the online resources for a much more in-depth description of action research. Before we provide examples of action research in health and human performance, we first discuss some concepts of action research.

Action Research Concepts

Sagor (2011) provided three questions that a researcher should ask to determine whether action research should be used to answer your research question. The first question asks: “Is the focus on what is going on with your profession?” This question may seem easy to answer; however, you must consider whether you desire to improve or evaluate your own profession. In other words, what are your motives for conducting this research? This leads to the second question, which asks: “Are you empowered to adjust future action based on your results?”

If you desire to evaluate and improve on your teaching or ability to work with clients and used this information to change your current practices, then action research is
Although you should use the same steps in the scientific method to answer the research question, Sagor (2011) provided a detailed description of the action research cycle. Figure 7.2 is a visual illustration of the action research cycle. The four stages that Sagor presented are very similar to the scientific steps to problem solving. Here, however, the researcher or practitioner is attempting to immediately use the information to change his or her own practice.

To better understand action research, take a look at some Research to Practice examples in the health and human performance area. As you can see, action research is very appropriate. The last question asks: “Is improvement possible?” Because you are taking the time to actively research your own profession and evaluate yourself, you must ask whether in fact improvement is possible. If for some reason this is not the case, you should ask yourself as a researcher and practitioner whether action research is the correct avenue to take.

**PULSE CHECK**

What is action research?

**TIP: HOW TO DETERMINE WHETHER ACTION RESEARCH IS APPROPRIATE TO ANSWER YOUR RESEARCH QUESTION**

According to Sagor (2011) you should ask yourself three questions to determine whether action research is appropriate to answer your research question.

1. Is the focus on what is going on with your profession?
2. Are you empowered to adjust future action based on your results?
3. Is improvement possible?

**RESEARCH TO PRACTICE: EXAMPLE OF ACTION RESEARCH IN HEALTH AND HUMAN PERFORMANCE**

- Anyon, Bender, Kennedy, and Dechants (2018) presented a systematic review of youth participatory action research. This systematic review offers recommendation for future research in this area.
- Documet, Troyer, and Macia (2019) utilized action research methods to examine social support, health and health care access to Latino immigrant men. The researchers found that using a community health worker to provide social support to this population, led to less depression and reduced binged drinking.
- Aytur et al. (2018) examined competitive sport participation in individuals with disabilities using an action research design. The researchers provided implications that were specific to therapeutic recreation and discussed how these changes could be implemented.
is a powerful research tool that can enable the practitioner to inform change immediately. The health and human performance areas can greatly benefit from this type of research.

**SUMMARY**

Mixed-methods research features both qualitative and quantitative research. Although qualitative and quantitative research have discernible characteristics, such as purpose, tools used, role of the research, interpretation of results, and type of reasoning, combining the two research methods can provide the researcher with a deeper understanding of the research question. Furthermore, a common goal of both qualitative and quantitative research is that the researcher attempts to assure the audience that the findings are accurate and believable. Although the two types of designs may handle the questions differently with regard to accuracy and credibility, they both address these issues and strive to ensure that the results are authentic. Creswell and Plano Clark (2011) identified four knowledge claims that refer to the theoretical perspective that lies behind the research design: postpositivism, constructivism, advocacy/participatory, and pragmatism. Postpositivism underlies most quantitative research, whereas constructivism and advocacy/participatory address most qualitative research. Pragmatism, however, is concerned more with what works and considers which approach will best suit the situation or solve the problem. Mixed-methods research approaches work well using this knowledge claim.

Six types of mixed-methods designs were presented, convergent parallel, explanatory sequential, exploratory sequential, embedded, transformative, and multiphase. Figure 7.1 provides good examples of how to incorporate qualitative and quantitative research a mixed-methods design.

Advantages and challenges to mixed-methods research were also presented. Advantages of mixed-methods research include creating partnerships, answering research questions that other methodologies cannot alone, and providing better and stronger
inferences with regard to the research questions. Nevertheless, with advantages come barriers. These barriers include the fact that funding structures usually address a single type of design (either qualitative or quantitative), keeping an open mind among colleagues, and fostering collaboration among faculty.

Action research is a type of research usually used in the educational arena. It can be defined as a process in which individuals collectively work together to solve a problem. Sagor (2011) provided three questions that should be asked by researcher to determine whether action research is appropriate: (1) Is the focus on what is going on with your profession?; (2) Are you empowered to adjust future action based on your results? and (3) Is improvement possible?

**Applying What You Learned**

1. Provide an example of what a mixed-methods research design look like in your area of interest.
2. Of the four theoretical perspectives that were presented (postpositivism, constructivism, advocacy/participatory, and pragmatism), which knowledge claim is most closely aligned with a mixed-methods research design? Why?
3. Of the six types of methods and data collection for the mixed-methods research designs that were presented, which design would be most appropriate in your topic area? Explain a potential research design while illustrating your understanding of the type of mixed-methods research design that is employed in your example.
4. Compare and contrast the steps in action research with the steps in the scientific method.
5. Action research is typically used in education; however, it can be used in other settings. What is an example in your profession in which action research could be used to benefit your current practices?

**Key Terms**

Action Research
Convergent Parallel Design
Explanatory Sequential Design
Exploratory Sequential Design
Embedded Design
Mixed-Methods Research Approach
Multiphase Design
Transformative Design
Qualitative Research Approach
Quantitative Research Approach

**References**


WHAT YOU’LL LEARN

■ How the historical context of the use of human subjects affected the federal laws that guide us today
■ How institutional review boards function and help ensure that research is conducted in an ethical manner
■ How informed consent forms are developed and why such aspects should be addressed early in the research process
■ How other ethical violations play a role in the research process

We have spent a great amount of time discussing different types of research designs. Chapter 5 was dedicated to quantitative research designs, in which we presented information on descriptive research, experimental research, and correlation research. In Chapter 6, we focused on qualitative research designs, in which we highlighted characteristics and procedures of qualitative research and specific research design types, such as ethnographic and phenomenological research. Finally, in Chapter 7, we discussed combining qualitative and quantitative research, known as mixed-methods research, and also presented on action research. These chapters were designed to present to you a variety of research designs that may assist you in answering your own research question or hypothesis.

When considering any of these types of designs, before developing your research proposal (Chapter 9), you also need to consider ethical concerns that go along with research. This chapter discusses ethical issues involved with research, including care of human subjects and the institutional review board process.

Ethics Within Research

Consider the following scenarios: You are collecting data on a subject and notice that the equipment you are using is not properly calibrated. This is your last subject, and you are on a strict deadline. You ask yourself, do I need to retest the subject? The answer may seem very obvious now; of course, you would. The data that you have
collected could be very inaccurate and could damage your internal validity credibility, so you must retest the subject. For many researchers, this is apparent; however, some individuals may hesitate when making this decision. They are ready to analyze their data, and they are on a strict timeline. They want to move forward. They convince themselves that the data they collected from the participants are “in line” with past data collection periods. The decision to not retest the subject can be very tempting; however, is it the right thing to do? Now consider a researcher who is requesting individuals to participate in research without their knowledge or consent. Does this seem fair or ethical?

Ethics is a branch of philosophy that pertains to the study of right and wrong conduct. What is ethical or sometimes referred to as moral is defined by a particular group.

Essentially, when considering ethical issues in research, we refer to a particular association, such as the American Psychological Association (APA), Department of Health and Human Services (HHS), National Institutes of Health (NIH), and World Medical Association (WMA). These associations are great resources to understand ethical guidelines in research and identify right and wrong conduct; see the Tip for more information.

Although the difference between right or wrong when performing research may seem obvious for researchers, surprisingly, enough unethical behaviors have occurred and endangered human subjects to warrant governing principles for human subjects research (Faden & Beauchamp, 1986; Osman, 2001). Therefore, a discussion of the historical context of human subjects research is important to better understand the critical ethical elements that are involved with human subjects research. Please note that we are focusing on human subjects research, because most of the research in health and human performance is completed on human subjects. Please see the Tip if you are interested in learning more about using animals in research.

**TIP: RESOURCES FOR PROTECTING HUMAN PARTICIPANTS IN RESEARCH**

The American Psychological Association (APA) provides resources through their ethics office, as well as through their research resources.

- Ethics Code of Conduct and additional ethics resources are available online through their ethics office (www.apa.org/ethics)
- Responsible Conduct of Research (RCR) is summarized online as: “Responsible conduct of research (RCR) includes most of the professional activities that are part and parcel of a research career. As defined by federal agencies, RCR encompasses the following nine areas: (1) Collaborative Science; (2) Conflicts of Interest and Commitments; (3) Data Acquisition, Management, Sharing, and Ownership; (4) Human Research Protections; (5) Lab Animal Welfare; (6) Mentoring; (7) Peer Review; (8) Publications Practices and Responsible Authorship; and (9) Research Misconduct.” (www.apa.org/research/responsible)

Resources are provided through the Office of Extramural Research (OER) for the National Institutes of Health (NIH) and the United States Department of Health and Human Services (HHS)
Research involving human subjects through OER summarizes the website as: “This site “provides links to important NIH policies and guide notices related human subjects research applications and funded studies. Resources for federal regulations and other agency information are also provided.” (https://grants.nih.gov/policy/humansubjects/policies-and-regulations/research-guide-notice.htm)

- Additionally, the Office for Human Research Protections (OHRP) through the Department of Health and Human Services (HHS) provides a great deal of information: www.hhs.gov/ohrp
- World Medical Association (WMA) provides policy resources and the WMA Medical Ethics Manual.
  - Policy resources for medical ethics can be searched (www.wma.net/policy/)
  - The Medical Ethics Manual can be downloaded (www.wma.net/what-we-do/education/medical-ethics-manual/)

Historical Context of Human Subjects Research

Although issues of right and wrong conduct should be obvious when conducting research, this is not always the case. Many historical examples involve researchers using unethical practices to collect data from human subjects. During World War II, Nazi Germany researchers used concentration camp inmates, and other living human subjects, for research without their consent. German physicians were tried for their medical experiments in the Nuremberg War Crime trials.

These trials led to the development of the Nuremberg Code of 1947. The Nuremberg Code is a set of 10 principles that govern the ethical conduct of research on human subjects. This period is identified as the foundation for methodical safety of human subjects in research. Following are the Code’s ten principles:

Nuremberg Code

1. The voluntary consent of the human subject is absolutely essential.
   This means that the person involved should have legal capacity to give consent; should be so situated as to be able to exercise free power of choice, without the intervention of any element of force, fraud, deceit, duress, over-reaching, or other ulterior form of constraint or coercion; and should have sufficient knowledge and comprehension of the elements of the subject matter involved as to enable him to make an understanding and enlightened decision. This latter element requires that before the acceptance of an affirmative decision by the experimental subject there should be made known to him the nature, duration, and purpose of the experiment; the method and means by which it is to be conducted; all inconveniences and hazards reasonable to be expected; and the effects upon his health or person which may possibly come from his participation in the experiment. The duty and responsibility for ascertaining the quality of the consent rests upon each individual who initiates, directs or engages in the experiment. It is a personal duty and responsibility which may not be delegated to another with impunity.

2. The experiment should be such as to yield fruitful results for the good of society, unprocurable by other methods or means of study, and not random and unnecessary in nature.
3. The experiment should be so designed and based on the results of animal experimentation and knowledge of the natural history of the disease or other problem under study that the anticipated results will justify the performance of the experiment.

4. The experiment should be so conducted as to avoid all unnecessary physical and mental suffering and injury.

5. No experiment should be conducted where there is an a priori reason to believe that death or disabling injury will occur; except, perhaps, in those experiments where the experimental physicians also serve as subjects.

6. The degree of risk to be taken should never exceed that determined by the humanitarian importance of the problem to be solved by the experiment.

7. Proper preparations should be made and adequate facilities provided to protect the experimental subject against even remote possibilities of injury, disability, or death.

8. The experiment should be conducted only by scientifically qualified persons. The highest degree of skill and care should be required through all stages of the experiment of those who conduct or engage in the experiment.

9. During the course of the experiment the human subject should be at liberty to bring the experiment to an end if he has reached the physical or mental state where continuation of the experiment seems to him to be impossible.

10. During the course of the experiment the scientist in charge must be prepared to terminate the experiment at any stage, if he has probable cause to believe, in the exercise of the good faith, superior skill and careful judgment required of him that a continuation of the experiment is likely to result in injury, disability, or death to the experimental subject (Nuremberg Code, 1949).

**TIP: USING ANIMALS IN RESEARCH**

You are encouraged to look into the overall Animal Welfare Act (7 USC, 2131–2159), which sets the minimum standard for the use of animals in research.

- A very informative website is provided for the Animal Welfare Act that includes more details and a plethora of resources: [www.nal.usda.gov/awic/animal-welfare-act](http://www.nal.usda.gov/awic/animal-welfare-act)
- Resources are also provided through the Office of Extramural Research (OER) for the National Institutes of Health (NIH) and the United States Department of Health and Human Services (HHS).
- The Office of Laboratory Animal Welfare provides a great deal of information about using animals in research. [https://olaw.nih.gov/](https://olaw.nih.gov/)

Sadly, unethical behaviors continued after the Nuremberg Code. In 1932, the U.S. Public Health Service supported a research project that constituted an example of unethical behavior known as the Tuskegee Syphilis Study. In 1932, no cure was available for syphilis. The government initiated a study in Macon County, Alabama, in which the researchers began to examine the long-term effects of untreated syphilis. Macon County was known to have the highest rate of syphilis, which is a sexually transmitted disease caused by the bacterium, *Treponema pallidum*. Additionally, the county was a poor, semi-illiterate area. One assumption from the researchers was that African Americans responded differently to the disease than other racial groups. Researchers began to follow the long-term effects of syphilis on African Americans.
until their deaths of untreated syphilis. The subjects were provided free physicals and treatment of minor health problems to recruit men diagnosed with the disease. During those treatments, subjects were never told of the study or given an opportunity for informed consent to participate in it. In the 1940s, when penicillin was discovered, treatment was still withheld, and the study continued for approximately 40 years. The study was exposed in 1972. In 1974, the United States agreed to pay an out-of-court settlement to survivors and heirs of deceased subjects. Not until 1997 did President Bill Clinton apologize for the study.

Other unethical research continued to be conducted in the 1950s and 1960s. Often, mentally retarded children or older adults with chronic diseases were used as human participants without any form of consent. Beecher (1966, reprinted 2001) documented 22 studies in which unethical behaviors were present. As we move through the timeline of policy development for ethical treatment of human subjects, this study played an important role in U.S. policy-making decisions. See Figure 8.1 for a visual timeline.

In 1964, the Helsinki Declaration by the World Medical Association (WMA) was enacted. The declaration provides ethical guidelines for medical research involving human subjects. The policies have been amended over the years, and the most recent revision was in 2008. For more information on the Helsinki Declaration, see the WMA website and resources that were previously cited in the Tip: Resources for Protecting Human Participants in Research.

In 1974, the United States established the National Commission for the Protection of Human Subjects of Biomedical and Behavioral Research and required institutional review boards (IRBs) that receive Department of Health Education and Welfare support for human subjects research. In 1979, the Belmont Report was published by the National Commission for the Protection of Human Subjects of Biomedical and Behavioral Research. The Belmont Report cited three ethical principles: respect for persons, beneficence, and justice. Respect for persons speaks specifically to providing informed consent to participate in research. Beneficence obligates researchers to protect persons from harm and to maximize benefits and minimize risks to individuals. Justice refers to treating subjects fairly.

In 1981, the Department of Health and Human Services (HHS) enacted Title 45, which established federal rules and regulations that govern research involving human subjects. The latest revision of the document occurred in July 2018. In 2000, the HHS established the Office of Human Research Protection (OHRP). The office assumes responsibility for the development, coordination, and monitoring of policies relative to the protection of human subjects in research. For more information on the OHRP, see the website and resources that were previously cited in the Tip: Resources for Protecting Human Participants in Research. Through this brief historical look at ethical issues concerning human subjects, we hope you will fully appreciate the meaningfulness and importance of the policies and procedures that are in place to protect human subjects. Let us now discuss these areas, beginning with institutional review boards.

Figure 8.1 Timeline of Codes of Ethical Conduct
Institutional Review Boards

Institutional review boards (IRBs) are committees that exist in any institution that conducts research. Institutional review boards can be found in hospitals, grant foundations, and educational institutions.

Other names may exist, such as the Human Studies Council, at your institution; however, the purpose of the committee is the same. The IRBs are established by federal regulations at research institutions to protect human subjects from abuses through prior review of the research proposals. If you are conducting your own research study, you will more than likely need to seek approval of your research proposal through your institutional review board. Depending on the institution, the policies and procedures regarding how to apply for approval of a research study differ. We provide information from two institutions in the research to practice note in this section and encourage you to browse through the resources available. We suggest that you look at your own institution’s IRB website for resources and guidance through the review process.

RESEARCH TO PRACTICE: GUIDELINES AND RESOURCES FOR CONDUCTING RESEARCH USING HUMAN SUBJECTS FROM TWO SAMPLE INSTITUTIONS

- Institutional review board at the University of Connecticut—Information regarding the research process using human and animal subjects, applications, polices, and procedures manual. (https://ovpr.uconn.edu/services/rics/)
- Institutional Review Board at Central Connecticut State University—Information regarding the research process using human subjects, such as an application, and informed consent form that are suggested as “boilerplates.” (www.ccsu.edu/hsc/)

Institutional review boards usually comprise a variety of individuals who have different perspectives when reviewing the research proposal. From an institution of higher education perspective, faculty involved in research and those not involved in research may sit on the board. Additionally, lawyers, clergy, doctors, and neighborhood leaders may be involved in the committee. There can be many different perspectives. However, this enables the committee to provide a more comprehensive review of the proposals. In addition to committee membership, different types of reviews are considered.

PULSE CHECK

What is the role of an institutional review board?

Expedited and full reviews are the most common types of reviews in higher education. An expedited or exempted review may not require a full committee meeting, but selected individuals from the committee may review the proposal to consider its merits. In most cases, these types of research proposals are not considered as invasive or potentially harmful as a proposal that may warrant a full review.

Examples of proposals that may go through an expedited process include research using survey methods. Often this type of research is attempting to describe a current
In addition, other specific issues that the IRB will review include the right to privacy or nonparticipation of the subjects, the right to confidentiality or anonymity, and the right to expect experimenter responsibility.

For example, codes may be used instead of names; however, the codes cannot be linked to any names. Confidential data may involve having data locked in a filing cabinet that is only accessible by you. Before you get to the fourth step of developing your research methodology, think about the risks and benefits of your proposed ideas; see Tip: Questions Regarding Conducting Research Using Human Subjects. As part of the research protocol, the IRB also examines the informed consent required of all subjects when performing research. Specific components that must be included on an informed consent form.

**Informed Consent**

The informed consent is a key element in human subject protection. The subject must be given adequate information and be able to give voluntary written consent before participating. Understanding the elements of the informed consent will help you keep such aspects in mind when you are proposing your research study.

**TIP: QUESTIONS REGARDING CONDUCTING RESEARCH USING HUMAN SUBJECTS**

If you were on the institutional review board at your institution, what are some considerations you would take into account before approving the proposed research study?

- What are the risks involved with conducting this research?
- What are the benefits of conducting this research?
- If there are risks involved, will the risks be outweighed by the potential benefits of the research; is the knowledge gained a significant amount to outweigh the risks?
We encourage you to review this information when you are ready to put your informed consent form together for your research study. The Office of Human Research Protections (OHRP), which was previously suggested as a resource, has general requirements for informed consent; the Tip: Resource for General Requirements for Informed Consent shows where to access this information. Please also consult the online resources for more details on the regulations of informed consent.

**TIP: RESOURCE FOR GENERAL REQUIREMENTS FOR INFORMED CONSENT**


Before we continue to discuss some of the specific elements of an informed consent, you should think about deception. Typically, some level of deception is always present within research, but the key is to not actively deceive those who are participating. Deception will occur when such knowledge may influence those to respond in a specific way based on that knowledge; however, the knowledge that is omitted must not affect any decision to participate.

For example, when the questions on the survey are asking about exercise and eating habits, the purposes of the research will be evident; you do not need to share exactly the relationships or differences you are looking for in the study. There is always a limitation of honesty when responding to questionnaires. Any additional thoughts by the subjects regarding how they should respond will further influence the results. In another example, when two groups, experimental and control, are involved, the caveat of what the study “may” include or involve is used. This allows the subjects to be fully aware of all the possible procedures or expectations, without fully understanding into which group they are placed. Effects of knowingly being in either group may affect the results. This type of deception by omission is an attempt to minimize any potential threat to the research quality. Deception crosses the line when it is active deception.

Generally speaking, active deception leads to anger and resentment, which is not acceptable when conducting research using humans. In addition to thinking about deception by omission, specific elements of an informed consent need to be considered; these are presented in the following list. Overall, make sure that the form is readable and understandable.

**PULSE CHECK**

What is the difference between deception by omission and active deception?

**Elements of the Informed Consent**

1. Participation must be on a volunteer basis, and no coercion is involved; consent to participate must be given by the subjects without any force.
2. Procedures must be fully explained, and all expectations by the subjects must be described appropriately.
3. Clear description of any potential risks must be presented to the subjects, as well as any reasonable and potential benefits. When risks are involved, provide additional information, such as any available treatments if injury or distress occurs during the research study.
4. Statement indicating whether data will be anonymous or the level of confidentiality; indicate who will see the individual results of the subjects.
5. Contact information must be included for purposes of explaining; all subjects have the right to ask any questions at any point during their research involvement; this typically includes contact information for the principal investigator for questions about the research itself and also contact information for the IRB contact individual, who can answer questions about the subjects’ rights.
6. Must include a statement that indicates subjects may refuse or withdraw at any point without any negative consequences.
7. Authorization statement is typically included that reiterates the key points of the informed consent, yet at no point can a release of liability for negligence be given when participating in the research study.

RESEARCH TO PRACTICE: SAMPLE INFORMED CONSENT

INFORMED CONSENT FORM

- Department Name
- Institution Name
- Street Address
- City, State Zip

<table>
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<th>Student Investigator</th>
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PROJECT TITLE: Measuring Research Variables in the Exercise Science Field among College Students Enrolled in Measurement and Evaluation in Exercise Science

You are being asked to participate in our class project measuring various research variables in the area of exercise science. Your participation in the research study is voluntary. Before you agree to be part of this project please read the following information carefully. Feel free to ask questions if you do not understand something.

If you participate in this study, you will be asked to complete several short demographic questionnaires, diet analysis, a cognitive survey, as well as surveys assessing your thoughts and perceptions of physical therapy and cardiac rehabilitation. Additionally, you may be asked to participate in static and dynamic warm ups, agility testing, 1-mile run, balance tests, sit and reach, bench press, leg press, pushups and sit-ups. Your responses and scores will only be seen by the principal investigator and held in strict confidence. Only group data will be reported and used in the class data analyses.
I hereby understand that my participation in this study is voluntary and have been informed that this study is to measure research variables in the exercise science field.

I hereby understand that I may refuse to participate in this project. If I choose to participate, I hereby understand that if at any time during the project I feel uncomfortable I may choose to withdraw my consent and terminate my participation at any time during the project without any negative consequences.

I understand this project may not benefit me directly, however, there is the possibility that I will learn about the research process through my participation.

I have been informed of the procedures and understand what will be required during this project.

I understand that all information obtained during this project will be confidential. I will not be identified individually in any way as a result of my participation in this project.

Please feel free to ask any questions about anything that seems unclear to you and to consider this project and consent form carefully before you sign.

Authorization: I have read the above information and I have decided that I will participate in the project described above. The principal investigator has explained the study to me and answered my questions. I know what will be asked of me. I understand that the purpose of the study is to measure research variables in the exercise science field. If I don’t participate, there will be no penalty or loss of rights. I can stop participating at any time, even after I have started.

I agree to participate in the study. My signature below also indicates that I have received a copy of this consent form.

_____________________ _________________________
Signature of Participant Date

Please Print Name

Before you begin to develop your own informed consent form for your research study, please check to see whether your institution has a format or “boilerplate” to use. Remember that in some cases you will not need to be so specific with the details of your research design. For example, if you are using survey techniques, a brief description of the purpose, together with assuring anonymity or confidentiality and privacy, may be sufficient information. Additionally, if you are using subjects who are younger than age eighteen, you will need to also obtain parent or guardian consent. For an abbreviated informed consent form that was used for a class project, please see Research to Practice.

**PULSE CHECK**

What are the elements of an informed consent form?

**Other Ethical Issues**

Even though protecting the rights of your subjects or participants is paramount in your research, other ethical issues should be considered. These include plagiarism, data collection, data storage, and data fabrication or falsification.
Another area of unethical behavior often occurs during data collection. Consider data collection that was conducted unethically; obviously the researcher would need to collect the data over again on the subject. Issues such as time constraints and expense sometimes cloud the researcher’s judgment. Ensuring proper equipment calibration, as well as consistency in how you are collecting your data is important to both the internal and the external validity of your study. If you are attempting to generalize your results to a larger population, your data collection procedures should be sound and accurate.

DATA STORAGE
How your data are stored and the time frame of storing your data are also important issues when conducting research. A typical time frame to keep your data is approximately three years. If questions arise regarding your raw data collected directly from the subjects, you can easily access your data. Data storage should include hard copies of all subjects’ informed consent forms, individual data, and digital copies of all data, including statistical analyses.

Data Fabrication or Falsification
Thomas, Nelson, and Silverman (2015) refer to this as “cooking your data.” Obviously, making up your own data or not including data that may not be meaningful would be
inappropriate. Unfortunately, just as with ethical issues surrounding data collection, individuals make bad decisions. Your data are your data. You should not attempt to change your data in any way or not report data because it was not “significant.” If you consider issues that may threaten internal validity, the need to even consider this would be minimized.

SUMMARY

Ethics includes moral obligations that involve principles of right and wrong in behavior. When considering ethical issues in research, we normally identify with a specific association, such as the American Psychological Association or World Medical Association, to emulate appropriate and safe research practices. Due to the fact that most of your data will be collected using human subjects, we emphasized the need for protecting them. Additionally, many historical examples exist of researchers using unethical practices to collect data, and we outlined a few for you to gain a better understanding of the historical context surrounding rights of subjects. Steps to ensure subject safety and minimal harm are also included; more specifically, the process of the application to conduct research with your institutional review board. Along with the safety of subjects, we also presented other important ethical issues surrounding the research process. These include plagiarism, issues with data collection and data storage, and data fabrication or falsification. Although protecting human subjects is an important ethical issue when collecting data, these issues are also important to identify and consider when you are collecting data.

Applying What You Learned

1. Explain the meaningfulness of understanding the historical context of human subjects research.
2. Examine your own institution’s institutional review board and determine the steps to gain approval of a research study.
3. Referring to the sample informed consent form, identify the aspects of the form that relate to the three principles of the Belmont Report.
4. Discuss the important components of an informed consent.
5. Although the informed consent is a major issue in human subjects research, what other factors are important when performing research?

Key Terms

Active Deception
Anonymous
Confidential
Deception by Omission
Ethics
Expedited Review
Institutional Review Boards
Plagiarism

References


WHAT YOU’LL LEARN

- How nonrandom sampling techniques are different from random sampling techniques
- How to write your introduction
- How to write an appropriate statement of the problem that aligns with your research question
- How delimitations and limitations affect the development of the research methods
- *How, who, what, and when* questions to help develop your research methods

In Chapters 5 through 7, we presented various research designs that are used in health and human performance. These research designs include quantitative research designs covered in Chapter 5; qualitative research designs covered in Chapter 6; and mixed-methods research designs, including action research, presented in Chapter 7. As you consider your own research, you should now have a better understanding of the type of research design that will best answer your research question.

At this point, you are ready to develop your research design and methodology while keeping in mind ethical considerations that were presented in Chapter 8. Different types of sampling techniques may be used. As you begin considering your research question, you need to know from where you want to obtain your answers, so how you select your participants is crucial. Next, we will show you how to develop a proposal for your study, including the introduction; statement of the problem; identifying delimitations and limitations of your study; defining specific terms related to your study; and developing your methodology. We hope that the earlier chapters related to research concepts, ethical issues, and research designs will help you make the connections needed to develop your own methodology.

**Sampling**

As you begin considering your research proposal, an important issue is who will you sample and how will you access the sample? Many different concepts are important in sampling procedures. First, with quantitative research, most of the time we are interested in generalizing our results back to a larger population. An ideal scenario would be one in which the researcher identifies a fully accessible target population.
An example of a target population would be Division III student-athletes. This population may not be completely accessible given the fact that Division III student-athletes cover a wide range of individuals across the country. This is not a truly accessible population. An experimentally accessible population would be ideal. This is a known list of people or objects from the target population.

Questions you can ask yourself include: Will the sample be representative of the larger population? Is the experimentally accessible population similar to the target population? These can be huge inferential leaps. But if we use correct sampling procedures, you will minimize these concerns. Usually we refer to the experimentally accessible population as simply the “population,” which is the list of all possible subjects to be studied. The sample is defined as a subset of the population.

Finally, the sample unit is one of the elements or subjects on the list. Because we are discussing sampling for quantitative research right now, the assumption is that we desire to use inferential statistics to answer our research question. More information on using inferential statistics is included in Chapters 10 and 11. With inferential statistics, we need to define the population, randomly select participants, compute statistics to answer the research question, and then offer conclusions and findings. The first step is to identify the population and then randomly select from that population. The real desire is to randomly select from the population.

Some of the ways in which random sampling can occur include: (1) simple random sampling and assignment, (2) stratified random sampling, or (3) cluster sampling.

**Simple Random Sampling and Assignment**

Simple random sampling refers to using either a computer-generated program or a table of random numbers to randomly select the sample.

This method of sampling begins by identifying the target population to which you wish to generalize the results. Use a random numbers generator to randomly select the desired number of individuals for your sample. For an example using a table of random numbers, see the Research to Practice example.

Random assignment operates under the same principles as random selection. Random selection is used to acquire subjects for your study, and random assignment takes place after your subjects have agreed to participate in your study.

A table of random numbers also can be used to determine who is in the treatment and control groups.

**Stratified Random Sampling**

In some instances, the researcher must replicate subgroups from the population to the sample. The researcher wants to have the same percentage of each of the subgroups in the sample as exist in the population. In all cases of sampling, you want to make sure that the sample is a good representation for the population. If your sample does not reflect back to your target population, it will be harder to generalize your results.

When the researcher wants to identify certain demographics in their sample such as sex, ethnicity, major, or socioeconomic status, stratified random sampling should be used in the research design.

**PULSE CHECK**

What is random sampling?
Simple random sampling is also used here; however, first you need to determine the percentage of each of the different subgroups in the population. Then, select the same percentage of each group for the sample. For examples of stratified random sampling, see the Research to Practice.

**RESEARCH TO PRACTICE: USING A TABLE OF RANDOM NUMBERS**

- Before you start, number the population list from 1 to N.
- Looking anywhere on the table of random numbers, select where you will start and make sure you are aware of how many columns you need to use based on your total N.
  - For example, if you have 200 people in your population, then you will need to look at three columns. See the table of random numbers in this section. If you decided to start in the third column (which starts with 3120), you would use columns 3, 4, and 5.

- If you want to select 20 people for your sample, and then look at the first number. If the number is between 1 and 200, say 120 in this example, then the person you coded as 120 will be part of the sample.
- You will continue to go through the numbers, skipping those numbers higher than 200, until you have a sample size of 20. Also keep in mind that your population is without replacement. Without replacement ensures that you do not have the same people answer your survey or participate in your study twice.

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**PULSE CHECK**

What is the difference between random selection and random assignment?

Simple random sampling is also used here; however, first you need to determine the percentage of each of the different subgroups in the population. Then, select the same percentage of each group for the sample. For examples of stratified random sampling, see the Research to Practice.
Cluster Sampling

In a cluster sample, the primary sampling unit is not the individual. Rather, the unit is a group of subjects.

To use cluster sampling, you need to determine the target population and identify sampling units to collect data from as opposed to individuals. You would use simple random sampling procedures to select a sampling unit that consists of many subjects. For examples of cluster sampling, see the Research to Practice example.

RESEARCH TO PRACTICE: USING STRATIFIED RANDOM SAMPLING

Here is an example with sex. Say you had a population with 60 percent female and 40 percent male employees (total population = 1,000). You decide you want to sample 10 percent of the population. You would identify all the female employees and randomly select 60 females and then identify all the male employees and randomly select 40 males. In this way, your sample would be a better representation of the population than just simple random sampling. A simple random sampling approach may not produce a sample with the same proportion of males and females as is in the population.

Consider a more complex example: a population of majors in which 300 were physical therapy majors, 700 were defined as allied health, and 500 were identified as other. In percentages, this equates to: 20 percent physical therapy, 47 percent allied health, 33 percent other. As a researcher, you want to randomly select a 10 percent stratified sample, using a sample size of 150. Based on the percentages, you would need to randomly select 30 physical therapy majors, 70 allied health, and 50 others. Thirty physical therapy majors equate to 20 percent of the physical therapy majors in the population; this is the same for the "allied health" and "other" categories.

RESEARCH TO PRACTICE: USING CLUSTER SAMPLING

If you wanted to sample physical therapy programs in the United States you would first obtain a list of all programs. Second, you would identify the program as your sampling unit and randomly select samples. Last, you would then test all subjects within each selected program.

You want to determine outside-of-class behaviors of children in third, fourth, and fifth grades. If you have a rather large city, you could cluster sample. This would allow the researcher to focus on the classes of grades instead of attempting to access the entire population of third, fourth, and fifth graders, which may be very unrealistic.

PULSE CHECK

What are the different types of random sampling?
Writing Your Introduction

The introduction to a journal article contains the rationale for completing the research study. Additionally, you present the most relevant literature on the topic area. The introduction should lead to a gap that exists in the literature, which will provide a rationale for the current research study. The introduction should lead the reader

Nonrandom Sampling
A procedure in which all participants do not have equal chances of being selected

Convenience Sampling
Includes participants who are readily available and accessible to participate in the research study

Intact Sampling
Includes groups of participants who are already grouped together for other reasons and all participate together in the research study

Systematic Sampling
Selection of samples using an organized system in which all participants do not have an equal chance of being selected

Volunteer Sampling
Includes those participants who elect to participate in the research study

Although random sampling procedures are preferable, researchers often use nonrandom samples. Nonrandom or nonprobability sampling is often used by researchers when it is difficult if not impossible to employ random sampling procedures.

Nonrandom sampling can include (1) convenience samples, (2) intact groups, (3) systematic samples, or (4) volunteer samples. When random sampling procedures are used, then every sample unit has an equal chance of being selected for participation in the research study. Thus, when nonrandom sampling procedures are used, some sample units are more likely than others to be selected for participation in the research study.

Convenience and Intact Sampling
Researchers often use participants because of access or convenience.

The question with convenience sample is whether the researcher would have found the same results had they used another sample. Does the relationship between the researcher and the sample have any influence on the results of the research?

Intact sampling is very similar to convenience sampling, except that when the sample is selected it comes as an entire group. For example, a researcher may use an entire class or team from her school.

This is considered a poor method because there is no randomness to the sample.

Systematic Sampling
In systematic samples, participants are selected from the target population using some system or pattern.

For example, going through the phonebook and selecting every fifteenth person on the list is a form of systematic sampling. What is wrong with this approach? Because individuals are listed alphabetically, a huge bias occurs as to how the individuals are selected. Bias as to who is listed in the phonebook may include ethnic bias to the alphabetical listing of a phonebook; the systematic process of selecting every fifteenth person means that all individuals do not have an equal chance of being selected.

Volunteer Sampling
Volunteer sampling is one of the most commonly used nonrandom sampling procedures.

Most research studies could not be completed without the use of volunteer samples; however, potential biases of volunteer samples are presented in the Tip below.

PULSE CHECK

What are the different types of nonrandom sampling?

Writing Your Introduction

The introduction to a journal article contains the rationale for completing the research study. Additionally, you present the most relevant literature on the topic area. The introduction should lead to a gap that exists in the literature, which will provide a rationale for the current research study. The introduction should lead the reader
TIP: POTENTIAL BIASES OF VOLUNTEER SAMPLES

- Do the characteristics of the volunteer match the characteristics of individuals in the target population from which you wish to draw inferences?
- What motives does the individual have in agreeing to participate in the research study?
- The major limitation of volunteer sampling is that the researcher may only draw conclusions to groups with characteristics similar to the volunteer sample.

directly to why your research proposal is important to the content area. Thus, much of your content for writing the Introduction should come from the summary of your review of the literature. After describing the existing gap in the literature, you present your substantive hypothesis or your statement of the problem. See the following Tips for more details and ideas to help write your introduction.

TIP: WRITING YOUR INTRODUCTION

The Introduction needs to make the case for your current research study. Thus, you should:

- First present an introduction to the topic area to acquaint the reader with your topic area.
- Review the most pertinent research articles in this area of research. If applicable, you may need to review in detail any research study on which your study is based. This should be your critical research that you used to write your literature review. In general, you are making the case for why your research study is being conducted.
- At the end of the introduction, present your statement of the problem and also provide a statement about what you hope to find. This is called your substantive hypothesis. If you are using qualitative methods for your design, identify the research question or questions you will answer through the qualitative process.

PULSE CHECK

What components should be included in your introduction?

RESEARCH TO PRACTICE: EXAMPLES OF STATEMENT OF THE PROBLEM

- Statement of the Problem for a Correlation Design:
  - The study will be designed to determine the relationship between state anxiety and golf performance of adult, beginner golfers.
  - The intent of the researcher will be to examine the relationship between agility and the anthropometric measures of knee flexion and extension for knee injury rehabilitation patients.
Statement of the Problem for a quasi-experimental design:
- The differences in grade point average (GPA) of high school athletes when in-season and out-of-season will be investigated in the current study.
- The intent of the researcher is to determine whether differences in depression scores exist between the extents of burn (minimal, moderate, and severe) for burn rehabilitation clients.

Statement of the Problem for a true experimental design:
- The intent of the researcher in designing the current study is to determine whether differences in physiological work and mechanical factors exist in stair climbing. Physiological work will be measured by oxygen consumption and heart rate. The mechanical factors selected for this study will be joint motion at the hip, knee, and ankle. Performances on three commercial stair-climbing machines will be evaluated.

Statement of the Problem for a qualitative design:
- The current study was designed to determine the perceptions of student athletic trainers on their readiness for profession.

Statement of the Problem
The statement of the problem (SOP) is a statement that identifies the purpose of your study. The SOP is included in the last paragraph of the Introduction to the research.

This statement should be brief but also describe the research design. Within the body of the SOP, you should include the research method, participants or subjects to be utilized, and the variables you will measure. Perhaps the best way to understand what goes into the SOP is to consider some examples; see the Research to Practice examples.

The SOP should indicate to the reader what the researcher intends to do for the study. Additionally, the SOP should be short and concise, no longer than two to three sentences. Finally, the SOP should communicate the method to be used, the general names of the research variables, and the general terms of the population under investigation. In each of the examples given in the Research to Practice, you should be able to determine the type of research design to be used, the participants, and the research variables to be measured.

Delimitations and Limitations
The next component of developing your research design is to recognize delimitations and limitations in your study. Delimitations are choices the research makes about the study. Limitations, however, are aspects of the study that are beyond the researcher’s control.

Both delimitations and limitations are directly related to internal and external validity issues. In Chapters 1 and 5, we presented internal and external validity issues. When the results of the study can be directly attributed to the study designs, internal validity is controlled. The generalizability of the research design is related to external validity. As you begin to develop your procedures for your research, you need to consider both internal and external validity. The choices you make, or your delimitations, about the research design should strengthen the internal validity or minimize the threats to internal validity. As you identify your limitations, or the issues you cannot control, you will have a better idea as to how the results will be generalizable to a specific population.
**Delimitations**

Delimitations are a chance for the researcher to indicate any restrictions made on the study. Delimitations may be considered a description of the scope of the study. The subjects and research variables under investigation need to be delimited; these aspects are the primary focus of delimitations. Other aspects are constructed as you make decisions about your research design and methodology. For examples, see the Research to Practice examples.

**PULSE CHECK**

What are delimitations?

**RESEARCH TO PRACTICE: EXAMPLES OF DELIMITATIONS**

Here are some examples of delimitations from various research designs:

- Customer satisfaction will be delimited to the responses to the survey developed for the current study.
- Only female subjects who have exercised aerobically five or more days per week for 45 minutes per day will be selected for the study.
- Assessment of perceived motivational climate was delimited to the scores from the Task-Involving Climate and Ego-Involving Climate dimensions of the Perceived Motivational Climate in Sport Questionnaire-2 (PMCSQ-2; Newton, Duda, & Yin, 2000).
- Participants were delimited to male and female youth sport participants who attended sport camps within New England.
- Sports teams were delimited to basketball, field hockey, football, lacrosse, soccer, softball, and volleyball teams.

**Limitations**

Limitations of the study address the aspects of the study that you cannot control. These aspects of the study may be either impossible to control or beyond your ability to control. Here, you should review your study and identify those elements that would fit in the limitations. If you have a lot of limitations, then the research design may have problems. A question you should ask yourself at this point is: Why conduct the study if you are unable to draw any conclusions from the results? Or, if you have too few, you may not have thought through the research design. If you have a reasonable number of limitations, you know which aspects may have an impact on your study but go beyond the scope of the project. In other words, these are simply flaws that you have to live with in any research study. You will never be able to control everything, but you need to be able to identify the shortcomings related to your study and feel comfortable that these are the minimized. For some common examples of limitations to a study and questions that you can ask yourself, see the Tip: Limitations Among Research Designs.
PULSE CHECK

What are limitations?

TIP: LIMITATIONS AMONG RESEARCH DESIGNS

Your limitations will be unique to your study; however, here are some general examples:

- Honesty, effort, and skill level of the participants are all limitations to your study. Questions that you can ask yourself to help recognize limitations:
  
  - Will the participants complete the survey, interview, and questionnaire honestly?
  - Are they motivated enough to perform their best?
  - Do they have the necessary verbal, physical, or mental skills to complete what you want them to do?

- The validity and reliability of the testing instruments are limitations to your study. Questions that you can ask yourself to help recognize limitations:
  
  - Does the survey or questionnaire have the validity and reliability needed to qualify as an acceptable measurement?

- When participation is based on volunteers, self-selection can be a limitation to your study. Examples that can help you recognize limitations:
  
  - For example, a study on anxiety may attract very confident individuals, whereas highly anxious individuals would rather not let anyone know they are anxious.
  - Coaches who have teams that are struggling may prefer not to get involved in a study on cohesion.

- Other forces that are beyond the focus of the study are also limitations. Questions that you can ask yourself to help recognize limitations:
  
  - Can interaction between the participants and coaches, parents, teachers, or others affect the results?
  - How might past performances (wins/losses) affect the responses of the participants?

PULSE CHECK

What is the difference between delimitations and limitations?
Substantive Hypothesis or Research Question

What is a substantive hypothesis? The substantive hypothesis includes what you think the results will be once you collect and analyze the data.

If you expect that an experimental condition should improve performance, here is where you get to make that statement. The literature that you have presented in the Introduction should lead to this substantive hypothesis, and the substantive hypothesis should lead to the Methods section. A research question is used if you are using qualitative methods or if you cannot clearly identify what the expected outcome will for your research study. See the Research to Practice examples.

RESEARCH TO PRACTICE: EXAMPLES OF SUBSTANTIVE HYPOTHESES AND RESEARCH QUESTIONS

Here are some examples of substantive hypotheses and research questions that would be included at the end of an Introduction section of a research proposal:

- Statement of the problem for a correlation design:
  - Lower state anxiety levels will be associated with improved golf performance among the adult, beginner golfers.
  - When patients who are in rehabilitation for a knee injury have better agility scores, the more knee flexion and extension will be evident.

- Statement of the problem for a quasi-experimental design:
  - Grade point average (GPA) of high school athletes will be higher in season than out of season.
  - Depression will be examined to determine differences among those who have minimal, moderate, and severe burns.

- Statement of the problem for a true experimental design:
  - Differences in physiological work and mechanical factors will be examined among three commercial stair climbing machines.
  - Differences in sexually transmitted disease (STDs) knowledge among students who receive sex education and those who do not.

- Research questions for a qualitative design:
  - What are the perceptions of student athletic trainers as they prepare for a career in athletic training?
  - How do athletes cope after a season ending injury?

Developing Your Methods

The Methods section of your proposal is the section that provides the reader with information about how you plan to perform your study. We will use an analogy of a recipe for developing a quality Methods section. When you bake something, like cookies, you need to follow the recipe for the cookies to come out successfully. The first part of the recipe usually includes the list of ingredients that you will need. The list of ingredients is followed by a step-by-step process of how to mix the ingredients...
Participants or Subjects Section

The first part of the Methods section is usually the participants or subjects section. Here you want to provide special characteristics of the participants. This is the “who” of your methods. Who are your participants, and why were these participants selected? What makes them appropriate for the study? You may need to identify such characteristics as age, sex, training status, and education status. This will really depend on your research questions or hypothesis. Are you performing a case study? If so, then you will be describing in detail the characteristics of your subject or case. If you are testing, interviewing, or observing several individuals, you will need to describe their characteristics as a group. You may provide an anticipated number you expect to use.

In this section, you would also identify that you will have subjects or participants sign an informed consent before any data collection, regardless of type. In Chapter 8, we presented information about human subjects protection and the use of institutional review boards. This is probably a requirement for any research study you will perform at your institution. At this time, you also may identify any of the subject/participant delimitations that you considered. This may include a specific demographic, age, fitness level, educational level, or socioeconomic status. You would identify these issues here in the subjects section.

In the participants section, you will also identify any incentives you plan on providing your subjects. Will you have a drawing for a gift certificate to encourage participation or adherence during the study? Can you provide a monetary reward? This is probably not very realistic, especially as a student. A more realistic option may be to provide the results of the study to them if they are interested, or to provide them together to make the cookie dough. Once you have the cookie dough, you are provided instructions as to how to place on the cookie sheets, what temperature to bake the cookies, and how long to bake the cookies. All of these steps are important to the success of a good cookie. If you forget a step, the cookies may not taste as good. Just like a recipe, the researcher must first provide all the ingredients, such as participants, measuring instruments, and protocols. Then the researcher provides instructions for how to mix everything together, which would be the procedures. In the next section, we present the ingredients first: participants, instruments, or apparatus. Then we discuss the procedures, or how to combine all the ingredients to create a successful research design. Additionally, we encourage you to not only consult Methods sections of primary research journal articles, but also use the AMA and APA manuals as a resource.

TIP: PUBLICATION RESOURCES

We encourage you to refer to the following sources depending on which format you are using:

  - Chapter 2 provides specific information manuscript preparation
  - Chapter 2 provides information on manuscript structure and content

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TIP: PUBLICATION RESOURCES

We encourage you to refer to the following sources depending on which format you are using:

  - Chapter 2 provides specific information manuscript preparation
  - Chapter 2 provides information on manuscript structure and content
with some information about their results. For example, perhaps you were examining a specific diet and how it may influence an acute aerobic exercise bout. Because you would need to perform a dietary analysis on the subject’s food diary, you may offer to review the food diary and discuss the nutritional information provided. Although this may seem time consuming, it may help in keeping your subjects through the extent of the study.

**Measurement or Apparatus Section**

Another section that is common in the method is a measurement or apparatus section. This is the subsection that describes the measurement component of your study. In this section, you describe the data that you will collect in your study. Common subsections that describe the measurement are: measurement instruments, development of questionnaire, or equipment/apparatus. This section is not necessarily how the data were collected, that is, the procedures, but rather the “what” was collected. Think about your research variables and what your operational definitions are for each variable.

For example, you would indicate that the perceived motivational climate will be measured by the Perceived Motivational Climate in Sport Questionnaire-2 (PMCSQ-2; Newton et al., 2000). You would then describe the questionnaire itself as a measuring instrument, not the fact that you will be administering the questionnaire before practice.

For a qualitative research design, you may have a section that describes the setting in which you will interview or observe a participant. For instance, if you are interested in the confidence of a first-year teacher in an elementary school, you may describe the specific setting or, in this case, the elementary school setting. Is the school suburban, urban, or rural? How students are enrolled in the school? How many teachers/classrooms are in the school? What is a typical day like for the specific teacher or grade level? These characteristics are important to the overall description of the setting or environment in which the teacher works. These pieces may assist you when you begin interpreting the data.

**PULSE CHECK**

What are the important components of developing your Methods section?

You will only be using subsections that are relevant to your study. Some of you may have more subsections than others, but it will depend on what you want to know. For a measurement instruments section, the researcher would include this section if he or she is using some form of a standardized measurement instrument. When describing the standardized instrument, you should consider many pieces in the description. First, define the construct that the scale attempts to measure, including the number of items on the scale. Describe how the items are formatted. Are the item responses based on a ranking, Likert, or categorical scale? Next, describe whether the scale is divided into subscales, or is there a total score? In addition to this, you should also identify how it is scored. Are the subscales totaled or summed? Or are subscales averaged? Do the authors of the scale identify any ranges to the scores? Are there norms to compare the scores? Next, you should provide some information about the validity and reliability evidence of the scale. We will be discussing in greater detail different
types of reliability and validity. For this section in the Method, you want to provide a brief synopsis of the validity and reliability evidence of the measuring instrument. You also may include an example of a few questions from the scale. You may want to show examples from each subscale, so the reader can have an idea of what type of questions were asked.

If you are developing a questionnaire, you need to provide a step-by-step approach to the development of the questionnaire. If you refer back to Chapter 5, we discussed in detail the steps to questionnaire development. Here, you would want to describe the steps that you used to develop the questionnaire you prepared to answer your research questions. You may discuss issues such as the objective of the questionnaire. What was the questionnaire designed to describe or measure? If the questionnaire had subsections, describe each subsection. Describe the types of items that were used. If necessary, describe the types of questions used separately for each of the various sections. When you describe the type of questions or items, you should be sure that you include a description of the response format (ranking, Likert, categorical) and the scoring (if appropriate). Finally, you also must describe the procedures that you will follow to establish the validity of the questionnaire. This could include a panel of expert reviewers for content validity (more in Chapter 10) and pilot testing. With pilot testing, if you needed to make changes to the questionnaire, you would note those changes here. Did you take a question out because it was unclear? Did you reword a question because the previous wording was ambiguous? These issues should be identified here in the questionnaire development section.

If you are using apparatus or equipment, you may need a section that identifies the equipment or apparatus you will use. In this section, you need to identify the various pieces of equipment that are used, and for each piece, describe the manufacturer, model number, and if necessary, the protocol.

When considering the type of measurement subsection needed in the Methods section, consider a heading that is appropriate to your study design. If you only have one measurement instrument, you would want to name the section by the title of the test or measurement instrument. When you have multiple measurement instruments, you may want to name the subsection something more generic and then have sections that describe each instrument. The information provided here should be a reflection of what you put in the delimitations and limitations you identified previously.

**Procedures Section**

The procedures subsection is a summary of each step of your research project. This is the “when” and “how” of the Methods section. Remember, if you think of your Methods sections as a recipe, the participants and measurement instruments subsections are the ingredients, and the procedures section is the instructions. Be sure that your procedures section describes how you will obtain permission to conduct the study. See Tip: How to Obtain Permission to Conduct the Study for some questions you can ask yourself regarding obtaining permission for your research study.

This step must be thought through with great detail. Who must you ask before you contact the participants? Often, your first step is to write one or more of these individuals a letter asking permission. If you do, then state this in the procedures or participants section, and add that letter as an appendix to your proposal. Often, the person you need to contact depends on the setting in which you are conducting your research. Schools, companies, and various organizations each have individual policies and procedures. You need to do what is required for you to gain access to the participants.
TIP: HOW TO OBTAIN PERMISSION TO CONDUCT THE STUDY

- To use high school athletes: Do you need permission from the superintendent of the schools, high school principal, director of athletics, coach, parent, or some combination of these individuals?
- To use college students: Do you need to contact the dean of student affairs, department chair, director of athletics, professor, coach, or some combination of these individuals?
- To use groups, individuals from a company, particular facility, or other specific setting: Do you need permission from the chief executive officer, company president, director, or person in charge of personnel?

Next, now that you have permission to gain access to your participants, you describe the process you will use to get an individual to volunteer to participate in your research study. You may also need to send letters to potential participants, put up posters, or go to a team practice. For survey research, especially if the survey is online, make sure that you include procedures to follow-up on nonrespondents. As you complete your procedures section, remember that you must write scientifically, so be clear and concise, at the same time providing enough detail that a reader would be able to replicate your study. See the following Tips for more considerations when writing your procedures.

TIP: HOW TO WRITE YOUR PROCEDURES

- Provide a step-by-step description that is presented in a logical order.
- Ensure that you are providing enough description to allow for replication.
- Re-read your entire Methods section and ask yourself: Is it logical, systematic, and replicable?
- Have a fellow student or advisor read your Methods section, and ask them the following questions: Can you follow what is being proposed for the current research study?

Data Analysis Section

Your statistical analysis or data analysis section describes how you will analyze the data that you collect. If you are using a quantitative data analysis, then you may call this section the statistical analysis section. In the statistical analysis section, you describe aspects, such as the research variables that are being measured, the independent and dependent variables, or the predictor and criterion variables. For independent variables, be sure to describe the levels of the independent variable and how the groups were operationally defined. The statistical or data analysis procedures that will be used to analyze your data should be the last section of your methods.

SUMMARY

In this chapter, we discussed the major sections of your research proposal. First, we introduced key concepts related to sampling. Selecting your sample is an important component to your research design. The selection of your sample will depend on the type of design and the ability to access subjects. Next, we discussed writing your introduction.
The introduction is the section of your research proposal that will provide the rationale and defense as to why the study should be completed. At the end of the Introduction, researchers usually identify their statement of the problem or their substantive or research hypothesis. Delimitations and limitations were identified. Delimitations are the choices the researcher makes with regard to his or her study. Limitations are aspects of the study that the researcher cannot control. Examples were provided to give you a better understanding of each. Finally, we discussed the development of the Methods section. The researcher can think of this section as the step-by-step process of the study. The methods should be able to be replicated. Parts of the Methods section often include a participant or subjects section, instrument section, procedures, and data analysis.

### Applying What You Learned

1. Provide an example and explanation as to why the different types of nonrandom sampling are considered nonrandom.
2. Provide an example in your area of interest that would utilize random selection and another example where random assignment would be more appropriate.
3. Utilize the concept of funneling from Chapter 4 and propose important components to be included in your Introduction.
4. Define potential delimitations and limitations of your current research that will help you in developing a quality research design.

### Key Terms

Cluster Sampling  
Convenience Sampling  
Delimitations  
Intact Sampling  
Limitations  
Nonrandom Sampling  
Operational Definition  
Random Assignment  
Random Sampling Sample  
Simple Random Sampling  
Statement of the Problem  
Stratified Random Sampling  
Substantive Hypothesis  
Systematic Sampling  
Target Population  
Volunteer Sampling

### References


WHAT COMES AFTER DEVELOPING a research design and methodology? Data collection and analysis is the next step in the research process.

We have covered a lot of ground so far and are working our way through the steps of the scientific method. You now have many tools and resources to understand research concepts, write a review of literature, and design your research study. Now, we need to discuss in depth how you will analyze your data. Before we discuss data analysis, however, Chapter 10 will cover important measurement concepts: validity, reliability, and objectivity. These terms were first discussed in Chapter 2. When you select a test or measure to assist in answering your research question, you need to ensure that the measure is valid and reliable. Also, you want to ensure that you as the researcher are being as objective as possible. Do you have other individuals on your research team? If so, are you all collecting data consistently? These are important concepts to understand and apply as you begin to collect data.

After we discuss validity, reliability, and objectivity, we move on to first presenting quantitative data analysis procedures. We will first discuss the concept of hypothesis testing (Chapter 11) and then present inferential statistical analyses, including $t$-tests, correlations, and chi-square (Chapter 12). Next, we will present steps for analyzing qualitative data (Chapter 13). Although these steps are different, having exposure to both types of analyses is important. Remember, it is all about your research question! You may find that qualitative research may be a better way to answer your questions. Alternatively, perhaps you will need to incorporate a mixed-methods approach and use both types of research. This section will provide you with the necessary resources to consider both types of analyses. Good luck!
WHAT YOU’LL LEARN

- How researchers can provide evidence for the validity, reliability, and objectivity of tests and measurements
- How validity and reliability of tests and measurements affect research design and methodology
- How objectivity impacts data collection
- How validity cannot exist without reliability, yet reliability can exist without validity

Now that you started to think about developing your research proposal in Chapter 9, we are going to continue to consider aspects important to quality research designs. The statement of the problem is crucial, because it affects future decisions of your methodology. By looking at a statement of the problem, readers should be able to identify the research design and analysis, as well as the level of participants. Look back at some of the examples in Chapter 9 and examine how they are written differently for correlational and experimental research designs. Chapter 9 further explains how to refine your research proposal by thinking about the proposed participants and sampling methods and the limitations and delimitations, all of which leads you into your methods and answering the who, how, and when of your research design and proposal.

Solid research design is based on the literature review and understanding of research designs from Chapters 5 through 7; however, we need to further examine research variables in terms of validity, reliability, and objectivity. You may even need to go back to your delimitations and limitations; revisions or additions may be warranted after learning more about validity, reliability, and objectivity concepts. These concepts refer to the measurements in your research design. Thus, how you propose to measure your variables is critical. For example, if one research variable is physical activity levels, this could be measured through self-report questionnaires, observations, or by wearing a heart rate monitor or another wearable fitness tracker, such as a sports watch or smartwatch. How valid and reliable are these measures for your level of participants? Measurements must have some level of validity and reliability evidence so that the collected data when analyzed produces quality research results.
Quality research results allow you to draw conclusions and allow practitioners to use the research in their professions.

**Validity Concepts**

Validity of a measurement indicates that the variable that is supposed to be measured is being measured appropriately. Take the example of physical activity levels; do the questionnaire items measure what they purport to measure? If yes, then the physical activity questionnaire is valid.

Again, note that validity refers to the quality of the tests and measurements themselves, as opposed to the internal and external validity, which refer to the research design itself. Chapter 2 explored these terms to help ensure that you develop a quality research design by balancing threats to internal and external validity. Here we focus on quality research with respect to using valid measurements within your research.

**PULSE CHECK**

What is validity?

Support for validity evidence is done through correlation and calculating correlation coefficients. Calculating correlation coefficients is discussed in Chapter 12; however, by way of review, the concept of correlation allows you to examine the relationship between two measured variables. Chapter 5 discussed correlation research designs, which examine the relationship between two variables, or how one variable (X; predictor variable) influences the other variable (Y; criterion variable). If two measured variables that are supposed to be measuring the same construct are correlated, they should be related to each other and therefore have a strong correlation coefficient. A stronger relationship means stronger validity evidence, and therefore, that the test is measuring what it is intended to measure. Providing this evidence for validity of tests or measurements can be done through a variety of ways. Looking at the validity flowchart in Figure 10.1, you will see there are three main areas of validity: content-related, criterion-related, and construct-related. The areas of validity are appropriate to different types of tests and measurements. Depending on the nature of your research variables, different types of validity evidence are more appropriate than other types of validity. Not all types of validity will apply to all research variables.

**Content-Related Validity**

Before we begin discussing content-related validity, let us first discuss some of the terminology. When establishing evidence of content-related validity for a specific research variable, the researcher will usually identify categories or factors that represent how the research variable would be measured. When a research variable is not easily observable and needs to be defined, then the research variable is known as a construct. For example, leadership can be defined as a construct. If leadership is your research variable, this is not easily measured without having categories or factors to represent that variable. In short, a construct refers to a theoretical factor that cannot be directly observed; it can be indirectly observed based on its proposed definition, as well as the corresponding characteristics that are outlined to help measure it.
If we think about leadership for a minute, we can define it in a number of ways. Additionally, given a specific context, leadership may be defined differently. In a sport context, we may be examining the leadership style of a coach or of a player. This type of leadership style may be vastly different from the leadership style of an administrator. If you are developing a new way to measure the leadership of a coach, you may have different categories in which you measure leadership. For instance, leadership may be divided into authoritarian or democratic leadership.

Whereas, if you were examining the leadership style of an athletics administrator, you may identify organization and communication as two factors or categories that define leadership.

Consider another example, health promotion. Defining health promotion will be dependent on a number of factors or categories. Many categories encompass health promotion, such as social and emotional health, personal values, and physical activity. If you were developing a new questionnaire for college-age adults regarding health promotion, these may be three factors or categories you would identify in your questionnaire. As the researcher, you would define these categories or factors of health promotion in college-age adults.

Content-related validity uses experts in the specific area of interest and traditionally does not involve statistical analyses.

The expert review process typically follows the Delphi Method (rounds of review until agreement is reached among the experts) until an 80 percent agreement among the content experts is reached. After each round, feedback is summarized and sent back out for another review. When providing content validity among questionnaires, experts examine domain clarity, content relevance, and content representativeness.

Domain clarity involves determining whether the categories are correct in representing the construct and whether the corresponding items are appropriate for the related categories. In the example of a proposed leadership style questionnaire in a different area, health care, experts in the area of health care would be asked to determine whether measuring authoritarian, participative, and delegative leadership styles
are appropriate factors with respect to leadership styles in health care. Definitions of the three leadership styles would be provided along with the items to a panel of experts in the area of health care. Experts would comment on whether these styles are suitable for measuring leadership styles in health care. Content relevance of the items is examined with respect to making judgments about their significance and whether important concepts of the factors are represented in the proposed questionnaire items. Is this item that is proposed to measure authoritarian leadership style aligned with the definition? Does the item measure what it intends to measure? Content representativeness is further used to determine whether the items as a whole represent the factor. Do the six proposed items for authoritarian leadership style completely encompass the factor? Could there be or are additional items required to better represent the factor?

Going through the content-related validity process of asking experts can take on a different look when tests and measurements are in the psychomotor domain. Face or logical validity is also conducted by experts in the appropriate area of study, yet it is performed in an applied setting. Consider the example of the curl-ups from a fitness test battery. Curl-ups measure abdominal muscle strength and endurance. When an individual performs a curl-up, an expert keeping an eye on the abdominal muscles can see the activation of the muscles. The process is “logical”; as an individual curls up, the abdominal muscles would be engaged, and the process is therefore valid. Overall, this makes sense and can be taken at “face” value. As a result, face or logical validity is controversial within research. Unlike other measures of validity, face or logical validity is not objectively supported.

### PULSE CHECK

What are the ways to provide evidence for content validity?

**Criterion-Related Validity**

Criterion-related validity measures two like variables to illustrate the relationship between the tests or measurements to provide validity support for the proposed research variable.

The greater the relationship, the more validity support is provided among the tests or measurements. Correlation analysis is used to calculate the correlation coefficient, or validity coefficients in this case, to determine the degree of the relationship. Validity coefficients are interpreted by using cutoff values for excellent, good, fair, and unacceptable levels of validity, see Table 10.1 to interpret validity coefficients. As mentioned previously, Chapter 12 discusses the process for calculating correlation and validity coefficients in detail. Criterion-related validity includes concurrent and predictive validity, as well as convergent and discriminant validity.

#### Table 10.1 Interpreting Validity Coefficients

<table>
<thead>
<tr>
<th>.80 and above</th>
<th>Excellent</th>
</tr>
</thead>
<tbody>
<tr>
<td>.70 to .79</td>
<td>Good</td>
</tr>
<tr>
<td>.60 to .69</td>
<td>Fair</td>
</tr>
<tr>
<td>.50 and below</td>
<td>Unacceptable</td>
</tr>
</tbody>
</table>
**Concurrent Validity**

All forms of criterion-related validity take the new test or measurement and compare it with other variables appropriate to the nature of the new test being validated. Two measures in concurrent validity are taken in close proximity to illustrate that the new test is measuring what it purports to measure. If the new test (X variable) is proposed to measure cardiovascular endurance and is paired with another test (Y variable) to measure cardiovascular endurance, the validity coefficient should be high. The higher the validity coefficient, the greater the support is for the criterion-related validity of the test or measurement. Subjective rating validity and previously validated test validity (PVTV) are common measures of concurrent validity.

Subjective rating validity and PVTV can be used in any domain of research; however, they are more commonly seen in the physical domain. Subjective rating validity compares the new test with a subjective rating by an appropriate individual. An example in the physical domain may include a new test for assessing fitness levels (X = new test) compared with a health fitness instructor’s perception of fitness levels (Y = subjective rating). The new fitness test is given, and the fitness level scores are recorded and compared with the perception of fitness levels provided by the health fitness instructor. High fitness scores on the new test would also be fit individuals as rated by the expert opinion of the health fitness instructor. As one score goes up, the other score goes up, illustrating a strong positive correlation and validity support for the new fitness test.

Previously validated test validity (PVTV) compares two objective tests to provide validity support. PVTV, the most common among criterion-related validity, compares the new test with the results of a validated test. Previously validated tests that are chosen are typically the gold standard in that area of study. You may ask: If there is a gold standard, then why is there a need for a new test anyway? Often the gold standard is not feasible or accessible to the researcher. As a result, quicker and more practical tests continue to be developed. For example, underwater or hydrostatic weighing is a gold standard for determining percent body fat; however, numerous other methods, such as skinfold testing, are available to estimate overall body composition. Similarly, diagnosing diabetes can be done through different methods, such as an oral glucose tolerance test; whereas, the gold standard is to examine blood sugar levels after a night of fasting on at least two different days.

To provide validity evidence using PVTV, the researcher needs to identify the gold standard of the construct and correlate it to the new test that he or she developed. If both tests (X = new test; Y = gold standard) are measuring the same construct, such as cardiovascular endurance, then the new test should correlate well with the gold standard. For cardiovascular endurance, a maximum oxygen consumption VO\textsubscript{2max} test may be used as the gold standard. The researcher’s new test, perhaps a new step test, would be the new test. Scores on the new step test should correlate with the VO\textsubscript{2max} test (gold standard). If they both are measuring the same thing, the validity coefficient will increase and provide support for the validity of test, concluding that the new step test is measuring cardiovascular endurance.

Both subjective rating validity and PVTV examples of concurrent validity use correlation analysis to illustrate the relationship between the new test and another related criterion variable. The stronger the relationship, the greater the support for validity of the new test or measurement.

**Predictive Validity**

Providing validity support through predictive measures takes the correlation one step further by using regression analysis. Two variables are still measured; however, if the criterion variable (Y) can be predicted based on the new test or measurement, then
support is provided. Take a new way to estimate percent body fat and measure a set of individuals and predict what their percent body fat would be if you did underwater weighing. When providing support for validity, one would need to also measure percent body fat through underwater weighing. If your prediction (based on the new test) correctly estimated the percent body fat through underwater weighing, then the new test has predictive validity. Subsequent measures of percent body fat would only need to be done through the new test, because the test was shown to measure what it was intended to measure.

Predictive validity can occur by predicting present and future performance. Using the example of predicting percent body fat of underwater or hydrostatic weighing from a new test is predicting present performance. The two measures are taken in close proximity. The criterion variable in predicting future performance cannot be measured until time has elapsed between the measurements of the new test. For example, a new employment success test predicts what employee ratings will be after six months on the job. If after six months when the supervisor ratings collected on their employees are correctly predicted, then the new employment success test is a good predictor of employee success on the new job. If any test of measurement claims to predict future performance, predictive validity should be investigated.

**Convergent and Discriminant validity**

Convergent validity is very similar to concurrent validity in that related variables are used to provide support for the new test; however, convergent validity compares the new test with other tests measuring a similar factor that in theory relate to each other. If the two factors are associated in theory, a high correlation should be seen, providing a greater degree of validity for the new test. For example, higher levels of depression are associated with greater levels of drug and alcohol use. If the questionnaire assessing depression is in fact observed to be related to higher levels of drug and alcohol usage, there is convergent validity among the factors.

Traditionally, when convergent validity is examined, discriminant validity is also examined. Discriminant validity is the opposite of convergent validity. Discriminant validity takes the new test and correlates it with another test measuring a different theoretical factor. The results of the two tests should not be correlated. Low to no correlation needs to exist to provide support for discriminant validity. For example, when researching a new test of self-esteem, you could relate the self-esteem score to the scores on a locus of control questionnaire, which traditionally are not related to each other in the research.

You may have a hard time thinking what theoretical factor you could pair with your variable that is unrelated. Often many theoretical factors are indirectly related to other factors. Discriminant validity also can be supported through examining differences between groups. Instead of finding another factor, you can find two or more groups that differ with the new test. The results of the new test should be able to discriminate between and among groups. For example, children in a reference group with psychiatric disorders and children in a nonreferenced group should be able to be correctly classified using a new behavioral checklist. Discriminant validity is supported when the new behavioral checklist can discriminate between the groups of children. Using group differences is sometimes referred to as divergent groups validity and known groups validity. The only difference between these two types of validity is that divergent group validity compares two groups, whereas known groups validity compares three or more groups. They are all under the heading of discriminant validity.
Construct validation is a broad term; in fact, all examples presented thus far could fall under construct validity. When providing validity support for tests and measurements, the proposed variables being examined are the constructs. Constructs are factors that need to be operationalized; in fact, all research variables are operationalized. Here, we apply construct validity to the internal structure of tests providing supporting evidence that it measures what it purports to measure. A construct refers to a theoretical factor that cannot be observed. Constructs can be observed according to the proposed definition of the construct, as well as the corresponding characteristics that are outlined to help measure the construct. For example, intrinsic or extrinsic motivation cannot be observed. You may think, yes, it can. Well, motivation can only be measured after you examine how it is defined, so you know what characteristics are necessary to observe intrinsic or extrinsic motivation. The assumption by the researcher is that content-related validity checks have already occurred, and the factor definitions and items are supported. Content-related validity involves a review process by a panel of experts with little or no statistical analysis.

Construct validity uses more advanced statistical procedures to examine the internal structure of tests after the expert review process. At this point, the questionnaire would be administered to a targeted sample and results compiled for analysis. An exploratory factor analysis (EFA) examines how each item “loads” to all factors. “Loading” refers to how an item is related to the proposed category of factor, also referred to as factor loading. Factor loadings are similar to correlation coefficients. As shown on the left in Figure 10.2, arrows go from all items to both factors, because it is “exploratory” in nature. The items that were developed for intrinsic motivation should load high while loading low to extrinsic motivation. Problems are present if an item loads high on both, loads low on both, or loads high on the incorrect factor. According to these characteristics, items are evaluated and revised appropriately.

**Figure 10.2 Exploratory and Confirmatory Factor Analysis**
Once items have been revised, the questionnaire would ideally be administered to a new sample, and a confirmatory factor analysis (CFA) would be run. The right-side example in Figure 10.2 illustrates how only those items proposed for that factor are tested; thus, the rationale for naming it confirmatory factor analysis. Using the same guidelines as in EFA, all items should load high because they are being tested for the proposed factor. If there are continued problems or items that do not load high, questioning the overall questionnaire development may be warranted. Ideally, at this point in the questionnaire development, CFA should be used to provide future support for the quality of the questionnaire being examined by the researchers. If you are developing your own questionnaire, EFA or CFA is not warranted at this point in your proposal development. If EFA or CFA has been done on a published questionnaire in your proposed research, then this would increase the quality of your research design.

Not all measures of validity are necessary or appropriate for your research variables. Even when validity evidence is provided, the validity coefficients may not meet the “excellent” or “good” cutoff values shown in Table 10.1. Many factors influence validity coefficients, which should be taken into account when you look at your proposed research variables. First, you should ask yourself, what are you measuring? As mentioned, the type of research variable warrants different types of validity. For example, providing construct validity for a curl-up test is not appropriate, whereas EFA and CFA would be beneficial when developing a leadership style questionnaire in the area of health care. Examining not only appropriateness, but also the data collection process to obtain data to determine the validity coefficient is important in influencing the interpretation of validity. The sample tested and its characteristics plays a role in the data that are collected. The sample should be a good representation of the targeted population for that measurement. For example, when providing validity support for measuring physical activity for older adults, a wide range of physical abilities are possible. Thus, the sample tested may influence the validity coefficients. If the sample tested were avid walkers, this does not represent characteristics of all older adults. When thinking about measuring physical activity in older adults or any age level, having multiple assessments to ensure you are measuring what you purport to measure is also a factor to take into account. Sometimes a “battery” of tests is more suitable to measure physical activity, because one test alone may have low validity support for measuring physical activity levels. Finally, consistency in administration needs to be taken into account during the actual data collection process. This is known as objectivity, which is discussed at the end of this chapter. In short, you need consistency during data collection; results are valid when there is uniformity of administration. For examples of validity evidence among published tests and measurements, please see Research to Practice: Examples of Tests with Cited Validity Measurements.

**PULSE CHECK**

What are the ways to provide evidence for construct validity?
RESEARCH TO PRACTICE: EXAMPLES OF TESTS WITH CITED VALIDITY MEASUREMENTS

- **Content Validity** of FitnessGram’s PACER test is still commonly utilized as a good example for illustrating logical validity. “An attractive feature of the PACER is its high content (logical) validity. The PACER is a progressive, multi-stage maximal exercise test that closely simulates a graded, speed-incremented treadmill test used in the laboratory to directly measure VO2max” (Cureton & Plowman, 2008, pp. 9–9).

- **Concurrent Validity** was investigated by Hoeboer, Krijger, Savelsbergh, and De Vries (2017) in reference to the Athletic Skills Track (AST). “The concurrent validity of the AST was examined by calculating Pearson’s correlation coefficients between the time to complete the AST and the age- and gender-related motor quotients (MQ) of the KTK (Vandorpe et al., 2011)” (Hoeboer et al., 2017, p. 3).

- **Convergent Validity** was investigated by Burns, Hannon, Allen, and Brusseau (2014), the purpose of the study “was to assess the convergent validity and relative accuracy in predicted VO2MAX between the 1MRW and various PACER models including a Linear PACER model, a Quadratic PACER model, and the Mile-PEQ” (pp. 5–6). Results were similar among the Linear, Quadratic, and Mile-PEQ, indicating good predictive accuracy.

- **Construct and Predictive Validity** of Athletic Mental Energy Scale (AMES) was conducted by Lu et al. (2018) who completed six studies that provided evidence for an 18-item scale. Study 1 utilized focus interviews and the framework was examined by seeking feedback from experts in Study 2. Exploratory Factor Analysis was run in Study 3, followed by Confirmatory Factor Analysis in Study 4, as well as concurrent and discriminant validity. Life stress, positive state of mind, and burnout were correlated with the framework on the AMES. Studies 5 and 6 provided further support for the AMES through invariance and predictive validity by utilizing samples from successful and unsuccessful martial artists.

Reliability Concepts

Reliability of a measurement indicates that the measurement is consistent. Consistency may be obtained without validity. One may use a specific measurement to assess quality of movements and consistently be obtaining the same results; however, in reality, the measurement is found to be assessing the frequency of the movements. This is why we discussed validity before introducing reliability; having validity is imperative. You cannot have validity without reliability; however, you can have reliability without validity.

Consistency is the key word with reliability, as well as objectivity. Reliability is often used interchangeably with objectivity; both refer to consistency. We differentiate the terms in the text. Reliability is consistency of the measurement itself; objectivity is consistency of the way in which the measurement is administered. Reliability can be understood better if you think about it in terms of the following: (1) consistency within itself; (2) consistency over time (stability); and (3) consistency of equivalence of the test itself, as well as administrators, which leads us right into objectivity. The areas of reliability are further depicted in Figure 10.3, which illustrates the breakdown of reliability and objectivity.
Similar to validity, support for reliability is done through calculating correlation coefficients. Again, correlation allows you to examine the relationship between two measured variables. In most cases, the two measured variables in reliability are within the test itself; thus, when you correlate them they should be related to each other. A stronger relationship means the test has a higher reliability, as well as consistency. Various factors may play a role in why a lower correlation coefficient, or in this case reliability coefficient, may be acceptable.

Nevertheless, there are reliability cutoff values, which are shown in Table 10.2. The table illustrates the values of the reliability coefficient that are considered excellent, good, fair, and unacceptable levels of reliability. In addition to factors that may affect reliability coefficients, different methods of reliability are appropriate to different types of tests and measurements.

**Pulse Check**

What is reliability?

![Figure 10.3 Reliability Flowchart](image)

**Table 10.2 Interpreting Reliability Coefficients**

<table>
<thead>
<tr>
<th>Coefficient Range</th>
<th>Interpretation</th>
</tr>
</thead>
<tbody>
<tr>
<td>.90 and above</td>
<td>Excellent</td>
</tr>
<tr>
<td>.80 to .89</td>
<td>Good</td>
</tr>
<tr>
<td>.70 to .79</td>
<td>Fair</td>
</tr>
<tr>
<td>.60 and below</td>
<td>Unacceptable</td>
</tr>
</tbody>
</table>
Alpha Reliability

The first area of reliability is consistency within itself. Within this area, we are going to focus on alpha reliability, which refers to internal consistency among items or elements of the test or measurement. Typically, evidence of alpha reliability is provided for questionnaires. Because we used an example of an extrinsic motivation questionnaire with CFA, we would take those confirmed items on the extrinsic motivation factor and correlate each item with the other extrinsic motivation items. If you look at the reliability coefficients in Table 10.3 for the five items on the extrinsic factor, what might be an appropriate conclusion? Do these items illustrate unidimensionality? Because these items are assessing the same factor, each item should be similar to that dimension or factor. One alpha reliability coefficient for each category or factor would be calculated and compared against the cutoff values in Table 10.2. For our purposes, we would like you to understand the concept of alpha reliability and how it is used in your area of interest, and not be so concerned with how to calculate the coefficients.

<table>
<thead>
<tr>
<th>Item 1</th>
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<th>Item 3</th>
<th>Item 4</th>
<th>Item 5</th>
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<td>Item 2</td>
<td>*</td>
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<tr>
<td>Item 3</td>
<td>*</td>
<td></td>
<td></td>
<td>.85</td>
</tr>
</tbody>
</table>

Test-Retest Reliability

The second area of reliability is consistency or stability of the test or measurement over time. Test-retest reliability is one of the most popular reliability measures that involve administering the test one day and then administering the test again on another day. Ideally, the same test administrator is used, as well as the same participants. Having continuity increases the control and reduces extraneous variables that could explain the results. In addition, depending on the nature of the variable, a minimum of four weeks between administrations is recommended. The scores taken on the first administration (X variable) are correlated with the scores on the second administration (Y variable). Correlating the results from the same test or measurement should be related. In a perfect situation, the scores from both would be extremely similar, if not the same. You may think, of course you will find a relationship; however, some factors may playa role in physical tests, such as maturation. Recall, in Chapter 2 when we discussed internal validity threats, we discussed the concept of maturation. Maturation refers to changes that may occur because of time passing. Some examples of maturation may include motor development, psychological development, and even hunger or fatigue. In knowledge tests or sometimes even physical pretests, a learning effect occurs and affects the interpretation of the test-retest reliability coefficient.
Parallel Forms Reliability

The last area of reliability is consistency of equivalent tests. Generally speaking, research that involves pre and post testing with different versions of the pretest and posttest would use parallel forms or alternative forms. Within quality research, you want the posttest results to be higher or better to illustrate that the intervention or program was successful. Results should be attributed to the intervention or program and not to the test itself. This is also seen in the physical domain, when pretest and posttests are given. Because participants have already been exposed to the test at pretest, this may influence their results on the posttest. Thus, forms are developed that can be used interchangeably, and results can be attributed to the validity of the measurement, as opposed to the test itself. If you refer back to Chapter 2, these concepts are related to internal validity threats.

PULSE CHECK

What is test-retest reliability?

Parallel Forms Reliability

Involves examining alternative forms of the tests that are similar in content, difficulty, and ability to discriminate groups to illustrate consistency of comparable tests.

PULSE CHECK

When might parallel forms reliability be utilized to illustrate consistency?

The same advice we gave regarding validity applies to reliability, that is, not all measures of reliability are necessary or appropriate for your variables. Also, your reliability coefficient may not meet the “excellent” or “good” cutoff values according to Table 10.2. Many factors influence reliability coefficients, which should be taken into account when you are looking at your proposed research variables. First, you should ask, what are you measuring? As mentioned, the type of research variable warrants different types of reliability. For example, providing alpha reliability on a physical test is not appropriate; whereas, calculating an alpha reliability coefficient for the items on a motivational scale would be beneficial. Additionally, laboratory research should have higher reliability; whereas, survey research or any research design using an affective measurement will typically have lower reliability, and this should be taken into account when determining the quality of the test and measurement.

Reviewing the data collection process for obtaining results is essential in influencing the interpretation of reliability. The sample tested and its characteristics play a role in the data that are collected. Children and beginners will have lower levels of reliability because of varying maturation and knowledge, skill, and ability acquisition levels from one test to another test. For example, some students may have physically developed more than the other students, and therefore the correlational results do not meet “excellent” or “good” cutoff values. For examples of reliability evidence among published tests and measurements, please see Research to Practice: Examples of Tests with Cited Reliability Measurements.
Objectivity Concepts

Objectivity refers to the consistency of test administrator during data collection. Consistency is the common aspect among reliability and objectivity. As mentioned, we differentiate the terms to emphasize the fact that reliability focuses on the test and measurement itself; whereas, objectivity is the data collection process of the test and measurement. As illustrated in Figure 10.3, objectivity can be broken down into two areas: (1) consistency over time (stability) and (2) consistency of equivalence among administrators.

Intra-rater Objectivity

The first area of objectivity is consistency of test administrator over time. Stability with yourself should be established, which is known as test administrator reliability, intra-rater reliability, or intra-rater objectivity. Maintaining a level of uniformity among administration or scoring is imperative for quality research. Results of the participants

PULSE CHECK

What is the difference between reliability and objectivity?

Calculating correlation coefficients allows you to examine the relationship between an administrator (X variable) and either the same administrator or another administrator (Y variable). If both are assessing the same thing, then the results should be related to each other. A stronger relationship means higher objectivity and the test administrators maintain consistency. Depending on the area of objectivity, stability or equivalency, different methods of objectivity are calculated among the tests and measurements.
should be attributed to their performance, not to your presence. For example, when administering a physical test, will there be encouraging words given or corrective feedback? One group may score significantly higher if you provide them with encouragement as opposed to another group who was not provided any encouragement.

**PULSE CHECK**

What is intra-rater objectivity?

**Inter-rater Objectivity**

The second area of objectivity is consistency of equivalent test administrators. Equivalency between others is critical for providing quality research results. The presence of one administrator over another should not influence the results or the performance of participants. If the same physical test was being administered to a group of cardiac rehabilitation patients, the presence of either therapist should not influence the results of the cardiovascular testing.

**PULSE CHECK**

What is inter-rater objectivity?

Whether only one administrator or multiple test administrators are used, objectivity must be taken into account, and measures should be in place to ensure consistency. For some points to ponder, see the Tip: Increasing Objectivity.

**TIP: INCREASING OBJECTIVITY**

Here are some points to keep in mind during the data collection process:

- Know the test and prepare yourself, as well as your participants.
- Develop test procedures:
  - Decide whether you are able to test individually or as a group.
  - Decide who will be the tester(s).
  - Decide the order of testing procedures to minimize fatigue.
  - Identify scoring requirements and develop a scoring sheet or sheet.
  - Decide what you will do if a participant makes a mistake (for example, curl-up with incorrect form).
- Decide how motivation and feedback will be given.
  - Develop directions that are easy to understand, and specify: administration, instructions, scoring and policy on incorrect performance, hints/techniques to improve scores.
  - Prepare participants by telling them in advance what the test involves; allow practice; explain techniques that will improve scores; make sure participants know pretest procedures (for example, type clothing, substances to avoid before testing, medical instructions).
SUMMARY

In summary, validity, reliability, and objectivity must be taken into consideration when determining how you will operationalize your research variables. How will you measure your research variables? How valid and reliable are these measures for your level of participants? These are some of the questions we started with, and we hope you see the importance of needing to appropriately answer them to produce quality research results. You must have validity among your research variables. You need to start with validity to ensure that you are measuring what you purport to measure. You cannot have validity without reliability, yet you can have reliability without validity. If your operational definition is an established test or measurement, please research the psychometric properties to determine whether there has been at least one validity measurement and one reliability measurement noted. Quality research is needed; otherwise, others will question the results and cannot apply your findings to practitioners.

You do not need to use all types of validity and reliability that were discussed in this chapter to show evidence for tests and measurements. Different factors need to be taken into account to determine the appropriateness of which validity or reliability type you may use. If you need to review the validity and reliability concepts or want more examples, we suggest you look to the online resources. In addition to the Research to Practice examples in this chapter, we recommend reviewing the Further Readings and Resources available to you online. The research journal articles can provide additional examples to connect the sometimes difficult and abstract concepts into practice. Examples always assist with understanding concepts. If the articles provided are not in your area of interest, we encourage you to find one yourself! Before you move ahead to analyzing data, please make sure you are comfortable with the concepts of validity, reliability, and objectivity.

Applying What You Learned

1. Provide your own research to practice example in your area of interest where an expert review process would be utilized to validate a questionnaire or survey and indicate the panel of experts.
2. Provide another research to practice example that illustrates the use of convergent and divergent validity in your areas of interest.
3. Illustrate how an assessment might have good reliability, yet unacceptable validity.
4. Provide examples to illustrate the difference between intra-rater and inter-rater objectivity.

Key Terms

Alpha Reliability
Concurrent Validity
Construct-Related Validity
Content-Related Validity
Convergent Validity
Criterion-Related Validity
Discriminant Validity
Face (or Logical) Validity
Intra-Rater Objectivity
Inter-Rater Objectivity
Logical Validity
Objectivity
Parallel Forms Reliability
Predictive Validity
Previously Validated Test Validity
Reliability
Subjective Rating Validity
Test-Retest Reliability
Validity

**References**


In Chapter 10, we presented concepts relating to validity and reliability to allow you to further explore and understand your research variables. In addition, we covered objectivity, to prepare you for data collection. These concepts are essential, especially when you are selecting a test to use to collect data, as well as when you begin data collection. Remember, research is a careful, systematic approach to problem solving. Selecting the correct test and ensuring validity and reliability evidence is crucial to the success of your data. Additionally, objectivity is important. When you collect data, you want to ensure that you as the researcher and others collecting data are consistent. An old saying from our statistics professor was “Garbage in, garbage out.” Careful consideration of validity, reliability, and objectivity will help eliminate any of the “garbage.” Recall Chapter 9, which discussed sampling, writing your substantive hypothesis, and presenting information on how to develop your methods. In this section, we highlighted defining your terms and identifying your variables, such as independent variables, dependent variables, or predictor and criterion variables. You will find that if you can understand the type of variables you have, the easier it will be to understand the kind of data analysis you will run.

This chapter will introduce you to basic statistics and hypothesis testing. We will present how to prepare your data for analysis and, based on your statement of the problem, how you will analyze your data. More specifically, we will cover levels of data, distributions of data, descriptive statistics, and hypothesis testing.
Introduction to Statistics

Now that you have collected data from a sample that was taken from your target population, you can now run various statistical analyses, which is the sixth step in the scientific method. To move to the next step of formulating findings and conclusions, you will need to analyze your data to make sense and meaning of your results. Before we start, we would like to emphasis a few points. Because this is not a statistics textbook, we are introducing important concepts and different types of statistics that are common in health and human performance. We understand that you may or may not have taken a statistics course, and we provide some statistical resources in the Tip: Statistical Resources that may be helpful to you during this process. Additionally, because this is probably your first exposure to the research process, we want to keep it simple and have you embrace the idea of conducting research. We are trying to practice our own advice of the KISS-LL principle: Keep It Simple and Short, but also Likeable and Learnable! If you choose to continue onto graduate school, you will take additional research courses, as well as a course or courses in statistics. Thus, our goal is to expose you to the basic concepts so you have a solid foundation for understanding more complex research and statistics.

TIP: STATISTICAL RESOURCES


Even if you find significance in your statistical analysis, the important part is your judgment and evaluation of those results. Without underscoring the importance of statistics, there is always a chance for error in research, which we will expand on with the discussion of Type I and Type II errors. We want to focus on the “so what” factor of your results and evaluating the results of the statistical analyses, as well as the overall research design.

Statistical Terms

Before we can jump right into running statistical analyses, a few concepts must be introduced. Understanding concepts, such as populations and samples, the difference between descriptive and inferential statistics, as well as the levels of data for each of our research variables will allow you to appropriately choose your statistical analysis and assist with interpreting your results.
**Introduction to Statistics**

Inferential statistics allow you to use the sample data to make conclusions about the population. Although we will be focusing on inferential statistics in Chapter 12, we wanted to introduce this type of statistic.

Ensuring that the target population has been appropriately identified is only the first step in conducting quality research. The more challenging aspect is to properly sample from this target population. Again, from Chapter 9 we encouraged using random sampling when feasible.

Some of the ways in which random sampling can occur include (1) simple random sampling and assignment; (2) stratified random sampling; or (3) cluster sampling. Nonrandom sampling includes (1) convenience samples; (2) intact groups; (3) systematic samples; or (4) volunteer samples.

Because you are trying to generalize your results to the target population from your sample, you want to ensure that your sample is a good representation of the population. One way of examining the characteristics of the sample and determining whether the sample is a good representation is looking at the distribution of the scores from the sample. This is discussed later when normal distributions are examined to see whether the sample is a good representation of the population or whether the sample is skewed and does not appropriately reflect the target population.

**Populations and Samples**

The term statistics itself comes from the word sample. This makes sense in that we are calculating statistics based on data we collected from our sample. When we discussed sampling in Chapter 9, we gave the example of sampling all Division III student-athletes. Although it would be ideal to collect data from the entire population, it is not realistic. Thus, we sample from this target population that we have identified as appropriate to the research design.

**Descriptive and Inferential Statistics**

The two types of statistics are important to recognize and include descriptive and inferential statistics. Descriptive statistics are computed to address our question: Is your sample a good representation of the population?

Descriptive statistics do not attempt to make any interpretations of or conclusions about the target population. Statistics are computed for understanding the sample only and include measures of central tendency, measures of variability, and standard scores. Tables and graphs are also used to summarize the sample data and better understand the characteristics and features of those sampled. Descriptive statistics are computed first not only to determine whether the sample is a good representation of the population, but also to determine the appropriate inferential statistic to calculate based on the sample characteristics.

**Pulse Check**

What are descriptive statistics?

Inferential statistics allow you to use the sample data to make conclusions about the population. Although we will be focusing on inferential statistics in Chapter 12, we wanted to introduce this type of statistic.

Inferential statistics are calculated to address your statement of the problem and answer your hypothesis. Various types of inferential statistics can be calculated to answer your hypothesis, many of which are beyond the scope of this textbook. As we mentioned, we will be introducing statistical analyses that will allow you to have a solid foundation for understanding more complex statistics. Just like research designs, statistics can get complicated quickly.
PULSE CHECK

What are inferential statistics?

**Levels of Data**

Because inferential statistics is based on and aligned with your statement of the problem (SOP), you must make sure you understand the characteristics of your research variables. The SOP is a statement that identifies the purpose of your study.

From your SOP, you identified your research variables and then how those will be measured in your research study. The way in which you defined the variables is known as your operational definition.

We used the example of perceived motivational climate as being measured by the Perceived Motivational Climate in Sport Questionnaire-2 (PMCSQ-2; Newton, Duda, & Yin, 2000). Now we need to look a little more into our operational definitions and identify the level of data.

The type or level of data that is produced is important to understand so the appropriate statistical analysis will be done on the data collected. In Chapter 2, we introduced the terms categorical and continuous data.

Categorical data is also known as nominal data. With continuous data, there is no set category that an individual would respond to. A range of scores known as ordinal, interval, or ratio data is produced.

Table 11.1 provides an overview of the four levels of data, nominal, ordinal, interval, and ratio, as well as examples of each.

The four levels of data build on each other. As you can see from the data, all levels classify the data; the second level not only classifies the data but also puts the data in order. The third level has equal distance between the order, and the last level has a meaningful zero point. Nominal data are typically used for collecting demographic information for purposes of putting participants into classifications or categories.

Nominal data also can be used when the data that are collected require a yes, no, or maybe response scale. Such examples of having nominal data within the research design as part of your question will require a chi-square analysis to be run, which is discussed in Chapter 12.

<table>
<thead>
<tr>
<th><strong>Table 11.1</strong> Levels of Data</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Level of Data</strong></td>
</tr>
<tr>
<td>Nominal</td>
</tr>
<tr>
<td>Ordinal</td>
</tr>
<tr>
<td>Interval</td>
</tr>
<tr>
<td>Ratio</td>
</tr>
</tbody>
</table>
Interval and ratio data are very similar; the only distinction between them is whether a zero point or a zero score is meaningful. Both have equal or equivalent distances between the data points. The difference between a score of 1 and 2 would be equivalent to the difference between a score of 6 and 7. A better example is using the time on a clock; the number of seconds between each minute is the same around the clock.

The key characteristic of ratio data is whether a zero point or zero score is meaningful; can you be in the absence of the data? If yes, then this is ratio data. A perfect example is temperature, which has a zero; however, we can never be in the absence of temperature. Thus, temperature is considered interval data. Interval and ratio data use the same inferential statistics, which will be discussed in Chapter 12.

Normal Distribution
As we mentioned, descriptive statistics are used to determine whether your sample is a good representation of the population. Before we can continue to discuss how to calculate descriptive statistics, we need to understand what we mean by representing the population. Collecting data from the whole population is ideal but not realistic. Why is it ideal? Having data from the whole population would allow us to have a normal
distribution of scores; thus, we want to collect sample data that are also normally distributed. The closer the sample data are to the target population, the more appropriate our conclusions, as well as our ability to generalize results is greatly improved.

**Characteristics of Normal Distributions**

What is a normal distribution? If you were to plot all scores from the population, it would approach a bell curve; see Figure 11.1. The X axis is the scores, and the Y axis is the frequency of the scores. As you see in the middle, all three measures of central tendency, mean, median, and mode, are the same. The mean is the average of all the scores; the median is the middle point of the scores; and the mode is the most frequent score. The fact that all three measures of central tendency are the same is another characteristic of a normal distribution. The median is a location point in which 50 percent of the scores are to the left and the remaining 50 percent are to the right. Having the same percentage of scores on either side of the curve is one of the characteristics of a normal distribution, a symmetrical distribution of scores. Because the mode is the most frequent score, you can see from the figure why the mode is also in the middle, because it is the highest point of the normal curve. The characteristics of a normal distribution are summarized in the following list. Remember that the characteristics of a normal curve are ideal. Your mean, median, and mode might not be exactly the same; however, if the three values are extremely different, this is not a normal distribution; it is a skewed distribution.

**Characteristics of a Normal Distribution**

1. Normal curve is in the shape of a bell curve.
2. Mean, median, and mode are the same.

![Figure 11.1 Normal Curve](image-url)
3. Symmetrical distribution of scores; 50 percent of the scores are to the left and the remaining 50 percent are to the right.
4. Greatest number of scores will be in the middle, the highest point of the bell curve.

**PULSE CHECK**

What are the characteristics of a normal curve?

---

**Examining Skewed Distributions**

Having a skewed distribution needs to be taken into account before you calculate any inferential statistics, as well as when you are interpreting your results. Many different types of inferential statistics are available, and many of the more common parametric statistics assume that you have a normal distribution. Comparable non-parametric statistics assumes that you have either ordinal data or a skewed distribution. More discussion on parametric and nonparametric inferential statistics will be presented in Chapter 12. Nevertheless, different types of skewed distributions are possible, depending on where and how your scores are distributed. In a normal distribution and skewed distributions, the median will always be in the middle. The median is a location point and will cut the distribution in half regardless of the values of the scores. Thus, what happens to the mean and mode will determine what type of skewed distribution you have, a positively skewed or a negatively skewed distribution of scores. When most of your scores (mode) fall to the left of the median, your mean will be pulled toward the right by the extreme scores or outliers. This is an example of a distribution that is positively skewed, which can be seen on the left side of Figure 11.2. The highest point of the curve is to the left, which represents the most frequent score or mode.

---

**Figure 11.2 Skewed Distributions**

![Positively Skewed Distribution](image1.png)  
![Negatively Skewed Distribution](image2.png)
When most of your scores fall to the right of the median, this will result in the distribution being negatively skewed. The mode will be to the right and the mean will be pulled toward the left by the extreme scores or outliers. This is illustrated on the right side of Figure 11.2. The mean is the average of the scores, which is found by taking the sum of all scores and dividing it by the number in the sample. The means in both positively and negatively skewed distributions are pulled toward the tail of the curve. Because the mean takes into account the actual values of the scores, it is most affected by extreme scores or outliers. It is natural to have extreme scores, but when more are sampled, those extreme scores do not affect the results as significantly. The more you sample, the closer your distribution of scores will be to the population. Thus, your sample becomes a good representation of the population.

**PULSE CHECK**

How would you describe a positively skewed curve?

How would you describe a negatively skewed curve?

**Examining z Distributions**

The distribution of scores in your sample is dependent on how you pick your sample from the target population and also the sample size; however, how the sample performs or what data you collect has an element of chance. This is where measures of variability are examined from the descriptive statistics calculated and should be taken into account when interpreting your results. Another aspect of the normal distribution is the fact that it is based on the $z$ distribution of scores. Notice in Figure 11.3 that the normal curve is divided by plus or minus units of standard deviation from the mean. The area or percentage of scores between each of those standard deviation units from the mean are determined based on the $z$ table, thus the $z$ distribution.

**Figure 11.3** Normal Curve with Standard Deviation Units
If you were to look on a $z$ table with the normal curve areas, the percentage of scores that fall between the mean and one standard deviation unit, you would find that a $z$-score of 1.00 is equivalent to 34.13 percent. Thus, approximately 68 percent (68.26%) of the scores will fall between plus or minus one standard deviation from the mean. This allows you to describe your research variable being examined and indicate reference points as to how often a range of scores will occur. You can also go plus or minus two standard deviations from the mean and approximately 95 percent (95.44%) of the scores will be between those score points. This is based on a $z$-score of 2.00, which is equivalent to 47.72 percent. Plus or minus three standard deviations from the mean and approximately 99 percent (99.74%) of the scores will be between those score points. This is based on a $z$-score of 3.00, which is equivalent to 49.87 percent.

**PULSE CHECK**
What percentage of scores would fall between $+1$ standard deviation from the mean?

**Examining Kurtosis**
As we mentioned, how the sample performs or what data you collect has an element of chance. Having the ability to say that 68 percent of the scores fall between a score of 20 and 40 or 95 percent of the scores fall between 10 and 50 provides a reference point and helps describe the sample data. Normal distributions have a bell-shaped curve. This refers to the skewness of the curve, but you should also examine the “peakedness” of the curve. The statistical term for “peakedness” is kurtosis. Instead of a nice bell-shaped curve, your curve may be flatter and spread out or it may be steep and clumped together. As you can see on the left side of Figure 11.4, the scores have a greater distribution that flattens out the curve, which is known as platykurtic. On the right side of Figure 11.4, most of the scores are similar, and there is not much variability, causing the curve to spike, which is known as leptokurtic. This is another way to determine whether your sample is a good representation of the population. You want to have a lower kurtosis score to indicate that you meet the basic assumption of a normal distribution. If your kurtosis score is high, you may want to look to see whether extreme scores or outliers may affect the results of your study. For more information on examining and calculating kurtosis scores, please refer to the cited statistical resources in the Tip earlier in this chapter, as well as look at the online resources for the text.

**PULSE CHECK**
What is happening to the scores of a platykurtic curve?

**PULSE CHECK**
What is happening to the scores of a leptokurtic curve?
Kurtosis

Figure 11.4 Platykurtic and Leptokurtic Curves

Meeting the basic assumption of having a normal distribution is only one basic assumption; however, it is one that should be examined before any statistical analyses are run. There is a direct relationship to how you choose your sample, as well as how many you sample. Whenever feasible, a form of random sampling should be used, and having an appropriate sample size will enhance the quality of your research, which improves internal validity. Having a normal distribution will also affect what inferential statistic is used. More importantly, a normal distribution is a better reflection of the target population and allows you to generalize your results, improving external validity. Let us look more into how you calculate descriptive statistics.

Descriptive Statistics

Descriptive statistics are computed to be able to better describe and get a picture of your sample you collected in your research study. Tables and graphs are used to visually see the distribution of scores within our sample. Simple or grouped frequency distributions, pie charts, bar graphs, and histograms are some examples of using tables and graphs to visually see the distribution of scores. Further discussion of creating and interpreting tables and graphs is provided in the online resources for the text. Additionally, measures of central tendency, measures of variability, and standard scores are computed to summarize sample data. Such statistics allows us to see the distribution of our scores. In the population, we assume a normal distribution of scores if all data were collected. Thus, we want to determine whether our distribution of scores is also normally distributed, or is it skewed?

Measures of Central Tendency

Using measures of central tendency allows you to see the similarities within the sample. The three measures of central tendency include the mean, median, and mode. The
Mean is the average of all the scores; the median is the middle point of the scores; and the mode is the most frequently occurring score.

**Mean**
The mean is commonly known as the average score among the data. The mean is represented by an X with a bar over the top. It is calculated by the summing up all the scores and dividing by the number in the sample. As you see in the formula in Figure 11.5, the sum of the scores is represented by the Greek symbol (Σ), and the X represents the raw data. The bottom of the formula is the total number in the sample, which is represented by N. Because the mean take into account the actual values of the raw data, it is most affected by extreme scores or outliers. The mean will be pulled toward the tail of the curve in plotting the distribution of your scores. Thus, the mean is most appropriate to report when you have a normal distribution.

**Median**
Because the median is the middle point of the scores, it is a location point in which half the scores are to the left and half are to the right. Regardless of the type of distribution, the median will remain the same and not be affected by extreme scores or outliers. This is evident by how the median is found, which is presented in Figure 11.6. We present not only the formula, but also an example. The first step in calculating is to list the raw data from the best score to the worst score. The second step is to use the formula to find the location of the median. The formula gives where the location of the median exists and not the median value itself. Once you find the placement of the median, the third step is to find the median itself. If the median location point is a whole number, then the median value is that data point; however, similar to the example, if the median location point is between two numbers, then find the mean of those two numbers, and that is your median.

**Mode**
The mode is the most frequently occurring score and typically does not warrant too much discussion. We would like to point out how the mode relates to the normal curve. Additionally, we would like to note the possibility of having multiple modes.

\[
\bar{X} = \frac{\Sigma X}{N}
\]

*Figure 11.5  Mean*
Introduction to Statistics and Hypothesis Testing

$$Mdn = (N+1)/2$$

Example with \( N = 10 \)

\[
\begin{align*}
32 & \quad \text{Example with } N = 10 \\
30 & \\
26 & \quad (10+1)/2 = 11/2 = 5.5 \\
24 & \\
21 & \\
19 & \quad \text{5th score} = 19 \\
18 & \\
17 & \quad \text{6th score} = 21 \\
16 & \\
11 & 
\end{align*}
\]

$20 = Mdn$

Figure 11.6 Median

First, there is no formula for the mode, other than the fact that it is the most frequent score point or points. If you were to plot the scores from your sample, the X axis would be the score points, and the Y axis would be frequency of those score points. Thus, when looking at a plotted distribution, the highest point of the curve will be the mode. Where the mode is located will help determine the type of distribution. If it is in the middle, toward the median, this is a normal distribution. A mode toward the left of the median is positively skewed, whereas a mode toward the right of the median is negatively skewed. Additionally, you may ask, what if I have more than one mode? This will probably indicate that you do not have a normal distribution and have a bimodal or multimodal curve. A bimodal curve has two high peaks; a multimodal curve has more than two peaks.

Pulse Check

What are the three measures of central tendency?

Measures of Variability

Using measures of variability allows you to see the amount of deviation within the sample. The measures of variability include the range, standard deviation, and quartile deviation.
Range

The range does not provide too much information, other than giving a reference point for interpreting the data. This is especially true when the scoring of the research variable is not common or is unknown to most readers.

Often, the possible range of scores is provided along with the range of the sample. The possible range of scores would be determined in the same way, the highest possible score minus the lowest possible score. See Figure 11.7 for the formula.

STANDARD DEVIATION

Standard deviation and quartile deviation have the same principle behind the definitions. Both reflect the degree of how the scores deviate from either the mean or the median.

This is assuming you have a normal distribution. If you think back to a positively or negatively skewed distribution, the mean was pulled toward the tail of the curve; thus, reporting the standard deviation may inappropriately reflect the distribution of the sample. As a result, the basic assumption is to report the standard deviation when there is a normal distribution and the research variables are interval or ratio data.

Calculating the standard deviation can be done by using two different types of formulas; see Figure 11.8. The first formula is known as the definitional formula, because you calculate the standard deviation by taking each score minus the mean; how each score deviates from the mean \((X – \bar{X})\). After you find each deviation, you square each and then find the sum \((\sum X^2)\). The second formula is the computational formula, which uses the sum of the raw data \((\sum X)\), the squared value of that sum \((\sum X^2)\), as well as the sum of each raw data point squared individually \((\sum X^2)\).

PULSE CHECK

How do you define standard deviation?

QUARTILE DEVIATION

Quartile deviation is very similar to standard deviation, yet it examines the amount of deviation surrounding the median. More specifically, quartile deviation takes the middle 50 percent of the scores and divides it in half; taking half of the interquartile range.

Quartile deviation is not commonly reported, yet it is appropriate for skewed distributions or when the level of data is ordinal.

Range

Range = highest score – lowest score

Figure 11.7 Range
Standard Deviation

\[ s = \sqrt{\frac{\sum (X-\bar{X})^2}{(N-1)}} \]

\[ s = \sqrt{\frac{\sum X^2 - ((\sum X)^2/N)}{(N - 1)}} \]

Figure 11.8 Standard Deviation

**Standard Scores**

Using standard scores allows you to transform scores and examine sample data. This may be necessary to have a reference point when you are comparing research variables that have different units of measurement. This is also commonly used with norm-referenced assessments that you may be using to measure your research variable.

Standard scores typically include transforming data into percentile ranks, z-scores, and T scores. A common example is looking at a fitness battery of tests, such as mile run, sit-ups, push-ups, and sit-and-reach scores that all result in a different type of score. You would then transform each test score into a standard score and compare the different tests. You would then be able to compare apples to apples rather than apples to oranges.

**Hypothesis Testing**

Now that you have a better understanding of descriptive statistics to describe your sample data, you are ready to start to calculate inferential statistics. Inferential statistics attempt to draw conclusions to the target population based on the data that were collected from the sample. Before you begin the process of learning, calculating, and interpreting inferential statistics, we want to cover hypothesis testing. Hypothesis testing becomes your statistical decision-making process. This will not tell you the importance of your results; you are the judge of the importance, and you need to interpret your results in light of your research design. There is always a chance of a Type I error or Type II error, even if you find significance; these terms will be discussed in more detail in the next chapter.
detail. As a result, the important part is to take statistical results into consideration along with your judgments. The following list presents the steps in hypothesis testing that will be covered. Some of the steps have already been covered in Chapter 9, and some steps will be covered in more detail in Chapter 12. Nevertheless, we want to introduce this process as your statistical decision-making process. Many aspects within hypothesis testing are true for any statistical analysis.

Steps in Hypothesis Testing
1. Identify your statement of the problem
2. Identify your statistical analysis
3. Identify your statistical or null hypothesis
4. Identify your alternative hypotheses
5. Determine your alpha level
6. Collect your data
7. Draw a normal curve (not essential when statistical analysis is run through computer software)
8. Determine table critical values (not essential when statistical analysis is run through computer software)
9. Run statistical analysis
10. Plot your results on the normal curve and determine results

The statement of the problem and determining statistical analysis was determined when you developed your Methods section (Chapter 9). The way in which you describe and write your statement of the problem will determine what the appropriate statistical analysis is for your research study. Although we will discuss more the specific statistical analyses in Chapter 12, this is related to your research design. We will use examples from a correlation research design and experimental research design.

Null Hypothesis
The next step, identifying the statistical or null hypothesis, is similar yet different from the substantive hypothesis. The substantive hypothesis indicates what you think will occur in your study; the null hypothesis tests against this and therefore indicates that there will be no significance. In statistics, you test against the null hypothesis.

The null hypothesis, which is represented by $H_0$, is assumed to be true until you find significance between the expected data and actual data. If the null hypothesis is true, you say that you accept the null hypothesis, which indicates that there is no statistical significance. Finding statistical significance will be discussed in more detail, but first alternative hypotheses need to be discussed.

PULSE CHECK
What is a null hypothesis?

ALTERNATIVE HYPOTHESES
Once you identify the null hypothesis, alternative hypotheses can be determined based on the statistical analysis. In most cases, there will be two alternative hypotheses, because the direction of the significance is not known. This is known as a two-tailed approach, which we can see from the normal curve in Figure 11.9.
Figure 11.9 Two-Tailed Approach

Alternative hypotheses are represented by $H_{a_1}$ and $H_{a_2}$. This is where the significance lies, you would say that the null hypothesis was rejected. Typically, in statistics you do not say that you accept the alternative hypothesis; because you are testing against the null hypothesis, you say you reject the null hypothesis, which indicates that there is statistical significance.

Examining Alpha Levels and Determining Significance

The next step in hypothesis testing is to determine the alpha levels, which include the significance levels. Alpha levels are p values or probability. The most common alpha level is .05. What does this all mean? A p value of .05 indicates that when you are conducting research and you find significance, there is still a 5 percent probability that those results were by chance. So, 5 out of 100 times your results are by chance.

Alpha levels are also described as the boundaries for the critical areas of the null hypothesis (Gravetter & Wallnau, 2017). This is further discussed and illustrated in Figure 11.10.

As mentioned, the most common and accepted alpha level is .05; however, the type of research you are conducting may influence the alpha level. The smaller the alpha level, the lower the probability that the results were by chance. When conducting basic research, you may want to have more stringent standards and will typically use a .01 alpha level. This type of research would be in a more laboratory setting, where more controls are used and the results are not left to as much chance. In basic research, researchers prefer to allow less risk when determining significance. The difference between an alpha level of .05 and .01 is illustrated in Figure 11.10. The area in the middle is the area of acceptance. This is where the null hypothesis would be accepted, and no significance would be found. The two areas on the outside are the areas of rejection. These are the alternative hypotheses and where significance is found. As you can see, the area of acceptance is larger and finding significance is harder when using the .01 alpha level, but remember that means a lower probability that your results were by chance. Determining your alpha level is typically based on the nature of your research, but also how much risk you are willing to take that significant results occurred by chance.
Hypothesis Testing

Examining .05 Alpha Level  
2.5%  
95%  
2.5%

Examining .01 Alpha Level  
.5%  
99%  
.5%

Figure 11.10 Examining Alpha Levels

PULSE CHECK

What are alpha levels?

How you will know whether your results fall into the area of acceptance or area of rejection? A few things need to occur, one of which is to collect your data. Once you collect your data, you will know your exact sample size, and you will be able to run your statistical analysis. You can draw out a normal curve, similar to that in Figure 11.9. The two lines that separate the areas of acceptance and rejection are based on the alpha level, as well as the size of your sample. Based on these two aspects, you can determine what these cutoff values are, which are referred to as table critical values. Before you run any statistical analysis, you will want to determine the areas of acceptance and rejection.

Once you run the statistical analysis, you can then plot your calculated statistic. You base where you plot your calculated statistic according to the table critical values. If your calculated statistic falls between the two table critical values, then you will accept the null hypothesis as true, and there is no significance. If the statistic falls outside of the two table critical values, there is significance, and the null hypothesis would be rejected. The different alternative hypotheses illustrate the type or direction of the significance. For example, in a correlation research design, if the statistic falls to the right, this would be a significant positive relationship among the variables; if the statistic is to the left, you would have a significant negative relationship. Falling to the left or right in experimental research designs relates to which group was higher or performed better. More detailed examples for each are presented in Chapter 12.

Despite finding or not finding statistical significance, there is always room for error within the research process. In previous chapters, this was referred to as threats to internal validity. In statistics, the terms that warrant further discussion include Type I and Type II errors. If you reject the null hypothesis, there is chance you made a Type I error; however, if you accept the null hypothesis, there is a chance you made a Type II error.

Type I and II errors are directly related to your alpha level. Alpha levels are determined ahead of time to minimize Type I errors. Gravetter and Wallnau (2017) best
describe the connection between alpha levels and Type I errors in this way: “When there is no treatment effect, an alpha level of 0.05 means that there is still a 5 percent risk, or a 1-in-20 probability, of rejecting the null hypothesis and committing a Type I error. Because the consequences of a Type I error can be relatively serious, many individual researchers and many scientific publications prefer to use a more conservative alpha level such as 0.01 or 0.001 to reduce the risk that a false report is published and becomes part of the scientific literature” (pp. 201–202).

Type I and II errors are discussed also in Chapter 12. Additionally, a discussion of determining statistical significance using computer software programs will be presented. You do not have to always draw out a normal curve and determine the table critical values. Running statistical analyses through statistical software programs, such as SPSS, can provide the necessary information to determine significance. On statistical outputs, there is typically a column for the significance level, which is equivalent to the p value. If you think back to the discussion on alpha levels, if this p value is less than 0.05, there is significance. If the value is greater than .05, the results are nonsignificant. If you are using a different alpha level, then you would use that level as the standard. More information will be presented in Chapter 12 when each statistical analysis is covered; however, there is significance when the p value is less than 0.05 and nonsignificance when the value is greater than 0.05.

**SUMMARY**

The term statistics is used when you are reporting numbers about your sample. In most cases, you would sample from a larger or target population to answer your research question. Different sampling procedures exist, including random and nonrandom sampling. Ideally, it is desired to sample randomly; however, this is not always realistic or feasible. Nevertheless, no matter which type of sampling procedure you use, you want to ensure that your sample is a good representation of your target population.

Two types of statistics are important to understand when presenting your research findings, descriptive and inferential statistics. Before you report descriptive or inferential statistics, however, you need to understand your level of data for your research variables. Four levels of data exist, and they build on each other. The levels of data include nominal, ordinal, interval, and ratio. Identifying the level of data of your variables will help you to understand the type of statistical analysis you will use after data collection. In addition to understanding the level of data, being able to identify how your data are distributed is essential. Distributions of data include normal, skewed, and kurtotic distributions. Descriptive statistics are computed to better describe your data, and inferential statistics are used to answer your research questions. Examples of descriptive statistics include measures of central tendency, measures of variability, and standard scores. When using inferential statistics, you need to apply the steps of hypothesis testing to determine the statistical significance.

Now that you have been introduced to the basic concepts of statistics and hypothesis testing, we are now ready to present you with tools to run the analyses for inferential statistics. Here, we will show you how to run the analyses using computer software, as well as by-hand calculations to better understand the statistical concepts. Finally, we will also show you how to properly report your statistical findings and conclusions. These examples will assist you when you run your own analyses and report on your data.
Applying What You Learned

1. Using one of your research journal articles, indicate the descriptive statistics that were utilized and note in what article of the article where they found.
2. Using that same research journal article, indicated the inferential statistics that were utilized in the data analysis.
3. Provide an example of a research variable in your area of interest for each level of data.
4. If the mean was 100, the median was 45, and your mode 25, what is the type of distribution?
5. Describe the steps in hypothesis testing as it relates to your proposed research design and data analysis.

Key Terms

Alternative Hypothesis
Categorical Data
Continuous Data
Descriptive Statistics
Inferential Statistics
Interval Data
Nominal Data
Nonrandom Sampling
Null Hypothesis
Operational Definition
Ordinal Data
Quartile Deviation
Random Sampling
Range
Ratio Data
Standard Deviation
Standard Scores
Statement of the Problem
Target Population
Type I Error
Type II Error

References


WHAT YOU’LL LEARN

- How parametric and nonparametric statistics differ and when it is appropriate to use either parametric or nonparametric approaches
- How to calculate and interpret correlation coefficients \((r)\) using both parametric and nonparametric statistics
- How to calculate various statistics, including \(t\) and \(F\), to determine and explain differences among groups
- How Type I errors differ from Type II errors

In Chapter 11, we introduced statistics and hypothesis testing. This chapter will continue to discuss inferential statistics and will introduce you to the various types of statistical analyses to answer your hypothesis. We will present the difference between parametric and nonparametric statistics, which is related to your level of data and the distributions of data. This chapter will introduce you to some basic types of statistics that are common in health and human performance. We do not go into the detail as a statistics textbook would; please refer to the statistical resources suggested in Chapter 11. We want you to be able to understand and interpret analyses so that you can interpret the findings of your research. This will provide you with a solid foundation for understanding more complex research and statistics. Examples are presented to assist with enhancing your learning, and we encourage you to also look at the online resources available for the text.

**Inferential Statistics**

Inferential statistics are calculated to be able to make conclusions based on the sample to the target population. Up until this point, the focus has been on understanding the sample and not on making any inferences back to the population. Calculating inferential statistics will now allow you to make conclusions back to the population, but more importantly will provide insight into the research question and hypothesis.

**Parametric Statistics**

Determining whether parametric or nonparametric statistics are appropriate to calculate depends on the level of data and the results of the descriptive statistics. Parametric
Parametric Statistics
Are calculated for research variables that are interval or ratio-level data, and the sample collected assumes there is a normal distribution for purposes of generalizing to the population.

Nonparametric Statistics
Are calculated for research variables that are ordinal-level data or the sample collected does not assume a normal distribution.

represents population. With a normal distribution, this is a better representation of the population; thus, parametric statistics would be calculated.

Additionally, the research variables must be either interval or ratio level of data to appropriately use parametric statistics. This will allow for more accurate interpretation when the distances between the data score points are equivalent.

Nonparametric Statistics
If the level of data is ordinal, then nonparametric statistics would be calculated. Because of the ranking nature of ordinal data, one has less ability to appropriately interpret the difference between the scores. Nonparametric statistics are calculated if the distribution is skewed, regardless of the level of data. When the distribution of scores is skewed, accommodations should be made in the analysis to take the skewness into account before interpreting the results.

Reviewing Hypothesis Testing
Now that you have an overview of parametric and nonparametric statistics, we remind you of the steps in hypothesis testing. Hypothesis testing allows you to make your statistical decisions to assist with the final steps of the scientific method of formulating findings and conclusions. We encourage you to go back to the list of steps in hypothesis testing in Chapter 11 and review the steps. As previously noted, drawing out a normal curve and determining the table critical values are not necessary elements when you are using statistical software programs, such as SPSS. The statistical outputs typically include a column for the significance level, which is equivalent to the \( p \) value or alpha level. An exact level of significance is presented on the computer outputs; however, if you use the guideline of above and below your alpha level, you can determine statistical significance. If you are using the alpha level of 0.05, then when the \( p \) value is less than 0.05, there is significance. If the value is greater than 0.05, the results are nonsignificant. If you are using a different alpha level, then you would use that level as the standard.

A summary of using alpha levels to determine statistical significance is presented in Table 12.1. Once again, you must further interpret your statistical findings and formulate your conclusions. We want to focus on the “so what” factor of your results and evaluating the results of the statistical analyses, as well as the overall research design.

Because this is not a statistics textbook, we will focus on some basic types of statistics that are common in health and human performance. This will provide you with a solid foundation for understanding more complex research and statistics. We base our statistical analysis on the types of research designs that were presented in Chapter 5. More specifically, we will be covering data analysis for correlation research designs, as well as for experimental research designs. Finally, in addition to the statistical resources we suggested in Chapter 11, we have provided some valuable resources for using computer software to analyze your data in the Tip: Excel and SPSS Resources.

<table>
<thead>
<tr>
<th>Significance Level (( p ))</th>
<th>Statistically Significant?</th>
</tr>
</thead>
<tbody>
<tr>
<td>If using an alpha level of 0.05</td>
<td></td>
</tr>
<tr>
<td>( p &lt; .05 )</td>
<td>yes</td>
</tr>
<tr>
<td>( p &gt; .05 )</td>
<td>no</td>
</tr>
<tr>
<td>If using an alpha level of .01</td>
<td></td>
</tr>
<tr>
<td>( p &lt; .01 )</td>
<td>yes</td>
</tr>
<tr>
<td>( p &gt; .01 )</td>
<td>no</td>
</tr>
</tbody>
</table>

Source: Note: Exact level of significance is typically reported; however, using this as a guideline will assist with determining statistical significance.

Table 12.1 Summarizing Using Alpha Levels to Determine Statistical Significance
Characteristics of Correlation Coefficients

To statistically answer whether a relationship exists between the two continuous research variables, you must calculate a correlation coefficient or \( r \) value. The correlation coefficient is the calculated statistic that represents the degree of the relationship. Correlation coefficients will never be greater than plus or minus 1.00. The actual number reflects the degree of the relationship, and the sign indicates the type of correlation. The closer the number is to plus or minus 1.00, the stronger the relationship; the closer to zero, no relationship exists. The types of correlation include a positive or direct relationship and a negative or inverse relationship. With a positive correlation, one variable goes up and the other variable also goes up. In an inverse relationship, one variable goes up and the other variable goes down. The characteristics of correlation coefficients (\( r \)) are summarized in the following list. Correlation coefficients may be calculated by two different methods, depending on the distribution of your scores, as well as the level of data.

**Characteristics of Correlation Coefficients (\( r \))**

- Coefficients range from \(-1.00\) to \(+1.00\)
- Coefficient number represents the degree of the relationship
- Coefficient sign represents the direction of the relationship
- Positive coefficients represent a positive or direct relationship among the variables
- Negative coefficients represent a negative or inverse relationship among the variables
Pearson Product-Moment Correlation Coefficient

One way to calculate correlation coefficients is through the Pearson Product-Moment Correlation Coefficient (PMCC). The PMCC or Pearson correlation is used with a normal distribution and interval or ratio-level data. These two points are characteristics of parametric statistics; thus, the Pearson correlation coefficient is a parametric statistic. An additional basic assumption for using the Pearson correlation is that the relationship between the two variables is linear in nature. If you were to plot the data points on a graph and draw a line of best fit, that line would be a straight line. One of the limitations of correlation coefficients is the fact that the variables are assumed to be linear in nature. This would limit any two variables that might be curvilinear. A common example in the area of sport psychology is the inverted U theory. Low anxiety levels are related to low performance levels, moderate levels of anxiety are related to high performance, and high levels of anxiety are related to low performance. If you were to plot the distribution of scores, the plot would resemble an inverted U. The correlation coefficient would be close to zero, indicating no relationship between the variables. Even though the \( r \) value is not significant, a significant relationship does exist between these variables. The correlation coefficient does not take into account the curvilinear relationship. The basic assumptions of the Pearson correlation are summarized in the following list:

Basic Assumptions of the Pearson Correlation

- Interval or ratio level of data
- Normal distribution
- Linear relationship

To illustrate the process of calculating the Pearson Product-Moment Correlation Coefficient, please refer to the Research to Practice. Within the example, you will find the formula that is used if you calculate this statistic by hand. The key element in the formula is the \( \Sigma XY \), which is each \( X \) multiplied by each \( Y \), and then the sum is found. The \( \Sigma XY \) is the “product-moment” portion of the name, which is the product of the two variables or moments coming together to determine whether there is a relationship.

Statistical findings and conclusions are presented in the Research to Practice example to illustrate how to formulate your findings and conclusions. Statistical findings would be found in the Results section, and the conclusions would be part of the Discussion section. An additional way to interpret the \( r \) value is through the coefficient of determination (\( r^2 \)). The coefficient of determination determines the amount of explained variability among the research variables. The statistic calculated by squaring your correlation coefficient is typically represented or reported in the form of a percentage. The higher the \( r \) value, the higher the percentage. Again, this relates to how much the predictor or \( X \) variable explains the criterion or \( Y \) variable. A significant relationship that is found may have a lower percentage of explained variability, indicating the presence of additional \( X \) variables that explain the criterion variable. For example, the relationship between nutrition and obesity levels has been found to be significant; however, additional predictor variables also explain obesity.
When you start to examine multiple variables, this is where more complex statistics would need to be introduced. Additionally, correlation analysis can lead to prediction or regression analysis. An example of using a simple prediction is to create prediction equations and measure an X variable and predict the Y variable. For example, using the Progressive Aerobic Cardiovascular Endurance Run (PACER) test results to predict maximal oxygen uptake ($V_{O2max}$) would use simple prediction. Again, things can get more complicated quickly when you need multiple X variables to appropriately predict the Y variable. An example of using multiple regression is predicting your percent body fat (Y) based on skinfold measurements at various sites, such as triceps, calf, and subscapularis. Further discussion on these more advanced correlation methods is beyond the scope of this textbook. Another way to determine correlation coefficients is using the Spearman Rank-Order Rho Correlation Coefficient, which is a nonparametric statistic.

**PULSE CHECK**

What is a coefficient of determination? What does it mean to say there is 36 percent of unexplained variability?

**RESEARCH TO PRACTICE—PEARSON PRODUCT-MOMENT CORRELATION COEFFICIENT**

Statement of the Problem—The relationship between attitude toward exercise and percent body fat will be examined among college students.

- Null Hypothesis—$H_0$: No relationship will exist between attitude toward exercise and percent body fat.
- Alternative hypotheses:
  - $H_{A1}$: A positive relationship; as attitude toward exercise increases, percent body fat will increase.
  - $H_{A2}$: A negative relationship; as attitude toward exercise increases, percent body fat will decrease.
- Alpha Level—This is an example of applied research in the field, and an alpha level of 0.05 is appropriate.

**Data Collection**

<table>
<thead>
<tr>
<th>Attitude Toward Exercise</th>
<th>Percent Body Fat</th>
</tr>
</thead>
<tbody>
<tr>
<td>78</td>
<td>10</td>
</tr>
<tr>
<td>82</td>
<td>13</td>
</tr>
<tr>
<td>65</td>
<td>18</td>
</tr>
<tr>
<td>44</td>
<td>22</td>
</tr>
<tr>
<td>31</td>
<td>25</td>
</tr>
<tr>
<td>63</td>
<td>21</td>
</tr>
<tr>
<td>86</td>
<td>15</td>
</tr>
<tr>
<td>73</td>
<td>18</td>
</tr>
<tr>
<td>22</td>
<td>35</td>
</tr>
<tr>
<td>35</td>
<td>30</td>
</tr>
</tbody>
</table>
RUN DATA ANALYSIS:

- By-hand computations (presented in Figure 12.1)
- Computer software (presented in Figure 12.2)
- Statistical findings and conclusions:
  - The correlation between attitude toward exercise and percent body fat was significantly less than zero, \( r = -0.92, p < 0.05 \)
  - The higher an individual’s attitude toward exercise, the lower the percent body fat.

Pearson Product-Moment Correlation Coefficient

1. Set up the following columns: \( X, X^2, Y, Y^2, XY \)

2. Find sums of \( X \) and \( Y \) columns (\( \Sigma X, \Sigma Y \))

3. Square each \( X \) and \( Y \) score, find sums for both (\( \Sigma X^2, \Sigma Y^2 \))

4. Multiply each \( X \) score by \( Y \) score, find sum (\( \Sigma XY \))

5. Calculate the \( r \) value using the formula

\[
r = \frac{n \left( \Sigma XY \right) - \left( \Sigma X \right) \left( \Sigma Y \right)}{\sqrt{n \left( \Sigma X^2 \right) - \left( \Sigma X \right)^2 \left[ n \left( \Sigma Y^2 \right) - \left( \Sigma Y \right)^2 \right]}}
\]

Figure 12.1 Pearson by Hand

Spearman Rank-Order Rho Correlation

The second way to determining the degree of the relationship is through calculating the Spearman Rank-Order Rho Correlation Coefficient. The Spearman is used with nonparametric statistics. The level of data is ordinal or can be interval or ratio; however, a skewed distribution would be assumed if interval or ratio data were used with the Spearman. Similarly, to the Pearson, the basic assumption is that the relationship between the two variables is linear in nature. The basic assumptions of the Spearman correlation are summarized in the following list:

Basic Assumptions of the Spearman Correlation

- Ordinal level of data
- Randomly selected for the population
EXAMINING RELATIONSHIPS

Using SPSS

- Analyze
  - Correlate
    - Bivariate
      - Move two variables into the variable box
    - Make sure the following are checked off:
      - Pearson
      - Two-tailed
      - Flag significant correlations
    - OK

(a)

Check Output

Correlations

<table>
<thead>
<tr>
<th></th>
<th>Attitude toward exercise</th>
<th>Percent body fat</th>
</tr>
</thead>
<tbody>
<tr>
<td>Attitude toward exercise</td>
<td>Pearson Correlation</td>
<td>- .925**</td>
</tr>
<tr>
<td></td>
<td>Sig. (2-tailed)</td>
<td>.000</td>
</tr>
<tr>
<td></td>
<td>N</td>
<td>10</td>
</tr>
<tr>
<td>Percent body fat</td>
<td>Pearson Correlation</td>
<td>- .925**</td>
</tr>
<tr>
<td></td>
<td>Sig. (2-tailed)</td>
<td>.000</td>
</tr>
<tr>
<td></td>
<td>N</td>
<td>10</td>
</tr>
</tbody>
</table>

** Correlation is significant at the 0.01 level (2-tailed).

(b)

Figure 12.2 Pearson by Computer

- Skewed distribution for interval or ordinal level of data
- Linear relationship

To illustrate the steps in calculating the Spearman Rank-Order Rho Correlation Coefficient, please refer to the Tip. The premise behind the Spearman correlation is the same as for the Pearson correlation; thus, the focus is on providing the steps in calculating this statistic by hand. The key element in the formula is the D, which is the difference between the two scores. The sum of D (\(\Sigma D\)) must always be zero. Thus, the next step is to square each of the D scores and then find the sum (\(\Sigma D^2\)) to use in the formula. Please note that running an example through SPSS uses the same steps as the Pearson previously presented; however, you check off the box for Spearman instead of leaving the default to Pearson. The same format of the null and alternative hypotheses would be used, as well as the findings and conclusions. What would be different is the type of research variable being examined. The research variable would be ordinal, such as ranking in the cross-country race or in a golf tournament. We encourage you to try an example on your own, as well as consult the online resources for more information.

PULSE CHECK

How is the Pearson different from the Spearman when trying to determine a relationship among the research variables?
Examining Differences

If you are examining differences among groups, this is considered an experimental research design. Experimental research designs comprise two types: quasi-experimental research and true experimental research; the difference lies in how the groups are defined.

Both types of designs have an independent variable, which is the grouping variable, and the dependent variable, which is measured.

Not only are the characteristics of the independent variable important in determining whether the design is quasi-experimental or true experimental, but the characteristics are also important in determining the appropriate statistical analysis. More specifically, are the groups independent of each other, or did the same group go through the measurement twice?

An example of independent groups would include people who have had a heart attack and people who have not had one.

An example of a repeated-measures group would include subjects who performed a pretest and then the same individuals performed a posttest. Examining differences between independent groups uses different statistical analysis than that used with repeated-measures groups. In more advanced statistics when you have multiple independent variables, you may have one or more be independent and one be repeated. For now, focus on understanding the differences between independent and repeated-measures groups.

**TIP: SPEARMAN RANK-ORDER RHO CORRELATION COEFFICIENT**

1. List the X and Y variables individually into columns from the best score to the worst score
2. Rank both the X and Y columns
3. Re-list the X and Y columns as they appear on the raw data
4. Next to the X and Y columns, put a column with the rankings from step 2
5. Add a column at the end for the difference between the ranks \((D)\)
6. Determine the \(D\) for each individual \((X\) rank—\(Y\) rank); sum the values; \((\Sigma D = 0)\).
7. Add a column at the end; square each \(D\) number; sum the values \((\Sigma D^2)\).
8. Calculate the correlation coefficient using the formula in Figure 12.3.

**SPEARMAN RANK-ORDER RHO CORRELATION COEFFICIENT**

\[
 r = 1.00 - \frac{6 (\Sigma D^2)}{N(N^2 - 1)}
\]

**Figure 12.3 Spearman Formula**

**Quasi-Experimental Design**
Focuses on comparing group differences in which the groups under study cannot be manipulated or randomly assigned

**True Experimental Design**
Focuses on comparing group differences in which the groups under study are manipulated or randomly assigned

**Independent Variable**
Includes the grouping variable in experimental research designs

**Dependent Variable**
Includes the measured variable or outcome in experimental research designs
Independent Groups Data Analysis

Determining the differences among independent groups include calculating an independent groups $t$-test, Mann-Whitney U, one-way analysis of variance (ANOVA), and Kruskal-Wallis. Basic assumptions are made for the various types of statistical analyses. Generally speaking, you need to ask yourself what the level of data is, what your distribution looks like, whether it is parametric or nonparametric, and how many groups form your independent variable. An alignment is presented in the Tip: Independent Groups Analyses to help you determine which independent groups analysis is most appropriate.

PULSE CHECK

How are independent groups different from repeated groups?

Independent Groups
Include subjects who were each measured once, and the groups are mutually exclusive.

Repeated-Measures Groups
Include subjects who were tested at all levels.

TIP: INDEPENDENT GROUPS ANALYSES

- Independent group $t$-test—parametric and independent variable (IV) has two levels
- Mann-Whitney U test—nonparametric and IV has two levels
- One-way analysis of variance (ANOVA) test—parametric and IV has 3+ levels
- Kruskal-Wallis test—nonparametric and IV has 3+ levels

Independent Groups $t$-Test

The independent groups $t$-test is considered a parametric statistic and is used when the independent variable has two levels. An example of an independent variable at two levels would be individuals who have a healthy heart and individuals who have been diagnosed with heart disease. Remember that the main purpose behind this statistic is to determine the differences between the groups in relation to the dependent or measured variable. Using an example of time running on a treadmill, are there mean differences in time between those with healthy hearts and those who have been diagnosed with heart disease? Before we continue with calculating to determine whether the mean differences are significant, the basic assumptions of the independent groups $t$-test are presented in the following list:

Basic Assumptions of the Independent Groups $t$-Test

- Both groups came from same population
- Normal distribution
- Standard deviations are similar same for both groups

To illustrate the process of using the independent $t$-test, please refer to the Research to Practice. Within the example, you will find the formula that is used if you calculate this statistic by hand. Please note that you have to first find the mean and standard deviation of both groups. You then find the standard error of the mean (SEM) for both groups, which is equivalent to the standard deviation of the distribution. You cannot
RESEARCH TO PRACTICE—INDEPENDENT GROUPS T-TEST

- Null hypothesis—H₀: No differences will exist between individuals who have a healthy heart and individuals who have been diagnosed with heart disease with respect to time spent running on the treadmill.

- Alternative hypotheses:
  - Hₐ₁: The individuals who have a healthy heart will have a higher time spent running on the treadmill than the individuals who have been diagnosed with heart disease.
  - Hₐ₂: The individuals who have a healthy heart will have a lower time spent running on the treadmill than the individuals who have been diagnosed with heart disease.

- Alpha level—This is an example of applied research in the field, and an alpha level of 0.05 is appropriate.

- Data collection:

<table>
<thead>
<tr>
<th>Status of Heart Disease</th>
<th>Time Running on the Treadmill (in seconds)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 = Healthy</td>
<td>1,014</td>
</tr>
<tr>
<td>1</td>
<td>1,034</td>
</tr>
<tr>
<td>1</td>
<td>900</td>
</tr>
<tr>
<td>1</td>
<td>990</td>
</tr>
<tr>
<td>1</td>
<td>840</td>
</tr>
<tr>
<td>1</td>
<td>978</td>
</tr>
<tr>
<td>1</td>
<td>1,002</td>
</tr>
<tr>
<td>1</td>
<td>1,110</td>
</tr>
<tr>
<td>1</td>
<td>864</td>
</tr>
<tr>
<td>1</td>
<td>636</td>
</tr>
<tr>
<td>1</td>
<td>638</td>
</tr>
<tr>
<td>2</td>
<td>708</td>
</tr>
<tr>
<td>2</td>
<td>786</td>
</tr>
<tr>
<td>2</td>
<td>600</td>
</tr>
<tr>
<td>2</td>
<td>1,320</td>
</tr>
<tr>
<td>2</td>
<td>750</td>
</tr>
<tr>
<td>2</td>
<td>594</td>
</tr>
<tr>
<td>2</td>
<td>750</td>
</tr>
</tbody>
</table>

- Run data analysis:
  - By-hand computations (presented in Figure 12.4)

- Statistical findings and conclusions:
  - The mean treadmill time for healthy individuals was significantly higher than the mean treadmill time for individuals with heart disease, \( t(16) = 2.73, p < .05 \).
  - Individuals with a healthy heart can run for a longer time on the treadmill than can individuals with heart disease.
1. Calculate standard deviation for both groups
2. Find the mean for both groups
3. Calculate standard error of the mean (SEM) for both groups

$$SEM = \frac{SD}{\sqrt{N_1}}$$

Standard Error of the Difference between the Means ($S_{x1 - x2}$)

$$S_{x1 - x2} = \sqrt{SEM_1^2 + SEM_2^2}$$

4. Calculate the $S_{x1 - x2}$

Independent Groups $t$

$$t = \frac{\bar{x}_1 - \bar{x}_2}{S_{x1 - x2}}$$

5. Calculate the $t$ value

**Figure 12.4** Independent Groups $t$-Test by Hand

**SPSS commands – Independent $t$-test**

- Analyze
  - Compare means
    - Independent samples $t$-test
      - Test variable = DV (interval or ratio)
      - Grouping variable = (two-level variable)
        - Define groups
          - Group 1 = 1
          - Group 2 = 2
        - Continue
      - OK

**Group Statistics**

<table>
<thead>
<tr>
<th>Group</th>
<th>N</th>
<th>Mean</th>
<th>Standard Deviation</th>
<th>Standard Error of the Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>Healthy</td>
<td>8</td>
<td>983.50</td>
<td>213.750</td>
<td>29.112</td>
</tr>
<tr>
<td>Disease</td>
<td>10</td>
<td>764.60</td>
<td>213.750</td>
<td>67.594</td>
</tr>
</tbody>
</table>

**Independent Samples Test**

<table>
<thead>
<tr>
<th>Treadmill time in seconds</th>
<th>Levene’s test for equality of variances</th>
<th>$t$-test for equality of means</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$F$</td>
<td>Sig</td>
</tr>
<tr>
<td>Equal variances assumed</td>
<td>1.700</td>
<td>.211</td>
</tr>
<tr>
<td>Equal variances not assumed</td>
<td>2.974</td>
<td>12.113</td>
</tr>
</tbody>
</table>

- Statistical findings and conclusions:
  - The mean treadmill time for healthy individuals was significantly higher than the mean treadmill time for individuals with heart disease, $t(16) = 2.73, p < .05$.
  - Individuals with a healthy heart can run for a longer time on the treadmill than can individuals with heart disease.

**Figure 12.5** Independent Groups $t$-Test by Computer
simply take the standard deviations of both groups; the distribution is a basic assumption and present within the formulas. Next, you “pool” the standard error of the means together to determine the standard error of the difference between the means ($S_{x1-x2}$). Now you can calculate your $t$ value using the formula presented, which is the mean difference divided by the standard error of the difference between the means.

**PULSE CHECK**

How many levels of the independent variable are there in independent groups $t$-tests?

Another way to determine whether the differences are significant among two groups is to use the Mann-Whitney U test. This is considered a nonparametric equivalent statistic to the independent groups $t$-test. For more information on how to run a Mann-Whitney U test, please refer to the online resources.

**One-Way Analysis of Variance (ANOVA)**

The independent groups $t$-test can be used only when the independent variable has two levels; therefore, when there are more than three groups, an analysis of variance (ANOVA) is run. An example of an independent variable at four levels is when subjects were exposed to three different goal-setting programs and the last group was the control group. The same purpose exists, which is to determine differences among the groups in relation to the dependent or measured variable. When one-way ANOVAs are used, more than two groups are being examined in the research study. The same basic assumptions exist, which are presented in the following list. Additionally, to illustrate the process of using the computer, please refer to the Research to Practice. Within the example, you will find the steps to run the ANOVA, as well as to make appropriate conclusions.

**Basic Assumptions of the One-Way Analysis of Variance**

- Both groups came from same population
- Normal distribution
- Standard deviations are similar for both groups

Another way to determine whether the differences are significant among three or more levels to an independent variable is to use the Kruskal-Wallis test. This is a nonparametric equivalent statistic to the one-way ANOVA. For more information on how to run a Kruskal-Wallis test, please refer to the online resources.

**PULSE CHECK**

What was the difference between independent groups $t$-test and an ANOVA?
RESEARCH TO PRACTICE: ONE-WAY ANOVA

Data analysis—Computer software (presented in Figure 12.6)

- Statistical findings and conclusions:
  - Significant differences were found in the mean frequency of goal-setting scores for the university students involved in Goal Setting Training (GST) 1, GST 2, GST 3, and control F = 17.95, p < .05
  - College students who were exposed to a GST program that teaches process-related goals, as well as students who were not exposed to a GST program, have a higher frequency of setting goals than students who were exposed to a GST program that teaches product-related goals.

Check with SPSS

Check with SPSS Output

Check SPSS Output

Figure 12.6 One-Way ANOVA—Computer
Repeated-Measures Groups Data Analysis
Determining the differences among repeated-measures groups include calculating a paired sample and Wilcoxon Signed-Ranks. Basic assumptions are made for the various types of statistical analyses. You need to ask yourself the same questions: what the level of data is, what your distribution looks like, whether this is parametric or nonparametric, and how many groups is your independent variable.

Paired Sample t-Test
Examining differences between two conditions when the same participants are measured twice is a repeated-measures research design. To determine whether differences exist, a repeated-measures or paired sample t-test would be calculated. Examining the effectiveness of a decision-making curriculum would be answered by pairing the pretest and posttest scores for all of the male and female students. The only difference from an independent groups design, and why a different statistical analysis has to be run, is the fact that the same participants are being measured at all levels. The basic assumptions of the paired sample t-test are presented in the following list. Additionally, to illustrate the process of using the computer, see the Research to Practice for an example. Within the example, you will find the steps to run the paired sample t-test, as well as to make appropriate conclusions.

Basic Assumptions of the Paired Sample t-Test
- Normal distribution
- Standard deviation is not necessary to examine, because one group is being examined

Another way to determine whether the differences are significant among repeated measures is to use the Wilcoxon Signed-Ranks test. This is considered a nonparametric equivalent statistic to the paired sample t-test. For more information on how to run a Wilcoxon Signed-Ranks test, please refer to the online resources. You also can run repeated-measures ANOVA if you have more than two levels. The type of statistic can get more complicated quickly; however, the concept, as well as interpretation, remains similar to the basic statistics, such as the independent groups t-test and one-way ANOVA. The computer commands are presented in the online resources.

PULSE CHECK

What is different about the independent variable for independent groups t-test, as opposed to paired sample t-test?

Additionally, you can examine multiple independent variables at one time. Similar to what we noted when we were discussing correlation, you can multiple X variables to determine the relationship among the Y variable. Here you are examining multiple independent variables to determine whether the classification and grouping makes a difference among the dependent or measured variable.

These are considered factorial ANOVAs. In our first example, say you also wanted to add sex to see whether it plays a role in the amount of time spent running on a treadmill. Thus, you would have a design that is a two-by-two independent groups ANOVA. We refer you to the online resources for examples and computer commands for running more advanced statistical analysis. With your basic statistical foundation, you have the ability to add layers and still understand the purpose behind the statistical analysis.
Chi-Square Data Analysis

When we introduced nominal data, we noted that if you are using this level of data within the research design, you will have to run a chi-square analysis. Nominal data categorizes data and includes categories of data that are mutually exclusive. Thus, chi-square analysis is used to determine whether significant differences exist in the number of people who are classified in the categories of the research variable. Within the formula, there are observed frequencies (\( f_0 \)), which are the actual number of people who are classified into each category and the expected frequencies (\( f_e \)), which are based on the theoretical number of people who would fall into each category. Typically, the null hypothesis is used that assumes there will be an equal number of people in each category. Basically, no differences in responses (yes, no, or I don’t know)
would be expected when students are asked whether they enjoy research methods. To illustrate the process using the computer, please refer to the Research to Practice. Within the example, you will find the steps to run the chi-square, as well as to make appropriate conclusions. A two-way chi-square can be used when examining more than one research variable within a research study, such as adding sex to the example. Again, statistics can get complicated quickly based on your design, and we refer you to the online resources for more information if you will be using this approach to answer your research question.

**PULSE CHECK**

When is a chi-square analysis utilized within research?

**RESEARCH TO PRACTICE: CHI-SQUARE**

Data analysis—Computer software (presented in Figure 12.8)

**Check with SPSS**

- Analyze
  - Nonparametric tests
    - Chi-square
      Move variable name to test variable list
      Leave both these checked off in the default
      Expected range
      $X$ get from data
      $X$ all categories equal
      OK

**SPSS Output**

Do you enjoy working research methods?

<table>
<thead>
<tr>
<th></th>
<th>Observed N</th>
<th>Expected N</th>
<th>Residual</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>16</td>
<td>9.0</td>
<td>7.0</td>
</tr>
<tr>
<td>No</td>
<td>7</td>
<td>9.0</td>
<td>-2.0</td>
</tr>
<tr>
<td>Don’t care</td>
<td>4</td>
<td>9.0</td>
<td>-5.0</td>
</tr>
<tr>
<td>Total</td>
<td>27</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**SPSS Output**

Test Statistics

<table>
<thead>
<tr>
<th></th>
<th>Do you enjoy working research methods?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chi-square$^a$</td>
<td>8.667</td>
</tr>
<tr>
<td>df</td>
<td>2</td>
</tr>
<tr>
<td>Asymp. Sig.</td>
<td>0.13</td>
</tr>
</tbody>
</table>

$a.0$ cells (.0%) have expected frequencies less than 5. The minimum expected cell frequency is 9.0.

**Figure 12.8** Chi-Square—Computer
Examining Type I and Type II Errors

Inferential statistics attempt to draw conclusions to the target population based on the data that were collected from the sample. Hypothesis testing becomes your statistical decision-making process, which determines whether you have significance. Remember that you are the judge of the importance of the results, regardless of finding significance. You will need to interpret your results in light of your research design, because there is always a chance of error. Alpha levels, also known as $p$ values or probability, indicate that if you find significance there is still a 5 percent probability that those results were by chance. So, five out of 100 times your results are by chance. The 5 percent comes from using the most common and accepted alpha level of 0.05; however, more stringent alpha levels can result in a lower probability.

Additionally, remember that when you are using hypothesis testing in your statistical decision-making process, you are testing against the null hypothesis. The null hypothesis is assumed to be true until you find significance between the expected data and actual data. If the null hypothesis is true, you say that you accept the null hypothesis and there is no significance. If you find significance, then you say that you reject the null hypothesis. Typically, in statistics, you do not say that you accept the alternative hypothesis; because you are testing against the null hypothesis, you say you reject the null hypothesis.

In light of the probability of making an error, this is where the terms Type I and Type II errors come into our discussion. If you reject the null hypothesis, there is a chance you made a Type I error; whereas, if you accept the null hypothesis, there is a chance you made a Type II error.

Within designing and conducting research, no perfect design will address and meet all your needs. You will need to determine which aspects are most important and result in developing a quality research study. Remember you want to control as many aspects to improve internal validity, yet not so many that you are unable to generalize your results. Finally, because no research is without error, especially within the statistical decision-making, addressing the “so what” factor in formulating findings and conclusions is imperative.

SUMMARY

This chapter has covered many different statistical analyses that can be used to answer your quantitative research questions. Inferential statistics includes statistics that allow the researcher to make conclusions to the target population based on the sample data collected. Two different types of inferential statistics were presented: parametric statistics and nonparametric statistics. Parametric statistics include statistics that are...
calculated when using interval and ratio levels of measurement; nonparametric statistics are used when the researcher is using nominal or ordinal levels of measurement. For each type of inferential statistics presented, you would follow the steps in hypothesis testing to answer your questions. Inferential statistics covered included correlation, independent groups analysis, paired samples analysis, analysis of variance, and chi-square analysis. Finally, we covered the two types of statistical error that need to be considered when using inferential statistics, Type I and Type II error. We have covered much about how to analyze your quantitative data; now we need to spend some time discussing how to interpret qualitative findings. The next chapter presents how to interpret your data from a qualitative perspective.

**Applying What You Learned**

1. Provide your own Research to Practice example for correlation that utilized the Pearson product moment correlation coefficient to determine the \( r \) value.
2. Provide your own Research to Practice example for experimental, true or quasi, that utilized one of the statistical analyses to determine the \( t \) or \( F \) value. Indicate what specific statistical analysis was utilized and illustrate why the analysis was appropriate for the research variables.
3. Indicate what statistical analysis is appropriate for your research design and indicate how you determined what analysis was appropriate for your research variables.

**Key Terms**

- Correlation Research Designs
- Criterion Variable
- Dependent Variable
- Independent Groups
- Independent Variable
- Inferential Statistics
- Nonparametric Statistics
- Parametric Statistics
- Predictor Variable
- Quasi-Experimental Designs
- Repeated-Measures Groups
- True Experimental Designs
- Type I Error
- Type II Error

**References**

Qualitative Analysis
Interpreting the Data

WHAT YOU’LL LEARN

- How to record your qualitative data
- How to manage your qualitative data
- How to employ data trustworthiness

In Chapter 6 we discussed many different types of qualitative research. Research methods that were presented included ethnographic research, phenomenological research, case studies, and narrative inquiries. Data analysis involves description and interpretation of evidence and documents as opposed to statistics, which is used in quantitative research. The last two chapters presented concepts related to quantitative data analysis. In this chapter, we describe information about how to analyze qualitative data. Because this is an introductory text, we provide only an overview of the ways to analyze qualitative research. You are encouraged to refer to the online suggested resources and websites for further details.

Recording Your Data

When you begin to record your data for your qualitative or mixed-methods research, several steps need to be carefully considered. First, the data need to be recorded systematically, which is the same process as recording data for quantitative research. When we collect any type of data, whether numerical or text, we need to be careful and systematic about the process, remembering the definition of research.

The first question a researcher should ask when collecting qualitative data is how the data will be obtained. Usually when you are collecting qualitative data, you are in a situation in which daily events are unfolding. For instance, during your study, if you are observing new student teachers during their practicum experiences, you need to observe them in the real-life setting. As you consider what, where, and when you will observe, you need to ensure that you will not interfere with daily events. Conversely, another way you may collect data is to interview participants. Although you may not be interfering in daily activities, you need to consider the scheduling of the interviews. Make sure that the interviews are scheduled for convenient times for the participants.
As you plan and consider these issues, an important way to minimize any problems during data collection is to perform a pilot or trial test. This can help you as the researcher gets comfortable with the process, as well as identify up front any shortcomings or issues that have not been considered. Finally, once you are ready to begin collecting data, you should also ensure that you understand how to use the equipment properly. For additional points to considering before collecting your data, see Tip: Data Collection Checklist.

Managing Your Data

Once you have begun collecting the data, you also need to consider how you will manage the data. As you begin the transcription process of the data, you need to ensure that you can organize and retrieve the data. How will you code the data? Color coding? Number coding? Remember, data analysis for qualitative research is not linear or sequential as in quantitative designs. Many times, you can be collecting and analyzing the data simultaneously. Data analysis can be very messy, but having a systematic way of managing the data can help to minimize the messiness. Marshall and Rossman (2006) identified analytical procedures for qualitative data analysis that include:

1. Organizing data
2. Immersion into the data
3. Generating categories and themes

TIP: DATA COLLECTION CHECKLIST

Here are some points to keep in mind during the data collection process:

- Extra batteries or chargers for your recording devices (video or audio)
- Additional recording devices in case of malfunction, such as an extra voice recorder, video camera, phone, or tablet
- Tripod for video recording
- Microphone for voice recording
- Labeling for external drives
- Pen or pencil
- Notepad for note taking
- Appropriate lighting considered for video recording
- Informed consent for before the interview
- Set of questions to ask

As you plan and consider these issues, an important way to minimize any problems during data collection is to perform a pilot or trial test. This can help you as the researcher gets comfortable with the process, as well as identify up front any shortcomings or issues that have not been considered. Finally, once you are ready to begin collecting data, you should also ensure that you understand how to use the equipment properly. For additional points to considering before collecting your data, see Tip: Data Collection Checklist.
Managing Your DaTa

Immersion in Your Data

The only way to get immersed in the data is to read, read, and read some more! Because you are the research instrument, you need to become very familiar with the data. Patton (2002) summarized the importance of this procedure in the following way:

The data generated by qualitative methods are voluminous. I have found no way of preparing students for the sheer mass of information they will find themselves confronted with when data collection has ended. Sitting down to make sense out of pages of interviews and whole files of field notes can be overwhelming. Organizing and analyzing a mountain of narrative can seem like an impossible task.

(p. 440)

Organizing Your Data

A number of ways to organize the data are possible, including software programs or organizing the “old-fashioned” way, using index cards or sticky notes. From the outset, the researcher finds a way to systematically organize the data. For instance, to review the piles of data that you have been collecting, you may want to provide a summary of the data. Regardless of whether you are using a computer program or the by-hand method, you need to find a way to easily access the data. Some information that should be included in a summary are date of data gathering, place of data gathering, type of data gathering (such as focus groups, observation, or interviews), who you gathered data from, and the main focus of the data-gathering activity; see Tip: Summarizing Organized Data. Having the data clearly organized and summarized will make it easier for you to access it later.

TIP: SUMMARIZING ORGANIZED DATA

Here are some points to include in summaries of organized data:

- Date of data gathering
- Place of data gathering
- Type of data gathered (such as focus group, observation, or interview)
- Who you gathered data from
- The main focus of the data gathered

Immersion in Your Data

The only way to get immersed in the data is to read, read, and read some more! Because you are the research instrument, you need to become very familiar with the data. Patton (2002) summarized the importance of this procedure in the following way:

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(p. 440)

Patton’s words can appear scary as you begin the data analysis process, but having a plan and an organizational structure can help minimize these fears. We suggest that during this process you keep a copy of your research questions close by to not lose sight of your purpose. As Patton indicated, the process can be overwhelming, but if
you stay focused on the research questions you want answered and can refer to them from time to time, it may help to minimize the overwhelming feeling during analysis.

**Generating Categories and Themes**

Once you have immersed yourself in the data, you can begin to identify themes or categories within the data. As you read the data over and over again, you will begin to identify patterns. Remember, the patterns are taken from the data; they are not preset. The qualitative research method uses inductive reasoning to identify patterns in the data that will assist in answering the research questions. Patton (2002) suggested using a matrix to identify themes or categories in the data. An example of a data matrix from Daggett, Bakas, Buelow, Habermann, and Murray (2013), is presented in the Research to Practice. Daggett et al. (2013) examined the needs of male combat veterans with traumatic brain injury (TBI).

**PULSE CHECK**

What are categories and themes in qualitative data analysis?

**Coding Your Data**

Coding the data refers to identifying passages in which the data represent the categories or themes you have identified. Essentially, these are your data! You are using the coded text as evidence and support for the themes and categories you have defined. Remember, however, during this process you are still immersing yourself in the data. So, you may find new meaning or a deeper appreciation to the themes. As we said earlier, these procedures are not sequential but rather simultaneous in nature.

**PULSE CHECK**

What is coding during qualitative data analysis?

**Offering Interpretations Through Memos**

During these procedures (immersion of data, generating themes and categories, and coding), the researcher should remark on the categories or themes that are generated. Your reflections as the researcher are important to the interpretation of the data. These comments can also keep you focused on the research questions you want to answer. Additionally, as you are reading a transcript from an interview, you may recall a lag point such as a non-audio observation during the interview. The memo can allow you to comment on that observation and provide insights based on the responses to the questions asked. Memos can provide two functions: (1) keeping the researcher on track; and (2) allowing for the researcher to reflect on specific coded text or categories and themes. When using memos, remember to time stamp them. If you are using a computer software program for your data analysis, this will be done for you. If you are using an alternative form of indexing, make sure to identify times and dates in your memo. Following the time history of your own reflections may reveal your process. This is an important factor when considering the trustworthiness of your results.
PULSE CHECK

What is the purpose of memos during qualitative data analysis?

RESEARCH TO PRACTICE: EXAMPLES OF USING A DATA MATRIX

Based on Daggett et al. (2013), they “conducted content analysis using a thematic matrix based on a conceptual model (Miles & Huberman, 1994) derived from Ferrans et al.’s HRQOL [health related quality of life] model (2005) and the TBI [traumatic brain injury] literature to categorize the needs, concerns, strategies used, and advice given for the Veterans with mTBI [mild traumatic brain injury]” (p. 331).

Table 13.1 Traumatic Brain Injury (TBI) Veterans’ Needs and Concerns, Strategies, and Advice

<table>
<thead>
<tr>
<th>Needs and Concerns</th>
<th>Strategies and Advice</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cognitive Impairment</td>
<td>Cognitive Impairment</td>
</tr>
<tr>
<td>Memory</td>
<td>Make lists; get a notebook and pen; memory book; write down everything important</td>
</tr>
<tr>
<td>Memory</td>
<td>Use electronics, VA phone (personal digital assistant) for appointments; alarm goes off 1–2 hours before appointment</td>
</tr>
<tr>
<td>Memory</td>
<td>Re-upload long-term memory through pictures, talking with siblings and relatives</td>
</tr>
<tr>
<td>Memory</td>
<td>Visual prompts, gather things ahead of time or set out things to remind to use (i.e., deodorant)</td>
</tr>
<tr>
<td>Memory</td>
<td>My parents give me a certain amount of time to remember things; they will call me</td>
</tr>
<tr>
<td>Memory</td>
<td>Speech-language therapy: word association repetition of sentences, rhymes; re-programming brain, different neural pathways</td>
</tr>
</tbody>
</table>

(Continued)
Table 13.1 (Continued)

<table>
<thead>
<tr>
<th>Needs and Concerns</th>
<th>Strategies and Advice</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Executive Functioning</strong></td>
<td><strong>Executive Functioning</strong></td>
</tr>
<tr>
<td>• I need help with monetary recognition and comprehension</td>
<td>• Do not use cash</td>
</tr>
<tr>
<td>• I need help understanding what other people are asking or saying</td>
<td>• Speech-language therapy, organizational skills (i.e., telling the therapist how to put the blocks back together)</td>
</tr>
<tr>
<td>• I asked others to break it down to where I understand</td>
<td>• I asked others to break it down to where I understand</td>
</tr>
<tr>
<td><strong>Symptoms</strong></td>
<td><strong>Symptoms</strong></td>
</tr>
<tr>
<td>• Headaches</td>
<td>• Headaches</td>
</tr>
<tr>
<td>• I need help managing my headaches symptoms and medications</td>
<td>• Take a nap, lie down, and do not get out of bed</td>
</tr>
<tr>
<td>• I need help functioning with my headaches</td>
<td>• Wear clip-on sunglasses at work</td>
</tr>
<tr>
<td>• I need help managing my musculoskeletal symptoms</td>
<td>• Take medications from the VA when really bad, melloys me out</td>
</tr>
<tr>
<td>• I need help managing my headaches</td>
<td>• Helps being in the dark</td>
</tr>
<tr>
<td><strong>Fatigue/Insomnia</strong></td>
<td><strong>Fatigue/Insomnia</strong></td>
</tr>
<tr>
<td>• I need help managing my sleep difficulties</td>
<td>• Take a nap when I get home</td>
</tr>
<tr>
<td>• I need help managing my fatigue</td>
<td></td>
</tr>
<tr>
<td>• I need help finding energy to work, play with my kids</td>
<td></td>
</tr>
<tr>
<td><strong>Tinnitus</strong></td>
<td><strong>Tinnitus</strong></td>
</tr>
<tr>
<td>• I need help managing my ringing in the ears, high-pitched sounds</td>
<td>• Information (pamphlet) on how to deal with</td>
</tr>
<tr>
<td></td>
<td>• Background noises help, like television and music</td>
</tr>
<tr>
<td></td>
<td>• Stay out of loud environment</td>
</tr>
<tr>
<td><strong>Emotions and Behaviors</strong></td>
<td><strong>Emotions and Behaviors</strong></td>
</tr>
<tr>
<td>• Anger</td>
<td>• Anger</td>
</tr>
<tr>
<td>• I need help managing my anger</td>
<td>• Silent method</td>
</tr>
<tr>
<td>• I need help with patience with my family</td>
<td>• Separation, do my own thing</td>
</tr>
<tr>
<td>• I need help finding a job</td>
<td>• Exercise</td>
</tr>
<tr>
<td>• I need help coping with physical limitations</td>
<td>• Do not go drinking</td>
</tr>
<tr>
<td>• I need help getting into the VA for care</td>
<td>• I share/talk to family members; family/friends help &quot;package the whole thing&quot;</td>
</tr>
<tr>
<td></td>
<td>• Go to counseling to talk</td>
</tr>
<tr>
<td></td>
<td>• Psychiatrist prescribed me some pills that have helped with anger-related problems</td>
</tr>
<tr>
<td></td>
<td>• Be patient; take it slow</td>
</tr>
<tr>
<td></td>
<td>• I tell myself, do not get upset</td>
</tr>
<tr>
<td></td>
<td>• Get a number for the VA and call; at the VA, everybody wants to help/support to figure out that has happened to you, why you are the way you are now. The VA is family-oriented</td>
</tr>
<tr>
<td>Needs and Concerns</td>
<td>Strategies and Advice</td>
</tr>
<tr>
<td>--------------------</td>
<td>-----------------------</td>
</tr>
<tr>
<td><strong>Fear (uncertainty)</strong></td>
<td><strong>Fear (uncertainty)</strong></td>
</tr>
<tr>
<td>- I am worried about long-term effects</td>
<td>- Tell them not to settle</td>
</tr>
<tr>
<td>- My ability to go back to school</td>
<td>- Take medication for depression</td>
</tr>
<tr>
<td><strong>Depression (sadness)</strong></td>
<td><strong>Depression (sadness)</strong></td>
</tr>
<tr>
<td>- I am sad about my loss of memory, my injuries.</td>
<td>- I try to keep a smile on my face because it’s helping other soldiers</td>
</tr>
<tr>
<td>- I am sad about my lost dreams</td>
<td>- I am depressed, lack interest</td>
</tr>
<tr>
<td><strong>Instrumental (Activities of Daily Living)</strong></td>
<td><strong>Instrumental (Activities of Daily Living)</strong></td>
</tr>
<tr>
<td><strong>Employment</strong></td>
<td><strong>Employment</strong></td>
</tr>
<tr>
<td>- I need help finding employment with my experience/the economy</td>
<td>- Use notes, constantly write down; prepare notes for work the night before; use a notebook; cheat sheets</td>
</tr>
<tr>
<td>- I need help to improve my work performance and my qualifications. I need vocational services</td>
<td>- We all talk, what need to do</td>
</tr>
<tr>
<td><strong>School</strong></td>
<td><strong>School</strong></td>
</tr>
<tr>
<td>- I need help with my concentration for school.</td>
<td></td>
</tr>
<tr>
<td><strong>Finances</strong></td>
<td><strong>Finances</strong></td>
</tr>
<tr>
<td>- I need financial help. VA disability benefits are not enough.</td>
<td></td>
</tr>
<tr>
<td>- I needed help applying for VA disability.</td>
<td></td>
</tr>
<tr>
<td><strong>Hobbies</strong></td>
<td><strong>Hobbies</strong></td>
</tr>
<tr>
<td>- I need help to increase my leisure/social activities.</td>
<td>- Work on motorcycles/cars</td>
</tr>
<tr>
<td>- My guys (employees) are sworn to refresh my memory</td>
<td>- Remodeling old house; refinishing old dressers</td>
</tr>
<tr>
<td>- I have just been rated 70% disabled with the VA so I will get job placement assistance</td>
<td>- Love to work outside; landscaping</td>
</tr>
<tr>
<td><strong>Interpersonal Interactions</strong></td>
<td><strong>Interpersonal Interactions</strong></td>
</tr>
<tr>
<td><strong>Communication</strong></td>
<td><strong>Communication</strong></td>
</tr>
<tr>
<td>- I need to talk to someone who knows what I have been through.</td>
<td></td>
</tr>
<tr>
<td>- I need others to understand how my brain injury has affected me.</td>
<td></td>
</tr>
</tbody>
</table>

(Continued)
### Needs and Concerns

<table>
<thead>
<tr>
<th>Relationships</th>
<th>Strategies and Advice</th>
</tr>
</thead>
<tbody>
<tr>
<td>• I need to spend time with buddies from my unit.</td>
<td>Relationships&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>• I do not spend time with my friends like I did before I was deployed.</td>
<td></td>
</tr>
<tr>
<td>• I do not feel close to my spouse and/or kids.</td>
<td></td>
</tr>
<tr>
<td><strong>Support</strong></td>
<td><strong>Support&lt;sup&gt;a&lt;/sup&gt;</strong></td>
</tr>
<tr>
<td>• I need help accessing resources in the community, e.g., veteran organization representatives.</td>
<td></td>
</tr>
<tr>
<td>• I need help understanding and filing for service-connected benefits.</td>
<td></td>
</tr>
<tr>
<td><strong>Community Re-integration</strong></td>
<td><strong>Community Re-integration</strong></td>
</tr>
<tr>
<td>• I need help dealing with feelings that I want to go back into the service to my unit</td>
<td>Return to combat unit</td>
</tr>
<tr>
<td>• I need help with social reintegration</td>
<td></td>
</tr>
<tr>
<td><strong>Adaptation to Society</strong></td>
<td><strong>Adaptation to Society</strong></td>
</tr>
<tr>
<td>• I need help adapting, transitioning; help finding resources to assist me</td>
<td></td>
</tr>
<tr>
<td>• I need help accepting what has happened</td>
<td></td>
</tr>
<tr>
<td>• I need recognition of my military service</td>
<td></td>
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<tr>
<td>• I need structure in my daily life</td>
<td></td>
</tr>
<tr>
<td><strong>Expectation of Others</strong></td>
<td><strong>Expectation of Others</strong></td>
</tr>
<tr>
<td>• I need help dealing with family/others’ expectations of me</td>
<td></td>
</tr>
</tbody>
</table>

*Abbreviations:*<sup>a</sup> Strategies nor advice identified by Veterans with mild traumatic brain injury.

As you have identified categories and themes and provided compelling evidence with the use of coding, the researcher is now ready to ask the question, “What does this mean?” This is when you need to make connections of the themes back to the data. Again, review your research questions here! Ask yourself, “What did I want to know?” and “What did I want to find out?” This will assist you when you are considering the connections and keep you on track.

**Searching for Alternative Understanding**

As with any type of research, qualitative or quantitative, the researcher should also identify alternative explanations for the findings. Was there something unique about the interviews that may have affected the findings? Rereading the themes and categories to challenge yourself as the researcher, to come up with a different perspective of the data, is important. Why do you think the data came out the way it did? What is unique about the data? How will you “back” up your findings? These are questions you need to answer here to see whether alternative reasons exist for your conclusions that may not have originally been part of your research question.

**Writing the Report**

Chapter 14 is devoted to writing the results and discussion, but let us discuss briefly how the qualitative research results should be presented. The results should be presented with descriptive narratives. Thick descriptions, which come from your coding of your categories and themes, should be used as evidence of your categories and themes. Just like the mean and standard deviation are often used to represent quantitative data, the codes that provide evidence of the themes are data too. Long and short text-embedded quotes are used to help the reader understand the categories and themes, as well as to use the participants’ voices. In addition to the amount of text that will be presented in the results, the researcher can also use figures and tables to present the data, just like in a quantitative results section. Examples of using tables and figures to help the reader understand the results of a qualitative research design are presented in the Research to Practice.

**RESEARCH TO PRACTICE: USING TABLES AND FIGURES TO PRESENT QUALITATIVE FINDINGS**

Refer to following studies to see ways in which qualitative data can be presented.


Moreira and Peixoto provide tables, figures, and pictures to present qualitative findings.


These researchers provide tables and figures to present their findings.
RESEARCH TO PRACTICE: USING EXCERPTS TO PRESENT QUALITATIVE FINDINGS

To provide a better understanding of how the data are presented in a qualitative research design, we direct the reader to the following qualitative research examples that we provided in Chapter 6. When reviewing these articles, look to see how the researchers present the qualitative findings.

NARRATIVE INQUIRY


CASE STUDY


STIMULATED RECALL


FOCUS GROUP


Trustworthiness of the Data

As you begin writing your results, you also need to provide the reader with evidence of trustworthiness of the data. Recall in Chapter 5 when we discussed quantitative research designs, we included the concepts of internal and external validity. Internal validity is related to how the results of the study can be attributed to the research design, whereas external validity addresses whether the results can be generalized to a larger population. In qualitative research, we do not usually use terms such as internal or external validity, but we do use the term trustworthiness.

Essentially, the question we want to ask is, “How can the researcher assure the audience that the findings of the study are accurate and believable?” With the following...
strategies, the researcher can assure the accuracy and believability of the study: prolonged engagement, peer debriefing, member checking, and triangulation.

**Prolonged Engagement**

Prolonged engagement refers to the amount of time the researcher can spend within the research setting. The longer the engagement, the longer the researcher has to understand and observe the participant(s) in the setting.

If the researcher is involved in the setting long enough, he or she can detect and observe nuances that may be connected with the data. In addition, the longer the researcher is engaged in the setting, the more time the researcher has to learn the culture of the setting as well as gain the ability to build trust among the participants. These are crucial pieces when attempting to get at especially sensitive issues.

**Peer Debriefing**

Peer debriefing is an important verification for the researcher. This is used to allow the researcher to discuss his or her findings with another party.

As the researcher is analyzing the data, he or she also meets with an outside party to ensure accuracy of the themes and categories that the researcher is developing. This process keeps the researcher honest. The role of the peer debriefer can take on almost a “devil’s advocate” role in which the person can ask challenging questions to the researcher. This can also help to discuss specific meanings, interpretations, and next steps in the data analysis phase for the researcher. In addition, this process also can help to clear the mind of the researcher, especially if he or she is dealing with sensitive issues. It can help to minimize judgment of the researcher.

**Member Checking**

Another important step in the verification of data is member checking. Here, the participants are given the opportunity to check their own responses. The copies of transcripts can be presented to the participants for review, and then participants can correct errors or add additional comments about an issue.

This is an excellent opportunity to provide a summation for the researcher and participant.

**Triangulation**

Triangulation refers to the act of bringing more than one source of data to bear on a single point. Triangulation is a process of determining the location of a point by measuring angles rather than measuring the distance between points. The term was derived from the navigational sciences, and this method is used by navigation and surveying occupations.

From a qualitative point of view, triangulation refers to the process of taking data from a number of different sources to confirm, expand, or clarify the data. Having more than one data gathering method, such as observations, interviews, and record review, would strengthen the trustworthiness of the study. Therefore, when you begin to collect data, you need to also think about how you will verify the interviewees’ responses. Can you receive confirmation or clarification from another source, from personnel records, or from observations? Having multiple data points makes your results more accurate and believable. You are using multiple data points to confirm your findings.

These forms of trustworthiness that were discussed need to be identified within the research design. Usually, in the data analysis section, you will find researchers discuss
how they were able to provide evidence of trustworthiness of the data. The analysis of qualitative data can prove to be a daunting task. The amount of data the researcher collects can be enormous. However, if this is the best way to answer the research question, then this form of data analysis is the most effective. The same can be said with a quantitative research design. Often researchers begin with vast amounts of data and are “crunching” numbers during quantitative analyses. Immersing yourself in the data is used in qualitative data analysis. The steps to research are the same no matter what design you chose to best answer your research question. Examples of providing trustworthiness in qualitative research can be seen in the qualitative research examples provided in Chapter 6 and presented again, in this chapter under Research to Practice—presenting qualitative findings. These studies also provide information on how the researchers established trustworthiness of the data.

**SUMMARY**

Qualitative data analysis can be overwhelming. As with any research design, developing a systematic plan of attack as to how you will record and manage your data is essential. Whether you use a computer software program to manage your data or a by-hand method, you need to find a process to be able to most effectively organize and retrieve your data. Marshall and Rossman (2006) identified seven procedures for qualitative data analysis: organizing the data, immersion in the data, generating categories and themes, coding the data, offering interpretations through memos, searching for alternative understanding, and writing the report. Although these procedures have been presented in sequential order, they can happen concurrently or simultaneously. Once you have developed a plan to obtain, manage, and organize your data, the other procedures may appear less daunting or overwhelming. These initial steps can prove very helpful during analysis. The last concept that was discussed was the concept of trustworthiness. The main question we ask here is how can the researcher assure the audience that the findings of the study are accurate and believable? The researcher can assure the believability of the data through triangulation methods, prolonged engagement, peer debriefing, and member checking. As we emphasized in the beginning of the chapter, this is only a mere introduction to the very vast methods of qualitative data analysis. The reader is encouraged to consider reading more in-depth procedures under the recommended readings online.

**Applying What You Learned**

1. Discuss the similarities and differences between a qualitative and quantitative research design, as well as how both are different with respect to the data analysis.
2. Explain how trustworthiness is obtained and how that impacts the data analysis and conclusions that are made by the researcher(s).
3. Provide your own Research to Practice example of a qualitative research study and identify the ways in which they collected data, how they analyzed the data, and how they ensured trustworthiness, as well as how they presented their results.

**Key Terms**

Member Checking
Peer Debriefing
Prolonged Engagement


WHAT IS THE NEXT STEP in the research process after data analysis? The last step in the scientific method includes formulating findings and conclusions. Additional courses in statistics may warrant appropriate analysis of your results, yet at this point we will also ask you “so what?” now. The “so what” factor will be discussed when you begin the final step of the scientific method of formulating findings and conclusions.

You are ready to write the results and discussion and think about presenting your research study. How the data should be written and presented in a Results section, as well as what goes into the discussion, are presented in Chapter 14. Here is where the “so what” factor is discussed in more detail. Additionally, poster and oral presentations are discussed in Chapter 15. Content that should be included in both types of presentations are discussed, as well as basic considerations to ensure effective and efficient presentations. These last chapters are designed to provide you with the resources to write your results and discussion (Chapter 14) and then to provide the tools to present your research, whether in poster format or orally (Chapter 15). Good luck!
WHAT YOU’LL LEARN

- How to write the Results section
- How to write the Discussion section
- How the “so what” factor plays a role in the last step of the scientific method
- How to write an abstract to summarize your overall research project

You have spent a lot of time researching your topic, developing your research design, collecting data, and analyzing your data. Now it is time to write about your findings. In this chapter, we provide you with information on how to present your research findings, regardless of the type of data you obtained. Whether qualitative or quantitative or both, you will be given tips and suggestions as to how to effectively present your research findings. Then, we will discuss how you can take what you found and offer conclusions, connect your results to past research, and discuss how the findings can be helpful to the practitioner.

You have worked hard at developing your research topic and collecting data in a careful and systematic way. Now, you are ready to present your results and offer ways in which your research can add to the existing body of research. This is the last step of the scientific method, which is to formulate findings and conclusions. Before any discussion can take place, the Results section needs to be written. Interpretation and evaluations are made of the current research, as well as suggestions for future research, in a Discussion section. The Discussion section reiterates the Results section, without any statistical jargon. Once you have completed the research process, you can summarize your study in the form of an abstract.

Results Section

Before we discuss the specifics of the Results sections, we offer a few suggestions. First, before beginning your Results section, make sure to review your analyses with your advisor. Questions you should be asking include:
■ Are the data lined up correctly?
■ Are the analyses selected correct?
■ If the data are quantitative in nature, what does significant mean?
■ Should I use tables/figures to present my findings? If so, which ones are most appropriate?
■ Do I need subsections for my results?
■ If qualitative in nature, have I saturated the data enough?
■ Have I identified all possible themes and categories?
■ Do I need to return to the data again?

Lots of questions! Remember, research is a careful, systematic approach to problem solving. You have not finished solving the problem yet. You also need a systematic approach to presenting the data. The first step is to verify the results. When you do meet with your advisor, make sure you come prepared to discuss the results of your research study. Because this is your research study, an expectation will be that you have run the analyses or qualitatively explored the data. Review Chapters 11 through 13 to make sure you understand your data analysis. You should use this meeting as a check to ensure that you have considered everything. Also, have questions yourself, such as those just mentioned. During and after this meeting, you can then begin to develop an outline of what you need in the results.

The second suggestion we have before you start writing is to consult a well-written current journal article in your content area. This can provide a great deal of information as to how the results should be presented. What kind of tables or figures do they use? How do they begin the Results section? In addition, ask your advisor what his or her expectations are for the results. A journal article often can compact the Results section. Many times, it is this section that gets cut down because of space issues in publication. From a student research perspective, your advisor may expect more detail. Confirm his or her expectations before you begin writing. Additional resources that may be beneficial for you to consult are included in the Tip: Additional Resources for Writing Up Your Research Study.

**Writing Your Results**

The beginning of your Results section should provide the reader with a general introduction to the purpose of your study and include an overview of your research design. Even though this may seem redundant from what you have already written in the introduction, revisiting the purpose of the study is important to provide a context again for the Results section. Also, despite the fact that you just wrote your methods, you cannot assume that readers will read sequentially.

**TIP: ADDITIONAL RESOURCES FOR WRITING UP YOUR RESEARCH STUDY**

Some readers may move through a journal article in a random fashion. They may review the introduction, skim the methods, and go right to the results. Therefore, although it may seem duplicative, we always suggest beginning the results with an introduction to the purpose of the study and a brief statement of the analyses that were performed. While discussing the analysis, this is where you should also provide some general descriptions of the variables. Depending on what your measured research variables include, you may need to note how the scores were determined. If applicable, you need to indicate any data that were excluded from the data analysis and why they were ethically excluded, which may include not completing the research. Please refer to the Tips: Introductory Paragraph for the Results Section for what to include in the introductory paragraph.

**TIP: INTRODUCTORY PARAGRAPH FOR THE RESULTS SECTION**

The first paragraph of the Results section should include the following points:

- Review the purpose and research design
- Introduce statistics used in the data analysis
- Define what scores were used to measure variables and how the data were condensed, such as total score used, average score used, or best score used.
- Include information on the number of participants selected and deleted, if applicable.

After the general introduction to the Results section, you may introduce descriptive statistics that includes demographic data about the participants. Or, you may include additional tables that are related to the dependent variables you measured; however, this will depend on how much data you have. If you were examining group differences, you may separate the groups and provide means and standard deviations for the reader to review. Keep in mind at this point you have not reported your results yet, so do not provide any conclusion statements such as, “The males had higher scores on the sexually transmitted diseases knowledge test than females.” You have not reported your results yet, you cannot state these differences.

If you are presenting qualitative findings, you want to introduce your purpose and perhaps include your research questions. In the beginning of the Results section, you want to identify the themes and categories that were identified during data analysis. A table of these themes and categories can help the reader get an overall picture of the themes you will be presenting in the results. Refer to Chapter 13 for examples of presenting qualitative data analysis used by researchers in the Research to Practice section on using Tables and Figures to Present Qualitative Findings.

When reporting the inferential statistical findings of your analysis, consider presenting the findings in a linear format. Briefly introduce each analysis that was performed. Report the basic assumptions that are related to the statistical analysis. Were any of these assumptions violated? If you need to, review Chapters 11 and 12 for these basic assumptions. If you decide to have a summary table of the analysis, you can introduce the table here. At the end of your description of the inferential statistics, finish the write-up with a properly worded statement of the findings. Again, you may need to review Chapter 12 for examples of statistical findings for the various statistical analyses. Remember, depending on the research question, you may have more than one analysis, or you may have run the same analysis for a number of variables. Make sure to introduce your independent variables first, then your dependent variables. In the

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<th>The first paragraph of the Results section should include the following points:</th>
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<tr>
<td>Review the purpose and research design</td>
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<tr>
<td>Introduce statistics used in the data analysis</td>
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</tr>
<tr>
<td>Include information on the number of participants selected and deleted, if applicable.</td>
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case of a correlation, present your predictor variable (X) before your criterion variable (Y). When you write your statistical findings, you may be able to combine findings. For instance, perhaps two of your dependent variables were not significantly different among the groups. You could combine a statistical finding statement to include both of those variables. If you found that two variables reacted significantly in the same way more for one group than for another, then you can combine those statements. Please refer to the Tip in this section for more on the remaining paragraphs of the Results section.

**TIP: REMAINING PARAGRAPHS IN THE RESULTS SECTION**

Later paragraphs of the Results section should include the following points:

- Presentation of analysis or analyses, which were computed to answer your hypothesis or hypotheses
- Presentation of any tables or figures
- Statistical findings

**PULSE CHECK**

What are the components of the Results section?

For qualitative research, instead of reporting numerical data and the statistical analyses that were performed, you are summarizing the major themes from the data. As discussed in Chapter 13, you are using the voices of your participants to document those themes. The codes that you identified in your data analysis serve as evidence and verification of these themes. As you identify the themes and categories of your data, you will use direct quotes from the participants to serve as the data. Refer to Chapter 13 for examples of how the data are presented in the results.

To summarize, in the Results section, you should report only the results. Keep it short and clearly and precisely worded. Avoid providing explanations of any results. Your explanations of the results and why they turned out the way they did will be included in the Discussion section. The purpose of the Results section is simply to state what you found based on your data analysis. The discussion expands on and explains these findings. In the Discussion section, the researcher offers conclusions, connections, and future directions.

**Discussion Section**

What now? Once you have finished putting the results together, you are ready to begin the most important part, your Discussion section. This is the opportunity for you to clarify your design, summarize your findings, relate your findings to those of other researchers, add any meaningful insights or interpretations, and provide recommendations for further research needed in this area. Even though you may be excited to have your study complete, the discussion is a critical component of the research study; do not short-change this section. This section provides you the opportunity to discuss
your findings. You should reflect on your findings and help the reader to understand the significance and implications of your research. This section is critical to a reader’s perception of the importance and quality of your research.

Now that you have your results—so what? What does this mean? What does this imply? This is an attempt to critically evaluate the research findings. Many times, this is where the practitioner is looking to determine how the study’s findings can best be used in practice. Before you sit down to write, imagine discussing your study and your findings with someone who has no background in the field. What would you say? What points would you highlight? Why are these points important? Answering these questions can help you to begin writing your discussion in a way that addresses the “so what” factor.

Be sure to stay close to your data. When making statements about what the data mean, or why they are important, you need to ensure that you can point to specific data that back up these claims. Avoid leaps of faith! For example, even though you may have found that students in the experimental group who listened to classical music in the background scored higher than the control group from the pretest to the posttest, you cannot say that listening to classical music makes you smarter. When writing the Discussion section, you should continually ask yourself, “Where do I have the data that allow me to make such a statement?”

These suggestions should provide you with some direction when you begin writing. As with the Results section, we encourage you to look at related journal articles and past research at your school. What was expected of past students? What is emphasized in related journals? How do the researchers present their discussion? What do they include first, second, or third? How do they conclude their discussion? You should outline the answers to these questions before you start writing. Be sure to have a plan before you begin writing the discussion. Think about how your research results relate to past research; reread your review of the literature; reread your introduction. Again, what empirical research did you use to make a case for your research in the introduction? Now you are answering the question, how does my research relate to the related research in my introduction? What does my research study offer practitioners and other researchers?

When you started this research process, we suggested that you go to the Discussion section of the research to identify how the researchers made connections to theory and past research. Additionally, we suggested that you consider following their future suggestions. No, it is time for you to offer future suggestions based on your findings. As you begin to sit down and write your discussion, have a plan or outline in place. The careful, systematic approach to problem solving still applies! Identify the related research you will use to support or dispute your own research claims. Consider what methodological issues you will want to highlight and how they may have influenced the outcome of the study. Identify the practical applications of your research, the “so what” factor. Finally, consider what future research ideas may be appropriate given your results. As you begin to outline and highlight these issues, you will begin to see your discussion take shape.

**Writing Your Discussion**

Within the Discussion section, you need to present the information in a sequential fashion. Your first paragraph should repeat the purpose of the study. Clarify what you were trying to do in your study. Next, you should provide a brief summary of your statistical findings. Yet, this time you will not use statistical jargon to present the findings, rather clear and concise language. After this first paragraph, you will begin to discuss your findings.

In the paragraphs that follow the introduction of the discussion, you may first relate your findings to other literature. The introduction to your research was building a case
for why your research was so important. Now, you are referencing past research to identify how your research agrees or disagrees with this past research. You do not want to repeat what was said in the introduction; however, you need to discuss how your research either supports or contradicts the related literature.

Another important point to bring into the discussion is methodological implications. Here you would emphasize any methodological issues that came up during the study. Identifying these issues can help you to develop more effective designs in the future. Another point you want to bring up is any limitations to your study. This is quite a balancing act. Identifying shortcomings of the study is important; however, you do not want to be overly critical of every minute detail about your study and need for improvement. The final piece of the discussion is twofold: identify implications or applications of your research, as well as possible future directions for research. If you think back to how you developed your own research question, you may have actually identified your direction by reviewing suggestions that were identified in a research article. For an example, please refer to the Research to Practice: Discussion Section.

**PULSE CHECK**

What are the components of a Discussion section?

We encourage you to take your time and read the examples we provided for the Results and Discussion sections. We also encourage you to review samples of past research at your institution, as well as review key research journal articles in your area. These are all excellent resources to help you along the way. Get a feel for how the researchers presented the findings and then reported on them in the discussion. What kinds of tables or figures were used to help the reader understand the data? Can you find the “so what” factor in the discussion? These are just some questions you may want to consider as you read the examples. Reading other research is the best way to improve your own scientific writing style, as well as using the examples as powerful learning tools. When you are writing your Discussion section, please see the Tip: Writing Your Discussion Section to make sure you are staying focused.

**RESEARCH TO PRACTICE: DISCUSSION SECTION**

- The first paragraph of the Discussion section should include the following points:
  - Clarify what you were trying to do in your study in a clear statement
  - Summary of findings without any statistical jargon
  - Example: When examining total pedometer scores, physical activity levels were higher when music was playing during warm-up and game time in physical education class. Playing music during the warm-up and game portion of a physical education class may improve the amount of physical activity performed by students.

- The following paragraph(s) should relate findings to research presented in the introduction.
  - Compare and contrast findings from the current study with other research, as well as
Suggest possible reasons for the current findings being a result of problems and limitations

- References made to ideas brought up in your introduction
- Example addressing limitations of the current study: There were however, some limitations among the current study that may have affected the results. During the no-music condition, there was a fire drill at the school, which could have influenced the student’s activity levels. In addition, the study was conducted in a small suburban school; therefore, the results may not be generalizable to larger urban school systems.

The remaining paragraph(s) should suggest more generalized conclusions and future research directions to address more quality research. Additional research questions that arise as a result of the current study conclude the Discussion section.

Example: The implication of this study is that music can serve as a motivational tool to increase students’ physical activity levels. Future research can be done using more technology, such as heart rate monitors, to get accurate levels of physical activity and intensity of exercise. Additional research is needed to explore what motivates children to be physically active and increase their activity levels.

TIP: WRITING YOUR DISCUSSION SECTION

- Make sure you give enough time and effort to writing up your conclusions, research connections, and future directions. The Discussion section is a critical section, yet at the same time, do not feel like you need to go on and on with your discussion.
- Make sure when you are writing the discussion to go back to the outline you developed; stay close to your data and your research study. It is very easy to drift off into another research track.
- Make sure that when you are writing your discussion, you are writing about how your results:
  - Influence the current body of research
  - Provide practical applications to your field
  - Offer future directions for related research

Writing Your Abstract

Although this is the first part of a journal article you may read, it is often the last part of the journal article that is written. The abstract is a short, informative, and descriptive summary of your research study. The abstract should be written after the study is completed. You need to analyze and interpret the data before you can summarize your research study. Additionally, your abstract should be descriptive and as such should identify the statement of the purpose and scope of the research study to start. The abstract should also be informative and summarize the entire research study. The abstract gives the reader an overview of the methods, findings, and conclusions of the study. The difficulty arises in that the abstract must be short, and typically not exceeding one paragraph. In total, the abstract should not exceed 400 words. After
the abstract, you should also identify three to five key words that would be used to describe your research study. Again, you are encouraged to review existing abstracts, whether they are from your institution or from a journal. We encourage you to review the articles we have referenced throughout this text and review the abstracts from the research articles. Note the information the authors provide. This is really the first piece of information most people go to when deciding to read the article. Make sure to provide the most pertinent and interesting details in the abstract. Follow the guidelines presented in the tip in this section for help in writing your abstract.

PULSE CHECK

What are the components of an abstract?

TIP: WRITING YOUR ABSTRACT

Perceived Motivational Climate and Beliefs about the Causes of Success Among Student-Athletes

Justin Case

Abstracts must include a title, which should include the research variables examined and the targeted population. Titles are typically approximately 10–12 words and should not exceed two lines. Titles should also be centered. Names must be included under the title, which is also centered. The abstract itself must be written in block paragraph form, using APA style. Abstracts should begin with the purpose and design of the study. Next, a brief overview of the methodology, including sample size and how variables were measured, should be presented. Results should be followed by conclusion statements. Go beyond stating significance or nonsignificance; include what is happening to the research variables examined, the “so what” factor. The conclusion or conclusions should be compared with your research journal articles. Synthesizing research is imperative, because there is not enough room in abstracts to ramble on and on. Abstracts should end with future research directions that are warranted.

SUMMARY

You are finally ready to write your results and discussion! You have been waiting to get to this point for some time. However, writing these sections does take some planning. Remember, you have worked very hard to develop your research design, collect your data, and analyze your data. Now, you are ready to report your findings and offer some conclusions about the findings. Before you begin your results, take some time to review your analyses and discuss your results with your advisor. Questions to consider include: Are the selected analyses correct? What does significant mean? Should I use tables or figures to present my findings? Did I saturate the data enough if qualitative analysis was used? Although this may seem like many questions to consider, remember, research is a careful and systematic approach to problem solving. Even the write-up of the results and discussion needs to be careful and systematic. Before writing, you should also consult a well-written journal article to use as a model when reporting
your data. As you begin writing your results, remember to first provide a general introduction and then move into general descriptive information. Once you have provided the background information, then you can report on the major findings of your study. The discussion is a very important part of your research. Here, you will clarify your design, summarize your findings, relate your findings to past research, and add meaningful insights and interpretations to your findings. In your discussion, do not forget to address the “so what?” factor. Make sure to emphasize the meaningfulness of your results. Writing your results and discussion is an exciting and culminating experience of the research process. Make sure to give these sections as much time and consideration as you have with your other pieces of the research.

**Applying What You Learned**

1. Identify some things you can do beforehand to better prepare yourself to write your Results section. Include what tables or figures you should include in your results.
2. Provide an example of a results statement and a corresponding conclusion statement that is aligned and goes beyond any statistical findings.
3. Using your example above, identify the “so what” factor of your Discussion section.
4. Again, using your example, identify elements to include in the abstract along with three key words.

**References**


WHAT YOU’LL LEARN

- How to decide what information will be included on your poster presentation
- How to effectively design a poster presentation
- How to prepare for the presentation of the poster itself
- How to decide what information will be included in your oral presentation
- How to put together and deliver an efficient oral presentation

Many times, not only are students expected to submit their written research work, but also may be expected to present their research project. Presenting research can take different forms, such as a poster or oral presentation. This culminating experience is exciting, yet it can also be nerve-racking to some students. You have been invested with your research project all semester or perhaps over multiple semesters; this is your opportunity to share your research interests and findings with others. If you are a little nervous, we encourage you to take a moment and realize how hard you have worked; this is your research project, and at this point you should be extremely familiar with your topic. Often a sense of nervousness comes from a lack of knowledge and confidence. You have the knowledge base from being invested in your topic, and we hope by the end of this chapter you will have the knowledge base of what goes into both poster and oral presentations. We will provide you with tips to successfully present your research in either poster or oral form. Whether you are required to create a poster or present your research orally, the information provided in this chapter will assist you with your presentation preparation. We hope that your strong knowledge base will improve your confidence levels and that you are excited to share your results with others, so they can learn from you.

Poster Presentations

A final capstone experience may be to present your research study to peers and departmental faculty in the form of a poster presentation. Usually this component of the research is completed at the same time or after you have submitted a final written copy of your work. Remember, we are only providing general guidelines for the poster; your school or institution may have other and more specific guidelines for you to follow. Make sure that
you also refer to those guidelines as you develop your poster. Any opportunity for you to present your research project at an undergraduate research day at your school or institution or at a state or regional conference is strongly encouraged. Not only will the experience help you professionally, but others will also benefit from your research project.

**Anatomy of a Poster Presentation**

A research poster usually includes the following: Title, Introduction, Methods, Results, and Discussion. Do these headings look familiar? They should; these are the components of a research journal article and are the headings used to write up your research study. Presenting your research in poster form enables you to present your Purpose, Methods, Results, and Discussion in a more visual manner. If you have completed a case study or systematic review, your poster headings will be aligned with the evidence-based practice approach. Poster components are not always the same due to the nature of the research question. Case study posters following PICO are presented online, as well as additional poster templates to meet a variety of research approaches.

Nevertheless, all individuals who view and read your poster should still be able to have a good idea of what you did, why you did it, and what the outcomes were. It is your job to extract the most important points from your written work to place on your poster. Keep in mind the poster is a visual document, and tables and figures will often assist you in capturing the essence of your study. Remember the saying “a picture is worth a thousand words.” You do not want to include only text on a poster, but you will also include tables, figures, or pictures that enhance the viewing ability of your poster. When text is included, it should be in bulleted format or summarized from your written report. Additional considerations for creating effective poster presentations are presented later in the chapter.

**Title**

First and foremost, your poster needs a title. Your title should include the title of your research, your name, and the name of your department or affiliation. If you are presenting among other schools or institutions, the name of your college or university should also be included. This provides the reader with information about who you are, which department you worked under, and a descriptive title of your research study. The title of a research study is sometimes scrutinized well after the results and discussion are written. Every word of the title should be meaningful, and your title needs to describe your research study. Take time to consider how you can provide an abbreviated description of your research. Your title should provide the reader with a general idea of what and who you studied. Also keep in mind the type of data analysis that was completed and how that may affect how your title is written. When you are working with your advisor on a title, take a look at titles of research within your content area. These titles can assist you in developing your own title. An additional resource to consult is Chapter 2 of the *APA Manual* (6th ed.), which is titled “Manuscript Structure and Content.”

**TIP: TITLES OF YOUR POSTER PRESENTATION**

- Titles should be at the top and centered, using a large font size; a font size of 80 is suggested. You want the readers to see the title first to capture their attention.
- Name and affiliated department should be presented below the title using a smaller font size; a font size of 60 is suggested.
Methods
The next component of your poster is the Methods section. The Methods section may be divided into a number of smaller sections, similar to the Methods section in your research study. The Methods section should explain who, what, when, and how you completed your study. Specific subsections will be unique to your research and selected based on the scope of your research. Sample subsections may include participants or subjects; measuring instruments; and procedures or testing protocol. The later subsection may be more specific to better reflect the scope of your research and may include treatments, training sessions, or lesson plans. Typically, Methods sections end with a description of the data analysis that was carried out. Quantitative data analysis would be reflected in the Results section, and a specific stand-alone data analysis may not be necessary. Conversely, the process employed during qualitative data analysis is important to summarize on a poster presentation. Please refer to the tip in this section on presenting your methods.

TIP: PRESENTING YOUR METHODS
- When writing the titles of the subsections, a font size of 44 is suggested.
- Have a picture when presenting a specific technique or protocol used in your methodology. Pictures or graphics can be very helpful to the reader to get a better understanding of your research design.
- Include tables and figures when appropriate to summarize qualitative data collection and analysis.

Results
The Results section on a poster is very similar to that of a written journal article; the main findings of your research are presented without interpretation. Here is where
Presenting your research

In addition to these main components of the poster presentation, you may also want to include references and acknowledgements. References may be one of the last sections of your poster. Often the people who are viewing your poster may be very interested in another study that you cited on your poster. These are the references that were

Discussion

The Discussion section provides the audience with the findings of the study, yet in a “real-life” context. Here, you should present the findings of your study in laypeople’s terms. Avoid the statistical jargon that you used in the Results section. Relate the findings of other studies that were reviewed in the context of your research study. Discuss how your findings could be applied for practitioners within your field. Think about the “so what” factor that we previously mentioned and critically evaluate your results. Finally, describe suggestions for future research. Here, you should expand on how the research can be altered: other tests that could be applied or other samples that could be studied. Please refer to the tip in this section on presenting your discussion.

TIP: PRESENTING YOUR RESULTS

- Include tables and figures when appropriate to analysis. Refer to Chapters 11 and 13 for examples of appropriate tables and figures that align with the different types of data analyses.
- Include tables and figures when appropriate to summarize qualitative data collection and analysis. Refer to Chapter 12 for examples in the Research to Practice section.
- When writing text within a figure, a smaller font size of 14 is acceptable, because the main focus is on the visual content.

TIP: PRESENTING YOUR DISCUSSION

- Relate findings back to the critical research that was presented in the Introduction of your poster. How were the results similar or different? Think about the differences among the research designs and also the limitations of your current research study.
- Focus on the practical applications and how your results can be used by those who may be reading your poster presentation.
- Provide suggestions for future research that is warranted as a result of your current research study.
- For text, a font size of 20–24 is suggested.

PULSE CHECK

What are the components of a research poster presentation?

In addition to these main components of the poster presentation, you may also want to include references and acknowledgements. References may be one of the last sections of your poster. Often the people who are viewing your poster may be very interested in another study that you cited on your poster. These are the references that were
essential to developing your research design and provided you the ability to draw conclusions about your research. These citations should be identified and recognized. Whether you decide to have copies of the references available or include them on your poster, having the references available is an important part of your poster.

The final piece of information that may be included on your poster is an acknowledgments section. Identifying the individuals who helped you along the way is important. These could include your advisor, other students, and most importantly, your participants! If not for your participants, you would never have made it to this stage. In addition to specific individuals, you may have had a sponsorship from a corporation or local company. Perhaps a local fitness center allowed you to access their members for data collection. Or perhaps you were able to use their facilities for data collection. Acknowledging these types of sponsors on your poster is a way to say “thank you” for their support in your research. Please see Figure 15.1 for an example of a research poster presentation template of how you can set up your poster. There is no “right” way to create your poster, but the template provides an example of the basic anatomy of a research poster presentation. Additional considerations in the poster, such as appearance and design, as well as the presentation of your poster, are discussed in the following sections.

**Basic Considerations of a Poster Presentations**

The content of your poster will come from your research project; thus, most of your time will be spent deciding how to present and organize your information on the poster itself. Making the poster aesthetically pleasing is the hard part. Remember, the poster needs to communicate to the reader what you did in your research study. With this in mind, the poster needs to be well-organized and inviting. Although this may seem overly detailed, even your selection of colors, as well as font styles and sizes, will play a critical role in the effectiveness of your poster.

![Figure 15.1 Poster Template](image-url)
Developing the Design of Your Poster

Your poster presentation is another chance to tell the research story. In most instances, a standard size for a poster is 3 feet by 4 feet. You must consider all the space you have on the poster and use it wisely. The best advice, just as in any scientific writing, is to be concise and clear. Being straightforward and maximizing the space on the poster is essential. Think about how you will lay out your “story” to the viewer. The best way to do this is sketch your ideas out before you get to the computer. This will give you a better idea of how you will use your space. During this time, consider what figures, tables, or pictures you may use to help tell your story. Where will you place them in the context of your text? Be sure to consider these before you begin developing your poster. Additionally, please see the Tip: KISS-LL Principle.

TIP: KISS-LL PRINCIPLE

- We suggest that you keep the KISS-LL principle in mind during your preparation of your poster presentation—KISS-LL: Keep It Simple and Short, but also Likeable and Learnable!
- Think about how you can present your ideas using bulleted text or timelines—something that can represent your work and will be easy to read. A reader will not want to read long narratives on your poster. Find a way to abbreviate your work or present it differently, but still in a format that is likeable and learnable.

Examining the Appearance of Your Poster

Once you have an overall idea about how and with what you will tell your research story, consider some more specific details about colors, as well as font styles and sizes. Do not try to impress readers with unique or loud colors; keep it simple and professional. As you plan your poster, consider contrasting colors for the background and font color. A white background can appear clean, crisp, and neat. If you are using a white background, a dark blue or black font will be easy to read. If you do choose a dark background, you would need to consider a lighter shade for the font, such as white or gray. Keep in mind that, depending on the printer, it may cost more to print a darker background and will always cost more when printing in color.

As you consider your fonts, make sure to stay with one font style and do not get too fancy. Fonts that are clean and neat include Arial, Times New Roman, and Helvetica. Try to stay away from the fancier font styles such as Gothic or Garamond. These types of fonts may be more difficult to read. As you begin writing out your poster, also consider your font size. The title and headings should be larger than the text itself. In addition, the text should be easy to read from about 4 feet away. Font sizes of approximately 20 points should be sufficient for people to read from that distance. Try to avoid font sizes smaller than this on the poster. The only instance when you may go smaller is for headings or legends in your figures, in which case 14 points is sufficient and acceptable. The general rules for font sizes are presented in Table 15.1.

Using only text would not draw attention to your poster, and the audience would find it tedious to read. Tables and figures, as well as pictures, are a great use of space, and visuals are always encouraged in a poster. However, make sure they are appropriate for the presentation. Avoid graphs that are too busy and difficult to read. One way to make a graph clearer is by using a legend. The legend is another name for a key, which provides information about the variables that are represented on the graph. If you need to include a number of variables on the graph, have a clear legend or key as a reference for the reader. Also, make sure to use colors that will be easy to view. For example, if you are using a white background and you decide to use yellow to depict a specific
Table 15.1  Font Styles and Sizes for Your Poster Presentation

<table>
<thead>
<tr>
<th>Title</th>
<th>Size</th>
<th>Here is your title using Arial</th>
</tr>
</thead>
<tbody>
<tr>
<td>Name</td>
<td>60</td>
<td>Here is your name using Times New Roman</td>
</tr>
<tr>
<td>Subtitles</td>
<td>44</td>
<td>Here is a subtitle of methods using Helvetica</td>
</tr>
<tr>
<td>Text</td>
<td>20–24</td>
<td>Here is text using Gothic font style that should be avoided.</td>
</tr>
<tr>
<td>Text within figures</td>
<td>14</td>
<td>Here is text using Garamond font style that should be avoided.</td>
</tr>
</tbody>
</table>

variable on your graph, readers will find this difficult to see. Using contrasting colors in the graph is essential. Make sure that pictures and figures are properly labeled. They should be able to stand alone; a viewer of the figure or picture should be able to interpret the graph or picture, with the use of proper labeling and legends, without having to read the entire text on the poster. If you use other images, such as clip art, make sure it is related to your research. Do not spend a lot of time coming up with “cool” clipart; the focus of your poster is the content of your study. Many other basic considerations when preparing for the appearance of your poster are related to reviewing, editing, and reviewing your poster again to ensure accuracy and consistency. Please see the tip in this section for additional suggestions on finalizing your poster presentation.

Preparing the Presentation of Your Poster

Although the poster is the forum in which you are presenting your research, you may also have additional items at your poster presentation. A common practice is to have copies of your abstract available. If your main handout is your abstract, then include your own contact information for any additional questions or comments to you as the principal researcher. Typically speaking, the abstract is not part of the poster itself. With a relatively small amount of space available to present your research, in essence, the poster is a detailed visual of your abstract. If presenting formally, abstracts are often included in the conference or symposium material that is available to all participants. For more information on what goes into an abstract, see the tip in this section on writing your abstract and refer back to Chapter 14 for more information.

TIP: REVIEWING AND EDITING SUGGESTIONS WHEN FINALIZING YOUR POSTER PRESENTATION

- **Computer and self spell-check.** Running a computer spell-check is a must! However, this is not the only form of spell-check you should be doing; you should also be reading your work to ensure proper spelling and grammar. Spelling and grammar mistakes imply carelessness and lack of effort. Remember: this is your final product of your research project. You have worked hard; make sure your poster reflects these efforts.

- **Check for consistent style.** When developing headings for each section, check to see that they are aligned the same way. For example, if you decide to center a heading in one section, you should center the headings in all sections. Also, graphs and figures should be the same size; otherwise your poster will look disjointed.
**Check for additional edits.** After the computer and self-spell-check, we suggest you review your overall poster again. When you are reading your poster over, make sure you are looking for mistakes, illegibility, and inconsistent style. This is a painstaking process, yet you will be rewarded with a better product if you take this time and review and edit your work. Also, you have been working closely with this project for some time, so have someone other than yourself review your work too. Having another set of eyes read over the poster for mistakes, style, and legibility can provide you with valuable feedback.

**TIP: WRITING YOUR ABSTRACT**

The abstract is a short, informative and descriptive summary of your research. The abstract should be descriptive and identify the statement of the problem of the study, methodology, results, and brief conclusions of the results. Usually the abstract is one paragraph in length, and it should not exceed two paragraphs.

Another type of handout would be an annotated bibliography. Whether or not you have references on your poster, an annotated bibliography of the resources you used during your research may be helpful for interested individuals. Typically speaking, the only references on the poster are ones cited on the poster. The annotated bibliography can provide additional resources to your audience. We encourage you to use the online resources for additional suggestions and examples of handouts given at poster presentations.

In addition to preparing a handout to have at the poster presentation itself, you also should be prepared for a short presentation of your poster. Although the poster itself is intended for people to read, and you are there to answer any questions, you may be asked to provide the reader with an overview of your research. We suggest that you prepare a short one- to two-minute presentation of your research study that highlights aspects of your poster. We also suggest that you prepare a more detailed two- to five-minute presentation for those who are more interested in your topic area, as well as for those who prefer to engage in conversation and look briefly at your poster to augment the conversation. We remind you to keep in mind your presentation skills and do not read from your poster, instead provide an overview and highlight aspects of your poster for your audience.

A lot that goes into the production of a research poster. We hope these pointers can assist you in the preparation of your own poster presentation. No “right” way or exact template exists to follow when creating your poster. We encourage you to review the anatomy of a poster and the general considerations, as well as your institution’s requirements, to ensure that all required information is on the poster. You also may be required to present your work in an oral presentation.

**Oral Presentation**

The oral presentation is another way to present your research findings. This can seem very frightening at first, especially if you have never presented research before. Relax! After you read our helpful tips, you will find it is not so bad. Just like the poster presentation, you need to prepare and review your presentation. Let us use a sport analogy. You would never go into a “big” game without preparing first. Preparing for a big game could take some time and most importantly, practice. You may practice different drills and plays to prepare for your opponent. The same holds true for an oral
presentation. If you want to be successful, practice and preparation is a must. When students are presenting, it is evident who has practiced and prepared; those are the students who are successful. So, we hope our guidelines and suggestions will be helpful as you prepare and practice for your presentations.

**Anatomy of an Oral Presentation**

As we discuss the anatomy of the oral presentation, you should find it somewhat familiar. An oral presentation is very much the same as what you find in a poster presentation, yet verbally explaining your research. The following are suggested components that should be included in an oral research presentation. Your institution may have different requirements and these presented below are only helpful suggestions for a successful presentation.

**Introduction**

As with any oral presentation, do not simply jump right into your study. One suggestion is to first provide a general outline of what you will present, which is aligned with the title of your research project. This provides the audience with an outline of what the presentation will be about, and it also helps you to ease into the presentation. In most instances, you are nervous in the beginning of your presentation. Spending the first slide discussing your presentation can help you “settle” down and dispel some of your butterflies.

Next, you should provide a general introduction to your research. A good question to begin with is: Why were you interested in this topic? Was it a course you took? A conference you attended? Was your career background important to your research idea? This introduction will provide the audience with a greater understanding of why the topic was so interesting to you. Next, you can begin to ease the audience in with some general information about the topic. Although you are very familiar with your research and the concepts that surround it, your audience may not be as familiar. This will also set the stage for the next part of your presentation, the review of the literature and definitions.

**Review of Literature and Definitions**

How you present your brief review of literature and any important definitions will depend on your topic. You may begin with a historical perspective of your topic area or with some theoretical constructs that are important to your research. Again, just like the general introduction of your presentation, you do not just want to jump into the actual studies. Provide a context for the audience to better understand the past research that is providing a rationale for your study. At the same time, you do not want to spend a lot of time on this. The audience wants to hear about your study, not the past research. It is quite a balancing act; you need to provide a rationale for your study using past research but do not go into great detail about their designs and methodologies. Focus on their purpose and what they found. Then explain how your research is going to enhance the existing body of knowledge. As you move through the past research, you should build a case for your study. The “story” you are telling needs to get to the purpose of your study. You need to bridge the gap between the past research and your study.

**Purpose of Your Study**

After reporting the most pertinent literature, you need to link your research to the past. Focus on the critical research studies toward the end of your review of the literature. These are the studies that assisted you in “funneling” your research design; thus, they will allow you to discuss the purpose of your study and transition into the methods.
Methods
As in the poster presentation, you need to include all related and important points of your methodology. The Methods section should explain who, what, when, and how you completed your study. Specific subsections will be unique to your research and may include participants or subjects; measuring instruments; and procedures or testing protocol. Within the methods, you may find that using a flowchart or timeline may best represent your procedures, just as in a poster presentation. A brief description of the quantitative data analysis should be presented; the data analysis employed during a qualitative study should be presented in greater detail.

Results
Now comes the most important points of your research: your results and discussion. You should have a good idea of what you need to present, but how you will make it understandable to the audience? Making your data analysis clear is extremely important. Again, this is where tables and figures can play a vital role. Instead of reading to the audience in text form what data were significant or not, having a table or figure on a slide that you can explain to the audience would be more appropriate and effective. Please refer to the tip in this section on presenting your results in an oral presentation.

TIP: PRESENTING YOUR RESULTS IN AN ORAL PRESENTATION

- Take time to explain figures; do not just show them and move on.
- Show a clear progression of findings to add to the clarity of your presentation.
- Keep in mind that you do not want the audience to spend all their time reading from the slide. Rather, you want them listening to you! The visual slides serve an ancillary purpose (as visual aids); your oral presentation should be the audience’s primary focus.

Discussion
The discussion and conclusion portions of your oral presentation are, again, very similar to that of a poster presentation. Keep in mind a “real-life” context, as well as presenting your findings in “layperson” terms. The findings of the study should relate back to the critical research that was presented. How were the results similar or different? Think about the differences among the research designs and also the limitations of your current research study. Discuss how your findings could be applied for practitioners within your field and provide suggestions for future research.

Summary
A summary slide of your presentation is often a good way to conclude your presentation. Like your outline at the beginning, the summary provides your audience with a wrap-up of your research. You also may use this slide to entertain any questions from the audience, or you may have an additional slide that prompts the audience to ask questions.

PULSE CHECK
What are the components of an oral presentation?
Basic Considerations for an Oral Presentation

Now that we have presented the basic anatomy components of a research oral presentation, here are some general considerations to remember while you are developing your presentation. For starters, how long is the oral presentation? This usually depends on your course or institution’s requirements. Present your results accurately and succinctly. An oral presentation of this nature usually should be between 20–30 minutes, with closer to 20 minutes being ideal. Twenty minutes seems to be a suitable time limit for students to present their research. When you do have an idea of the time you have to present your work, we suggest creating an outline of your presentation, using the anatomy of the presentation as a guideline. Consider how much time you want to spend on each area; place the emphasis on discussing your research study.

Once you have an outline, you can continue to create your oral presentation. When thinking about the content of your outline and what you will present on the slides, the use of tables and figures can be very helpful for audience understanding. People do not want to read a lot on the slide. They are there to listen to you present your findings. When using tables and figures, make sure they are meaningful. Tables and figures are not only used to present your methods and results; tables and figures can also be a nice way to present past research. We recommend having one slide that summarizes your work to the audience. In this way, all the information can be placed on one slide. The information can be brief enough that you need only to explain the similarities or differences of the studies. This will keep the audience interested and prevent you as the presenter from reading off the slides. We encourage you to think about how you organized your research journal articles before you started writing your review of the literature. Please see the Tip in this section: Presenting a Summary of the Research.

TIP: PRESENTING A SUMMARY OF THE RESEARCH

We direct you back to two published review papers that have tables included with their summary of the research. The way in which they summarized research may be helpful in presenting a summary of the research during an oral presentation.

  - The researchers provide a table of studies evaluating the impact of physical activity or exercise on the human gut microbiome

  - Seven tables are included that provide detailed information about specific studies based on a topic related hydration and performance

As with the poster presentation, keep your slides simple and follow the KISS-LL principle! Technology is great but having too many graphics and animations can be a distraction to the audience. Moreover, if this is your first time presenting, it is easier for you as the presenter to follow the slides if you do not have any fancy, slick slide transitions. Have the entire slide come in at once, rather than having the separate bullet
points coming in one at a time. This could be distracting for the audience, and it also may be distracting to you. Remember, the focus is on you and your presentation of the research findings, not how fancy the presentation looks. For an additional consideration, please see the Tip in this section on reviewing your slides.

**TIP: REVIEW YOUR SLIDES**

Not only should you run a spell-check, but you need to read over the slides for content.

- For instance, consider the next sentence: “Their is nothing more embarrassing than finding a misspelled word on your slides while your presenting.” Within this sentence there are two spelling/grammar mistakes: Their and your. Here is the correct version: “There is nothing more embarrassing than finding a misspelled word on your slides while you are presenting.”
- The lesson here is that you cannot rely on spell check alone. Review, review, and review your work again! An extra pair of eyes is always helpful. Have someone else review your slides too for spelling and grammar mistakes.

Once you are ready for your oral presentation, you need to think about creating a handout for your audience, as well as preparing for the delivery of your presentation. Similar to preparing for a poster presentation, we suggest providing your abstract or annotated bibliography. Additionally, a copy of your slides or any supplemental handouts related to your methodology that may be helpful with understanding your research project would be beneficial handouts to provide to your audience. For more information on presentation skills and preparing for an oral presentation, please see the Tip in this section on reviewing your slides.

**TIP: ORAL PRESENTATION SKILLS AND CONSIDERATIONS**

- **Practice.** Yes, this seems like an obvious point, but it needs to be emphasized. Practicing your presentation with your peers can help with timing and feedback. You need to make sure that you are within the time limit allotted. Additionally, practicing will help you to get more comfortable with your presentation. With proper practice, the presentation will become second nature. Practicing can help to minimize reading from the slide, as well as ensuring adequate use of time.
- **Delivery and pace.** When you practice your presentation, you should focus on the delivery and pace of your presentation. Try to keep the pace nice and slow. You may feel that you are talking slower than normal, but remember that your audience is probably listening to this for the first time, so keep your pace and delivery deliberate.
- **Professional dress.** How you should dress will be determined by your teacher or by the requirements of your institution. Because you are presenting your research project and it may be part of a culminating experience, professional attire is a must. You should take pride in your work, and your appearance does send a message regarding your level of professionalism.
Many of the same consideration points identified in the oral presentation are very similar to those of the poster presentation. You need to take time to develop your presentation, whether poster or oral. Do not think that the presentation will be completed in a day. The planning and preparation that goes into the presentation will take time, and the time you put into the preparation of your presentation will be evident during your presentation. We hope you have found these tips and considerations helpful. These same tips and considerations could be used if you are considering publishing or presenting your work at a conference. Requirements for publications and submissions to conferences vary, so we encourage you to speak to your advisor about how you can submit your work within your discipline.

SUMMARY

Usually with any written form of a research project comes some sort of presentation. We identified two common types of presentations we use: poster presentations and oral presentations. The anatomy and basic considerations were discussed, and more information is available in the online resources. The anatomy of each type of presentation is very similar, as well as the important points to consider for each type. The biggest difference is in the delivery of the presentation. For each type of presentation, we emphasize that editing and reviewing your work are essential to the success of the presentation. Our final words are to plan ahead, practice, relax, and enjoy! Good luck!

Applying What You Learned

1. If you were to prepare a poster presentation, what are some aspects to keep in mind when developing your poster? How will those components help ensure a thoughtful and successful poster?

2. What would be your one- to two-minute oral summary of your poster presentation? What would be your two- to five-minute oral summary?

3. What aspects should you keep in mind to ensure that your oral presentation is both efficient and effective?

References


Action research: typically takes place in an applied setting and leads to results and conclusions intended to directly benefit current practices

Active deception: knowingly withholding critical information or knowledge from human subjects that could result in subjects’ unwillingness to participate in the study

Allied research section: includes research studies related to topic areas and research variables, but not exactly aligned with proposed research questions

Alpha reliability: involves examining each item compared with the other items to assess their unidimensionality to a proposed factor on an affective questionnaire

Alternative hypothesis: includes the opposite of the null hypothesis, in which there is significance

Anonymity: the inability to link any research information back to the individual respondents

Applied research: focuses on the application of research findings that are based on individual observations and experiences; typically conducted in field settings

Basic research: focuses on the quest for knowledge that is based on theoretical foundations; typically conducted in laboratory settings

Behavioral observation design: includes the process of collecting objective information by a live observer or through the use of audio or video recordings

Case study: an in-depth examination into a case—such as a person, organization, incident, or community—employing a wide variety of data collection methodology to understand the case

Categorical data: data that are mutually exclusive and place subjects into specified groups

Cluster sampling: determining the sampling unit and then collecting data on that unit as the sample

Concept mapping: a way to diagram relationships among ideas

Concurrent validity: involves two measures taken in close proximity to provide support for the new test or measurement; examples include subjective rating validity and previously validated test validity

Confidentiality: researchers’ ability to link research information back to individual respondents; all information is accessible only by researchers

Construct-related validity: involves examining internal structures of tests to illustrate through exploratory and confirmatory factor analysis that the test items appropriately measure the intended factor

Content-related validity: involves an expert review process to determine the appropriateness of factors and the completeness of the corresponding questionnaire items to the factors in the cognitive or affective domains

Continuous data: data that include a range of scores within an interval

Convenience sampling: includes participants who are readily available and accessible to participate in the research study

Convergent parallel: the research collects both qualitative and quantitative data at the same time

Convergent validity: involves comparing two tests that measure the same or related theoretical factors

Correlation research design: focuses on determining the relationship between two continuous variables or
how much the predictor variable influence the criterion variable

**Criterion-related validity:** involves a new test or measurement and examination of its relationship to other variables or tests

**Criterion variable:** the variable explained by the predictor variable in correlation research designs; also known as the Y variable

**Critical research section:** includes research studies aligned with proposed research questions

**Deception by omission:** interpretation of results is not shared with human subjects, but this lack of information does not influence the decision to participate in the study

**Deductive reasoning:** a top-down form of problem solving in which new conclusions are based on theory

**Delimitations:** aspects of the research design that were predetermined by the researcher

**Dependent variable:** the measured variable or outcome in experimental research designs

**Descriptive research design:** includes research that provides exploratory data about the specific variables being examined

**Descriptive statistics:** allow the researcher to describe and summarize the characteristics of the data sampled

**Direct observation:** collection of data through the eyes of a qualitative researcher

**Discriminant validity:** comparing two tests that do not measure the same theoretical factor; factors are unrelated

**Duration recording:** involves determining the amount of time spent on a predetermined behavior

**Embedded design:** uses data that are collected simultaneously using both quantitative and qualitative approaches

**Ethics:** includes moral obligations involving principles of right and wrong in behavior

**Ethnographic research:** involves direct observation by a participant observer to better understand sociocultural phenomena

**Evidence-based practice:** a method in which you systematically review past research to inform how you will make decisions about patient care

**Expedited review:** includes research proposals using methods that are non-invasive physically, cognitively, or emotionally and in which the sample is from the general population

**Explanatory sequential design:** includes a sequence of collecting quantitative data and then qualitative data to better understand the initial quantitative aspect of the research

**Exploratory sequential design:** includes a sequence of collecting qualitative data and then quantitative data to better understand the initial qualitative aspect of the research

**External validity:** generalizability of the research findings

**Face (or logical) validity:** involves an expert review process in an applied setting to support tests or measurements in the physical domain

**Focus groups:** include many people to discuss specific questions asked by the researcher or moderator

**Frequency recording:** involves determining the number of times a predetermined behavior occurs

**Google Scholar:** a search engine that allows you to search an open-source Internet to find a variety of scholarly work

**Independent groups:** include subjects who were each measured once; the groups are mutually exclusive

**Independent variable:** includes the grouping variable in experimental research designs

**Inductive reasoning:** includes a bottom-up form of problem solving in which new conclusions are based on information generated from individual observations or experiences

**Inferential statistics:** include statistics that allow the researcher to draw conclusions about the target population based on the sample data collected
Institutional review boards: examine the risks and benefits of proposed research studies in terms of protecting human subjects and abiding by federal regulations

Intact sampling: includes groups of participants who are currently grouped together for another reason and all participate together in the research study

Internal validity: the degree to which the research findings and conclusions are related to the research design and methodology

Inter-rater objectivity: involves examining the consistency of two or more different test administrators to illustrate uniformity among the data collection procedures

Interval data: classifies data, with equivalent distances between the data points

Interval recording: involves determining whether the predetermined behavior occurs, or does not occur, within a specific time period

Intra-rater objectivity: involves examining day-to-day stability of the same test administrator to illustrate consistency of data collection procedures

Limitations: aspects of the research design that are not controllable by the researcher

Logical validity: See Face validity

Member checking: enables participants to ensure that data collected during an interview was accurately and appropriately transcribed

Mixed-methods research approach: research that includes both qualitative and quantitative aspects to lead to results and conclusions

Multiphase design: this design brings in sequential and concurrent methods to answer the research question over time

Narrative inquiry research: uses a form of storytelling through the collection of anecdotal information that is analyzed by a researcher or those who participated

Nominal data: classifies data into categories

Nonparametric statistics: are calculated for research variables that are ordinal-level data or the sample collected does not assume a normal distribution

Nonrandom sampling: a method of selecting participants in which participants do not have equal chances of being selected

Null hypothesis: includes no significance between the expected data and the actual data

Objectivity: consistency of the test administrator during data collection with respect to stability over time and stability of equivalency

Operational definition: statement of how the research variable will be measured in the context of the specific research study

Ordinal data: data that are classified and ranked or placed in order

Parallel forms reliability: involves examining alternative forms of the tests, which are similar in content, difficulty, and ability to discriminate groups, to illustrate consistency of comparable tests

Parametric statistics: are calculated for research variables that are interval or ratio-level data; the sample collected assumes there is a normal distribution for purposes of generalizing to the population

Peer debriefing: uses individuals who have not been immersed within the qualitative data collection to provide an alternative look at the data

Peer-reviewed journals: articles or research within an academic discipline that are evaluated by other scholars in the profession on the merits of the research before being considered for publication

Phenomenological research: involves interviews to better understand individual perceptions of a phenomenon or event

PICO: stands for Patient Problem or Population, Intervention, Comparison, and Outcome. This format helps the individual to organize information in order to answer a well-built clinical
question that is directed to the problem at hand

**Plagiarism:** using someone else’s work and identifying it as your own

**Predictive validity:** involves correctly predicting criterion variables from the new test, which can include predicting present and future performance

**Predictor variable:** used to explain the criterion or outcome variable in correlation research designs; also known as the X variable

**Previously validated test validity:** involves comparing a new test with a gold standard measurement in the area of testing

**Primary sources:** sources in which the author(s) themselves performed the research presented and that include Methods, Results, and Discussion sections

**Prolonged engagement:** immersion into the research setting to give the qualitative researcher an opportunity to build rapport and trust

**Qualitative research approach:** asks questions such as how or why to explore research topic areas from the participants’ descriptive perspective and lead to results and conclusions

**Quantitative research approach:** research that relies on numerical data to lead to results and conclusions

**Quartile deviation:** indicates the semi-interquartile range

**Quasi-experimental design:** focuses on comparing group differences in which the groups under study cannot be manipulated or randomly assigned

**Random assignment:** the determination of groups used in true experimental designs in which all subjects have an equal chance of being selected for each group

**Random sampling:** a method of selecting participants in which all participants have equal chances of being selected

**Range:** indicates the dispersion or spread of scores in the distribution by taking the highest score minus the lowest score

**Ratio data:** are classified and ordered, with equivalent distances between the data points, as well as a meaningful zero point

**Repeated-measures groups:** include subjects who were tested at all levels

**Reliability:** consistency of the test itself with respect to internal stability, stability over time, and stability of equivalency

**Research:** a purposeful and systematic approach to problem solving

**Research questions:** include descriptive and exploratory how and why questions for use with the qualitative research approach

**Research variables:** specific aspects measured in research studies that are based on the research question

**Sample:** includes a subset of people, events, or objects from the target population

**Scientific method:** steps in the research process used to answer research questions

**Scientific writing:** direct writing style that is clear and logically presented in the third person

**Secondary sources:** sources such as textbooks, reviews of literature, and position papers that present the research of individuals other than the author(s)

**Semistructured interview:** includes predetermined questions that the researcher uses as a guide, but the questions can be modified during an interview

**Simple random sampling:** involves a randomized method to ensure that all participants in the target population have an equally likely chance of being selected for the research sample

**Standard deviation:** indicates the amount of variability among the scores in relation to the mean, and how each score deviates from the mean

**Standard scores:** allow data scores to be transformed into common score
points, including percentile ranks, z-scores, and T scores

**Statement of the problem:** identifies the purpose of the proposed research and communicates the type of research design, research variables examined, and the level of participants

**Stimulated recall:** replay of the audio or video recording of an event to help participants recollect information or evoke emotions for purposes of future understanding

**Stratified random sampling:** determining critical characteristics of the target population to ensure that the same percentages are represented in the sample

**Structured interview:** includes predetermined questions that the researcher must follow verbatim during an interview

**Subjective rating validity:** involves comparing the new objective test with subjective ratings by an individual trained in the topic of the new test

**Substantive hypothesis:** the best educated guess about the outcome of the study

**Survey research design:** gathers information on perceptions and behaviors through the use of questionnaires

**Systematic sampling:** selection of a sample using an organized system in which participants do not have equal chances of being selected

**Target population:** includes a real or hypothetical set of people, events, or objects to which one wishes to generalize the results

**Test—retest reliability:** involves examining day-to-day stability of a test by correlating day 1 scores with day 2 scores to illustrate consistency in scores

**Transformative design:** this design is specifically shaped by the transformative theoretical framework, focusing on culturally diverse communities increasing social justice

**Triangulation:** employing multiple methods of collecting data that all measure the same research variable

**True experimental design:** focuses on comparing group differences in which the groups within the research are manipulated or randomly assigned

**Trustworthiness:** the integrity of qualitative data

**Type I error:** incorrectly rejecting the null hypothesis when in fact the null hypothesis is true within the population

**Type II error:** incorrectly accepting the null hypothesis when in fact the null hypothesis is false within the population

**Unstructured interview:** including a limited number of predetermined questions that the researcher may use as a reference, but the participant’s responses ultimately guide the direction of the interview.

**Validity:** whether a test is measuring what is intended to be measured

**Volunteer sampling:** includes participants who elect to participate in the research study
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