Getting Started: Basic Concepts of Research

CHAPTER OUTLINE

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LEARNING OBJECTIVES

This chapter is intended to provide a broad overview of the fundamental concepts and principles that underlie the research process. Much of the chapter content will be discussed in greater detail in subsequent chapters.
After reading this chapter, you should be able to identify, describe, or define:

- Types of variables as the focus of research
- Types of research
- Steps of the scientific method
- Structure and content of a research article
- Importance of ethical research principles

**VARIABLES AS THE FOCUS OF RESEARCH**

The major objectives of scientific research are to describe variables, the hypothesized relations among them, and the means of altering such relations through systematic forms of manipulation or control. For example, we might begin by describing the prevalence of certain psychological errors as observed in the speech of preschool children delayed in their expressive language development. Having classified or categorized these errors, according to the type observed, we might wish to understand how they vary in association with the quantity or quality of language stimulation in the home. On this basis, parents might be instructed to interact with their children in a manner hypothesized to facilitate phonological development. The potential effect of such intervention would then be assessed.

Within this context, the paradigms of the scientific method have been described. Beginning with an observation of a particular variable, we proceed to investigate its relationship to other variables and then to the manner in which these relations might be controlled through an active manipulation. A requirement for the understanding of scientific research is a basic understanding of the broad types of variables and the different roles they play in scientific inquiry.

**Definitions and Types of Variables**

Although describing, predicting, or controlling variables is the primary focus of most research, the meaning of the term variable is often ambiguous because of inconsistencies in usage. Perhaps this inconsistency is due in part to dictionary definitions of a "variable" as both an adjective (the tendency toward change) and as a noun (the thing that changes). For purposes of scientific research, the noun definition is the more common of the two, in that a variable "... is any attribute or property in which organisms (objects, events, people) are observed to vary." (Pedhazur & Schureman, 1981, p. 17). Variables can be broadly classified according to (1) their measurement properties, (2) how they are used in various types of research, and (3) the degree to which they exert an extraneous or confusing influence on the outcome of an experiment (see Table 2-1).

**Measurement Variables**

From the perspective of determining what kind of measurement can be applied to them, it is useful to distinguish between variables that can only be placed into certain categories versus those upon which mathematical operations can be performed. The former of these qualitative variables (i.e., categorical or grouping variables) are so named because they pertain to how people or things are placed together according to one or more attributes (e.g., gender, ethnicity, type of communication disorder, etc.). These variables can be placed into "other/or" categories of observation because people will possess at least two attributes of interest.

Dichotomous qualitative variables, such as gender, will have two levels of assignment (i.e., male or female). Polytomous qualitative variables, such as ethnicity (e.g., Caucasian, 


<table>
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<th>Type of Variable</th>
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<tr>
<td>I. Measurement Variables</td>
<td>Can only be placed into certain categories</td>
<td>Categorical/grouping/discrete/nominal variables</td>
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<tr>
<td>1. Qualitative Variables</td>
<td>(1) Dichotomous Variables</td>
<td>Two level of assignment (e.g., gender)</td>
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<td>2. Quantitative Variables</td>
<td>(1) Polytomous Variables</td>
<td>More than two levels of assignment (e.g., ethnicity)</td>
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<td>(2) Continuous Variables</td>
<td>Mathematical operations can be performed and they can be ordered, ranked according to their magnitude, expressed as the extent to which objects differ in degree, not in kind.</td>
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<tr>
<td>II. Research Variables</td>
<td>The independent factors that are manipulated, assigned, or grouped by the researcher in order to examine their effect on behavior.</td>
<td>Cause/treatment/factor/predictor/nonmanipulated variables</td>
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<td>4. Independent Variables</td>
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<td>6. Dependent Variables</td>
<td>The behaviors under study, the outcomes of a research study.</td>
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<td>III. Extraneous Variables</td>
<td>Nuisance factors unrelated to the dependent variable or independent variable that might exert unwanted influences on the outcomes of a research study.</td>
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Asian, Hispanic), will have more than two levels of assignment. Mathematically speaking, qualitative variables are said to be discrete because the values obtained from their measurement result in fixed and distinct counts. Suppose an audiologist wished to categorize the types of hearing loss seen in a particular clinic. Cases could have been coded according to the names of the hearing loss, such that conductive loss = 1, sensorineural loss = 2, mixed loss = 3. Subsequently, the audiologist further determined the relative number of cases falling into each of these categories. It makes no sense to perform arithmetical operations with such numbers. The numbers given are simply codes that specify particular categories into which a number of observations might fall. Such numbers are discrete in the sense that "type of hearing loss" cannot be treated numerically but only categorized into a finite set of units. Because no meaningful numerical values lie between these separate values, it makes no sense to say that any one number is "greater" or "less" than any other number (i.e., one type of hearing loss cannot be said to be more or less severe than another on the basis of their numerical coding). Any set of numbers could be used for such coding purposes. Thus, the numbers 9, 13, and 7 could have been arbitrarily assigned to the three types of hearing loss without altering the results. Obviously, it would make no sense to add these numbers or to subtract one from another. Beyond their coding value, such numbers are mathematically
meaningless, based on their mathematical properties, qualitative variables are termed nominal variables because they essentially exist in and not in kind. With respect to their mathematical power, quantitative variables that can be ordered according to their magnitude are at the highest level of the "quantitative" ranking order. Continuing with one previous example, an anatomist might determine that the frequency of observed hearing loss was highest in the conductive category, and that sensori-neural losses exceed mixed losses. Moreover, you might assign the numbers 1, 2, and 3 to each type of hearing loss, respectively, in order to rank their prevalence. Variables that are ranked according to some characteristic are called ordinal variables. Such variables provide more information than nominal variables because categories are not only named but also ordered according to their magnitude of occurrence. Nevertheless, just as qualitative variables are said to be "discrete," so too are quantitative variables possessing ordinal properties. This is because such a ranked set of numbers cannot be broken down into smaller units than whole numbers. For example, for purposes of ranking the prevalence of various types of hearing loss, it would make no mathematical sense to assign the number 30 to a conductive loss, 1.7 to a sensori-neural loss, and so on.

Still other types of quantitative variables are called continuous variables. Such variables are called "continuous" because they theoretically exist on a continuum ranging from low to high with infinite gradations in number size. Height, weight, age, mental ability, or scores on many spelling, language, or hearing tests are examples of quantitative variables. It's conceivable that the numbers representing each of these variables could be broken down into smaller and smaller units. For example, an age score could be represented as 7 years, 3 months, 2 weeks, 4 days, 12 hours, 31 minutes. In addition, an age score can be represented in decimal form such as 7.252 years, extending to an infinite array of smaller and smaller values. As represented in the population, the other continuous variables listed above possess the same properties. Quantitative variables of this kind have more mathematical power and mathematical meaning than variables that can only be represented by discrete values.

In addition to possessing the mathematical properties of ordinal variables, continuous variables share what are known as equal interval differences, meaning that size of the intervals on a measuring scale are judged as equivalent. Thus on a test of receptive language ability, such as the Peabody Picture Vocabulary Test, the difference between 30 and 40 correct answers would be the same as between 60 and 70 correct answers. Although such scores would reflect different levels of language competence, the interval sizes for the two sets of numbers would be the same (i.e., 10). This permits the operations of addition, subtraction, multiplication, and division to be performed on them. For additional information about the measurement properties of variables see Chapter 11.

Research Variables

From a research perspective, two broad classes of variables that play a central role in asking and answering scientific questions are called independent and dependent variables. Through knowledge of their control and manipulation, it is possible to distinguish a well-controlled experiment from one that is poorly done (Davis, 1993).

Independent variables are the antecedent factors that are manipulated, assigned, or grouped by the researcher in order to examine their effect on behavior. The behavior under study is termed the dependent variable. The term "dependent" implies that something is "dependent upon" the presence of something else. In the case of a dependent variable, it is a measured effect (outcome) assumed to be associated with or caused by the occurrence of the independent variable.
As was noted in the previous chapter, a research hypothesis is a statement that describes the relationship between one or more dependent variables and one or more independent variables. In the simplest case, only a single relationship may be expressed by the research hypothesis. For example, I might hypothesize that recovery of linguistic ability following a stroke is related to a person's age at the time of the insult. This statement expresses a hypothesized relationship between the factor of age (independent variable) and recovery of linguistic ability (dependent variable). However, I might wish to explore the relationship of multiple independent variables to the dependent variable within the framework of a single experiment. In this case, the hypothesis might be expanded to include additional factors such as premorbid intelligence and educational achievement in the list of independent variables. Indeed, I might wish to expand my hypothesis still further to allow for the investigation of multiple dependent variables by including, in addition to recovery of linguistic ability, the retrieval of occupational and professional skills as well. The various hypothesized relations between the independent and dependent variables just discussed are illustrated in Figure 2-1.

By applying what you learned in the preceding chapter, you should notice that the descriptions of the independent and dependent variables offered above are relatively vague and therefore would be of limited value in an actual research study. To have value, each of these variables would have to be operationally defined to allow for their measurement using objective criteria. For example, the participant's "age" at the time of stroke would need to be specified numerically in years and numbers of months, their "linguistic ability" according to scores on a particular test, and so forth. Furthermore, the construct of stroke, presumed to underlie the relationship between the independent and dependent variables, also should be operationally defined. Stroke is a generic term related to the appearance of certain neurological symptoms associated with impaired blood flow. It can result from several causes...
including embolism, thrombosis, hemorrhage, and the like occurring in various regions of the brain. Without a clear definition of the meaning of "stroke" according to its cause, severity, and anatomical location, the term has little value for research purposes.

Nonmanipulated versus Manipulated Independent Variables

In the example offered above, the independent variables were nonmanipulated variables. Age, intelligence, educational achievement, and similar physical and mental characteristics are not controllable by a researcher but present as states or conditions within the participants of a study. While a nonmanipulable variable can be made to vary indirectly by its group assignment (e.g., participants may be assigned to one group or another on the basis of age, gender, mental ability, etc.), as such cases the relationship of the independent to the dependent variable is only observed, not controlled or manipulated. As we shall discuss further in this chapter, such studies are best viewed as correlational research—not experimental research.

In contrast to correlational research, experimental research always involves an active manipulation of an independent variable in order to observe the effect of such a manipulation on a dependent variable. Exposing one group of participants in a study to a particular treatment, hypothesized to have therapeutic value, and then comparing the results to another group, unexposed to that manipulation, involves the same dependent variable and is a classical paradigm for this type of research. Only through an active manipulation of the independent variable can an outcome be causally related to the influence of that manipulation. To arrive at a valid explanation of the causal nature of such an association, variations in the dependent variables resulting from sources other than the independent variable must be ruled out.

Extraneous (Confounding or Nuissance) Variables

Some variables may operate, in an experiment, either known or unknown to an experimenter, that can exert an unwanted confounding influence on the dependent variable. Because of the presence of such extraneous (nuissance) variables, valid inferences about changes in the dependent variable, resulting solely from manipulations of the independent variable, may be difficult if not impossible to make. For example, suppose you wish to investigate two therapy approaches, A and B, in a downtown clinic of a large city that has no parking facilities. Participants in group A are scheduled at the clinic early in the day when metered street parking is generally available at a modest cost. On the other hand, as the consequence of being scheduled later in the day, participants in group B often must opt for more costly parking at a nearby garage. It is quite possible that the attitudes of these two groups might differ considerably in ways that could influence their participation. Obviously, to manage what could be "the confounding influence of parking" the participation should be treated as fairly as possible. One way of neutralizing such a confounding factor would be to compensate all participants for their parking expenses.

Confounding influences due to the intrusion of extraneous variables are not always as easy to identify as in the above example. Other examples of potentially confounding influences that could have differentially impacted the performance of the two groups include possible differences in the test environment (lighting, temperature, noise levels) as well as group differences as a base of subject characteristics (age, mental ability, gender, social class, language competence, severity of the problem, etc.). As we emphasize in Chapter 6, researchers should attempt to identify as many extraneous variables as possible prior to an experiment in order to eliminate or control for their potential confounding effects on the dependent variable. As the adage goes, "Problems are best solved in advance instead of second-guessing what might have been."
INTRODUCTION TO THE TYPES OF RESEARCH

In a concise review of the history of the profession, Duchan (2002) noted that while some of the early treatments of communication disorders might be viewed as quackery by current standards, "... the pioneers, several of whom were the founding group of ASHA, set out to design diagnostic tools, concepts, and normative data for creating a more scientific base for research and practice in the field." (p. 29). An extensive list of references pertaining to the history of speech-language pathology and audiology is available on ASHA's Web site, www.slah.org.

This literature makes clear that the knowledge base that underlies the daily work of clinicians has accumulated through systematic investigations that is, the research process. Such work has enabled the contributions of professionals from diverse disciplines including medicine, psychology, education, and the social sciences, among others. Regardless of the field of scientific inquiry, the purpose of research is to discover new knowledge by asking questions that can be answered through valid and reliable research methods. In the discussion to follow, you will be introduced to some of the terminology used by researchers to identify several of these methods along with the conceptual basis for their use. From the outset, it is important to recognize that scientific research is not a unitary approach to problem solving but includes a broad range of activities and methods that contribute toward the development or refinement of knowledge. In the field of communication sciences and disorders, perhaps the most common type of research involves the testing of hypotheses presumed to exist among variables underlying the processes of speech, language, and hearing. Two major paradigms that guide scientific inquiry are quantitative research and qualitative research.

Quantitative Research

The traditional quantitative research paradigm used in communication sciences and disorders involves a systematic and highly disciplined approach to problem solving. Deductive reasoning is used initially to generate hypotheses that are then tested under tightly controlled conditions designed by the researcher to minimize bias and maximize the reliability and validity of information. In quantitative research, formalized tests and measuring instruments are applied precisely and objectively specify the characteristics of data in numerical terms. Typically, such data are used to compare a group of individuals having a particular communication disorder (experimental group) with a normal group of individuals (control group). As we shall see in later chapters, comparative measures of averages and variances between such groups are considered by many to be the hallmark of valid research. Such an approach can be described as an extensive research model because it involves the aggregation and subsequent analysis of numerous individual scores as unitary indices of performance such as group mean averages. Statistical tests are then used to draw inductive inferences as to the probability for finding similar between-group differences in a comparable population of people tested or evaluated under similar conditions or circumstances.

The ultimate goal of most quantitative research is to prove that the hypothesis under evaluation is either true or false. Suppose that the hypothesis being tested is that children who are delayed in some aspect of language development (experimental group) will perform as well on a verbal memory task than children whose language development is normal (control group). The participants (subjects) employed in this study will be selected so as to be equivalent or closely so in all respects except for their differences in language development—this is, the sample of subjects forming the two groups will come from the same socioeconomic sector of the population, be equally represented with respect to age, gender, health...
status, and so on. Suppose further that we compare the scores on the verbal memory test and find that the control group achieved a relatively high verbal memory score (say, 95%) while the experimental group achieved a lower verbal memory score (say, 87%). Is this a difference that makes a difference in statistical terms? To answer the question as to whether or not our hypothesis is true or false we must ask whether or not this "sample fact," derived from a small number of observations, approximates a "true fact"—the fact that would be obtained if we repeat this study again and again.

By applying various techniques of statistical inference, we are able to determine in quantitative terms just how confident we can be in generalizing our finding to large groups or populations based on our sample results for individuals believed to represent these populations. Referring to our study of verbal memory, if our results were determined to be statistically reliable, we could expect the experimental group to have a lower mean verbal memory score than the control group almost every time the study is repeated. In the jargon of statistics, a statistically reliable result is called a significant result. On the other hand, should the results of statistical testing suggest that the findings could have resulted from chance (accidental) factors unknown to the researcher, the results from the study would be judged as unreliable or nonstatistically significant. In passing such statistical judgments, researchers evaluate the odds for making certain types of errors (drawing wrong conclusions). The nature of such errors and the means of controlling them are discussed in Chapters 4 and 5.

Although the majority of research studies in communication sciences and disorders and related behavioral sciences have been based on what is sometimes called the extensive research approach of quantitative research, there has been a shift in recent years toward increased use of intensive approaches (single-subject research). Such methods are particularly adaptable to studying changes in one or a few individuals over an extended period of time. Such methods should not be confused with the so-called one-shot case studies. Although the latter studies often serve as a basis for a particular clinical focus, because they lack any control over extraneous variables, they have no value in establishing cause-effect relationships (see Chapter 8).

For reasons to be discussed more fully in Chapter 8, several researchers favor the use of intensive single-subject or small-N designs over extensive large-N studies for some types of problems. Single-subject studies, sometimes called applied behavior analysis, are aimed at the precise analysis, control, or modification of behavior. Often, data description procedures are based on the mere visual inspection of results recorded in graphic form. Furthermore, as opposed to most group designs, single-subject research emphasizes numerous repeated measurements of single subjects under controlled conditions.

Although there are many types of single-subject designs, the classic paradigm involves (1) establishing during a baseline period the operant level of stable responding for a dependent variable prior to treatment; (2) introducing during a treatment period a single independent variable while recording any response changes in the dependent variable; and (3) removing the independent variable during a withdrawal period while recording any response changes in the dependent variable (see Figure 2-2). Although it is impossible to generalize results to a population based on one subject, single-subject designs may attempt to bolster the external validity of experimental findings by (1) describing the results from a number of individual subjects with similar characteristics (e.g., age, gender, IQ); (2) controlling sources of variability for each subject; and (3) demonstrating replicated findings with different subjects within the same experiment (Sidman, 1980).

The essential criterion for any study is the reliability of findings as judged by their replication in subsequent experiments. As will be discussed more fully in Chapter 8, single-subject designs typically take the form of a series of baseline-treatment trials on the same subject.
Differences between the baseline and treatment conditions are evaluated within each individual subject separately. Intensive designs are particularly applicable to many clinical studies in which generalizations about individual subjects rather than groups of subjects are sought. The "clinical situation" can provide a highly fertile source of research because human problems can be seen and intensively studied under controlled conditions apart from the ordinary circumstances and confounding influences of everyday life.

Qualitative Research

Some researchers hold that qualitative rather than quantitative methods are more appropriate for the study of many social and cultural aspects of human behavior. Such behavior is believed to involve a subject matter that is far more complex, dynamic, and less amenable to quantification than are the phenomena studied by biological and physical scientists. The study of patterns of family interaction in caring for a member with a terminal disease such as amyotrophic lateral sclerosis (ALS), or of the grief and coping mechanisms of parents upon learning that their child was born deaf, or the attitudes of potential employers towards persons who stutter—these and problems of a similar kind are not easily reducible to a set of numbers or measures that have meaning.

Qualitative studies involve several types of approaches that emphasize data collection in the "natural setting" such as the home, school, community, and the like. A classic example of naturalistic research is embodied in the early work of Piaget (1932), whose approach to the study of language development consisted primarily of observing and recording children's questions, reflections, and conversations. From such qualitative methods, Piaget published a number of scientific papers concerning various stages of what he termed "operasemia" and "socioconce" speech development that in turn stimulated much additional research of a similar kind.

Unlike quantitative researchers who define as clearly as possible the concepts, variables, and hypotheses before a study begins, qualitative researchers are a variety of descriptive and interpretative methods that remain more flexible in application and thus allow for the discovery of new leads to knowledge as the data emerge. As noted previously, quantitative researchers tend to emphasize relatively rigid research designs to control or eliminate bias.
and extraneous factors. On the other hand, qualitative researchers are likely to interact more freely with participants while trying to understand and interpret how they construct meaning from the standpoint of their own experiences.

Although the methods employed may differ, all qualitative studies are designed to allow the investigator to "get close to the data." In his seminal report of street corner culture, Liebow (1967) emphasized the importance of the investigator actually entering the experience of the individuals under study in order to adopt their perspective from the "inside." Similarly, Glenn and Pedak (1992) stated that the main goal of qualitative research is to "understand and interpret how the various participants in a social setting construct the world around them" (p. 6). In this same vein, Kitt and Miller (1986) defined qualitative research as a process of "watching people in their own territory and interacting with them on their own terms" (p. 347).

DeVoss and Griffin (1994) have identified four basic principles of naturalistic inquiry that characterize much of qualitative research: investigator involvement, the interactive process of gathering information and analysis, prolonged engagement in the field, and use of multiple data collection strategies.

- **Investigator involvement** is an integral part of these approaches to qualitative research since the investigator is in the major data-gathering role. Instead of striving to adopt an entirely objective attitude toward the subject under investigation, as do most quantitative researchers, the central premise guiding qualitative research is that the best means of understanding the "lived experiences" of people is to become involved in their life situations or circumstances. To accomplish this goal, the investigator engages in fieldworks—that is, enters the "life field" of the people under study.

- **Gathering and analyzing information** on an ongoing basis is still another principle shared by qualitative researchers. Whereas in quantitative research data collection and analysis occur during a defined time, qualitative researchers generally collect and evaluate information throughout the entire length of the investigation. Based on an investigator's perceptions, thoughts, and feelings about how one piece of information might link to another, the focus and methods of data gathering, shifting in accordance with "who, what, when, where, and why," might require further study. Through a dynamic process in which data collection and analysis becomes increasingly refined as new knowledge emerges—becomes "richer," "thicker," "more in-depth," and so forth—so too does the writer's understanding and interpretation of reality.

- **Prolonged engagement in the field** is required in all qualitative studies. This is necessary to allow the researcher to become sufficiently immersed in the problem under investigation to obtain an in-depth understanding. However, unlike quantitative studies, wherein data is typically collected on each participant during a prescribed time period, the length of the data collection period is not predetermined in qualitative studies but can vary widely depending on the researcher's judgment as to whether or not sufficient information has been obtained.

- **Multiple data collection approaches** are employed in qualitative research including observing, listening, and interacting with people in the natural context of their lived experiences; asking questions through the use of various interview techniques not only to obtain information from the informants but also to clarify and verify the accuracy of the information; and examining written materials such as records, diaries, charts, and progress notes in a search for recurring themes and patterns related to the phenomenon under study. Qualitative data are recorded in a variety of forms including field notes, diaries, photo-
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graphs, audiotaapes, videotapes, and so on. To facilitate the accuracy and trustworthiness of recording and reporting data, two or more data-gathers may be used who have been trained for this purpose and who record their observations independently of one another.

In addition, to assure the accuracy of information, qualitative researchers sometimes employ the method of triangulation, in which the results of several data collection strategies bearing on the same phenomenon are compared.

Qualitative research is guided by several types of research perspectives or traditions including:

- **Ethnography**—studies that seek to document the customs, social patterns, and rule-governed behavior of a culture or group of individuals. Ethnography grew out of anthropology—the science concerned with the manner in which culture influences and is influenced by how people behave, how they talk to one another, and the things they make.

- **Grounded theory**—studies that focus on the symbolic interactions among people and how they use symbols, such as language, to interpret or “make sense” of their experiences over time. Grounded theory is rooted primarily in the discipline of sociology—the science concerned with generating theories to explain social experiences. Grounded theorists do not begin a study with perceived theories or focused research questions. Instead, concepts and explanations are derived from research findings that emerge gradually in the process of collecting, coding and analyzing data—the theory that eventually evolves is “grounded” in such data.

- **Phenomenology**—studies that aim to understand how people attribute meaning to events and interactions with others during the course of daily living. As an approach to understanding the experiences of people from their own subjective viewpoints, phenomenology has a long tradition of use in the disciplines of philosophy and psychology. When adopting a phenomenological perspective, the researcher attempts to enter the world of the participants to the greatest extent possible in order to understand their thoughts, attitudes, feelings, and beliefs about various aspects of existence. The researcher gains insight through observations, in-depth interviews, and by participating in and reflecting on the lived experiences of others.

- **Discourse analysis**—studies that are concerned with the analysis of spoken and written text messages used to convey meaning or to perform particular social functions such as asking or answering questions, accusing or complimenting others, justifying actions, and the like. This approach evolves primarily from the discipline of sociology. As stated by Coyle (1998), “Discourse analysis sees language not as simply reflecting psychological and social life but as constructing it” (p. 244).

Regardless of their approach, practitioners of qualitative research are likely to eschew the use of quantitative measurement or data analysis techniques that could potentially influence or conceal the natural interaction of research subjects with their environment. When numbers are used, their primary purpose most often is to describe or represent the mere presence or absence of the quality under study rather than quantifying a specific attribute.

Categories of behavior are compared, contrasted, and sorted in the search for meaningful patterns and relationships (Shariff & Stribbins, 1991).

Although an advantage of qualitative methods may be found in their flexibility in studying a wide variety of human problems, the use of nonstandardized procedures can present many difficulties in collecting reliable and valid data. Unless attention is focused carefully on
True Experimental Research

A large number of experimental methods are available for use in scientific research that seeks to establish lawful relationships among variables. The use of all such methods goes beyond efforts to observe and describe problems or their prediction, and control.

True experimental designs can be distinguished from all others on the basis of three main factors. The first of these involves the random assignment of subjects to at least two or more groups. The second requirement is for some type of active manipulation to be performed. Third, one group of subjects is treated (experimental group), and these compared with another non-treated group (control group). When compared to other research methods, true experimental designs are the most effective in controlling for sources of variance extraneous to the causal relationships under study.

For many practical and ethical reasons, it is sometimes impossible for an investigator to assign subjects randomly to treatment groups or to indiscriminately apply a particular treatment to one group while withholding it from another. This is often the case in clinical studies in which an insufficient number of appropriate subjects may preclude the use of randomization procedures. In addition, it could be argued that withholding a treatment from a target population or administering an alternative treatment with unknown effects rather than one with established benefits is not unethical if not illegal practice.

Quasi-Experimental Research

Quasi-experimental research designs are generally selected when true experimentation is impractical or impossible to perform. Typically, subjects are assigned to groups on the basis of preexisting conditions or circumstances. Suppose you work at a hospital where you treat many adult patients for loneliness accompanied by vocal nodules. Following diagnosis, the availability of therapy is on a “first-come, first-served” basis, so many patients are on a waiting list for three months or more. Although the use of randomization procedures may not be possible, you still wish to draw some conclusions about the efficacy of your treatment program.

An alternative way to estimate your program’s effectiveness would be to use a constructed control group suitable for comparison with a treated group of patients. The two groups would be matched on a number of variables prior to treatment; these variables would possibly include such factors as degree of loneliness, size of nodules, duration of illness, occupation, age, gender, or alcohol/caffeine consumption. Such matching would be done to rule out as many extraneous variables as possible to see that any subsequent positive or negative group differences could be confidently attributed to your program.

As a means of coping with extraneous variables that might invalidate an experiment, quasi-experimental methods often necessitate the use of more control procedures than true experiments. Consequently, they are considered to be less powerful, as stated previously.
and are generally recommended only when true experimentation is not possible. Yet, some investigators believe that quasi-experiments can be as effective as true experiments.

Such true experimental and quasi-experimental designs incorporate procedures that are aimed at establishing causal relations among variables. Although it is sometimes impossible in any research study to determine that an experimental manipulation has clearly caused an intended effect, designs of this type offer the greatest promise of producing unambiguous results.

Nonexperimental Research

Our type of investigation in which causal relations definitely cannot be established is nonexperimental research. In such research, there is no attempt to achieve randomization, nor is any purposeful effort made to manipulate the variables under study. In such studies, many of which involve qualitative approaches of the type described previously, only correlational, supported to casual, relations can be evaluated.

Attempting to infer causal relations on the basis of the mere association between factors X, Y, or Z is risky. To illustrate why correlational designs are subject to ambiguity, consider the associative relations often found to exist between attention deficits, low I.Q. levels, and developmental language delays (Bartlett, 1960). It might be argued that any one of these factors could give rise to the others. Alternatively, all three factors could be the common results of still another more generalized delay or abnormality in development.

Efforts to derive causative relations from correlational findings alone can lead to the kind of fallacious reasoning that is represented metaphorically by "putting the cart before the horse." Such reasoning, sometimes described as "vicious circularity," occurs when an answer is based on a question and a question on the answer. For example, one might ask: "Why do slow learners experience academic failure?" Answer: "Because of language-learning disabilities." Question: "But how do we know they are language-learning disabled?" Answer: "Because they exhibit academic failure!"

Correlational studies are generally leading in purposeful experimental manipulations that are aimed at establishing the variables under study. For this reason, they are often called pre/post facto studies because they search for past causes of a phenomenon that has already occurred. Efforts to derive causal relations in this manner can be hopelessly confused in the type of circular reasoning processes described above. As Overton and Jenkins (1970) wisely noted, "...correlational designs are subject to an ambiguity of interpretation considerably greater than the normal uncertainty inherent in any research attempt." (p. 47).

Clinical Research

In evaluating and selecting a particular research design, it is important to bear in mind the purpose of the study. In particular, in the context of the clinical setting, problems are more often encountered in a qualitative form. It is often the case that numerical data are unavailable, information must be collected from a variety of sources, including written questionnaires, client and family interviews, prompting records, formal and informal test procedures, and the like. Ultimately, the clinician must work with whatever historical and current information about the individual clients that is available. By examining the possible solutions among historical factors and current conditions, an effort is made to form [a tentative hypothesis about the cause(s) of the problem and an appropriate treatment plan. The research-oriented clinician may collect data on a number of clients with similar problems under controlled conditions of testing or treatment. It is generally the case that
such a preliminary or exploratory investigation begins because of the apparent association between two or more variables. For example, the clinician might have noted during his or her work with children that weaknesses in phonological encoding and word retrieval seem to go hand in hand. Subsequently, a formal research study may be performed where a strong positive relationship between the two variables is demonstrated based on the strength of their statistical correlation (see Chapter 11). The next step may be to sharpen the investigative focus through the use of a true experimental or quasi-experimental design in an effort to determine whether or not the observed relationship is associative or causal in nature. To accomplish this objective, special conditions must be established to determine the extent to which an active manipulation of one factor might cause a significant change in another.

Given the hypothesis that phonological encoding skills underlie word retrieval abilities, the clinician might set up a program designed to improve phonological awareness in an already assigned experimental group and then evaluate the effects of such training against a randomly assigned control group (true experiment). Alternatively, a comparison group matched on relevant variables might be used instead (quasi-experiment).

In choosing a particular research design, the investigator must weigh the design's relative advantages and disadvantages in view of the questions asked and the answers sought. Some designs are more appropriate at one stage of an investigation than another. Furthermore, the physical limitations imposed by certain experimental settings, the unavailability of suitable subjects and instrumentation or test materials, external control, and the potential for ethical or legal violations are but some of the constraints that may influence the final selection of a specific research plan.

Applied versus Basic Research

Because the main orientation of the profession of communication sciences and disorders is to help clients solve practical problems, most scientific research focuses on solutions to problems that have immediate application. Such applied research is sometimes distinguished from basic research (pure research) that might have no presently identifiable application but is done simply to advance knowledge for its own sake. It is not to say that one type of research emphasis, applied versus basic, is better than the other. Indeed, much of the foundation of our clinical knowledge is enlightened and directed by advances in the study of "pure" or "normal" processes of speech, language, and hearing. For example, from the study of normal physiology of the inner ear, invaluable information has been gained leading to applications involving cochlear implantation. Through efforts to understand the molecular genetics of normal hearing, genetically transmitted hearing loss may be preventable in the future. Conversely, an understanding of the genetics of normal hearing may be gained by studying individuals with heritable hearing loss.

In the opinion of the present authors, the applied versus basic research distinction is somewhat irrelevant to the actual work of scientists who, regardless of the problem, engage certain thinking and action processes designed to provide better and more representative solutions to problems. Such work proceeds by what is commonly called the scientific method.

THE SCIENTIFIC METHOD AS A RESEARCH PROCESS

As noted in the previous chapter, science involves a systematic way of thinking and behaving to solve problems. Although the term "scientific method" is often used to describe an interconnected series of steps or organized activities that are uniformly followed by scientists in achieving their research goals, such a view can be erroneous or misleading. In reality, the so-called scientific method is better conceived as a research process that evolves though
several cyclical stages. The process is sometimes depicted in the form of a loop. As shown in Figure 2-3, the major components of this process include:

- **Identifying a problem** that leads to an idea for a research question or hypothesis
- **Developing a research design** appropriate for investigating the question or hypothesis
- **Collecting data and analyzing results** pertinent to the question or hypothesis
- **Interpreting the results** in a manner that refines understanding and leads to new questions

As we are about to discuss, these components of scientific work are well reflected in the various sections of a scientific article.

### Structure and Content of a Research Article

Writing up the results of a research study for publication in a professional journal within one's field is an integral part of scientific work. Why the study was done, how and to whom it was done, as well as the results and implications of the study must all be made clear. Familiarity with the structure of a research article and the kind of information contained within each section will help the reader assess the degree to which these goals have been achieved. As you read subsequent chapters in this book, you will sharpen the concepts and skills needed for the critical reading of a research article. Specific criteria for evaluating each component of a research article are covered more thoroughly in Chapter 13. Meanwhile, we will provide a brief overview of the prototypic structure and content of a research article as outlined in Table 2-2.

#### Abstract

Most research articles begin with an abstract or concise summary of the problem investigated, the methods used, highlights of the results and their statistical significance, and a concluding statement of implications. Key words are sometimes listed at the bottom of the abstract as cues to the specific topics covered. In essence, a good abstract provides a convenient yet accurate summary of the substance of the article as a whole. Its main purpose is to provide readers with just enough information to help them decide if they should read the entire article.

#### Introduction

The introduction section of an article, although usually not labeled as such, includes a historical overview of the theoretical foundations of the problem to be investigated based on the results of previous research. A review of relevant literature is akin to the process of scientific discovery that, as noted previously, involves collecting, organizing, and interpreting available
<table>
<thead>
<tr>
<th>Section</th>
<th>Methods</th>
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<tbody>
<tr>
<td>Abstract</td>
<td>Concise summary of the research (approximately 100-150 words) that includes a description of the problem, the experimental procedures, highlights of results, and a statement of implications</td>
</tr>
<tr>
<td>Introduction</td>
<td>Review of relevant literature, theoretical foundations and rationale, purpose statement/research questions or hypothesis</td>
</tr>
<tr>
<td>Method</td>
<td>Design of study, subjects and sampling techniques, controls used, apparatus or test materials, experimental procedures, logical basis for choice of statistics</td>
</tr>
<tr>
<td>Results</td>
<td>Systematic presentation of relevant data, figures and tables, evaluation of data to point out significant/non-significant findings</td>
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<td>Interpretation of the meaning and importance of findings, evaluation of hypotheses and their generality, implications for future studies</td>
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<td>References/Bibliography</td>
<td>Complete citations of the work of others</td>
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Background information (also related to the current problem. Such information is assembled so as to provide the basis for a logical argument or research rationale used to justify the need for additional investigations. Based on a review of existing knowledge and the theoretical propositions of other researchers, the introduction should lead naturally to a statement of the current problem. The researcher might state the problem by denoting the purpose of the research or posing a research question. For example:

The purpose of this study was to examine the relative frequency of different types of phonological errors (omissions, substitutions, distortions) in the speech of children with verbal apraxia.

A third type of problem statement based on theoretical reasoning, prior data, or both is called a research hypothesis. As a means of defining a research problem, the use of a formal hypothesis is typically reserved for predicting associative or causal relations among the variables under study. For example:

Verbal apraxia in children is associated with (or causative of) a significantly higher frequency of substitutions than other types of phonological errors involving omissions or distortions.

The manner in which the problem is stated in the introduction often provides some hint about the general type of statistical methods used in analyzing the data. Of the problem statements, illustrated here, all three imply that measurements will be carried out to quantify the frequency of certain types of phonological errors. In the case of the first two statements, the frequency measures will at least be totaled, averaged, converted into percentages, or statistically described in other ways. However, it is clear only in the case of the third statement involving the research hypothesis, that sampling statistics also will be used to infer the significance of difference in the frequency of types.
Method

Unfortunately, the method section of a research article is frequently given the least attention by the reader because, as the seminal blunder for the investigation, this section often contains many redundant details. Yet, the framework of the entire investigation either stands or falls based on the strength of its methodological foundation.

Most research studies will include important information about how a study was conducted. Such information will pertain to the (1) design of the study; (2) subjects used and how they were selected; (3) apparatus or test materials employed; (4) procedures for collecting data; and (5) statistical analysis techniques. The researcher must carefully address each of these topics prior to conducting a study if it is to be successful. It will be too late to correct a methodological error after the study has been done. Each of these topics is discussed in greater detail below.

Design. It is important for a researcher to provide clear and complete information about how a study was designed. From such information, the reader should learn whether the design used was primarily intended to describe the characteristics and/or associative relations among variables or was the goal to describe causal explanations through the use of experimental strategies. Typically, descriptive methods are chosen if an investigator wishes to observe, record, or perhaps measure certain events but has no desire to manipulate the variables of interest. The basic need of design is systematic observation of the phenomena under investigation. Observations of individuals or groups in the clinical or natural setting, survey of attitudes and opinions, content analysis of written material, and the use of incidence studies are examples of problems that call for non-experimental research designs (see Chapter 9).

When the researcher is primarily interested in exploring the effect of one variable, the independent variable, upon another, the dependent variable, he or she selects either experimental or quasi-experimental techniques. In the field of communication sciences and disorders, such explanatory methods are frequently used to test a hypothesis about a causal relationship. Such methods are commonly employed in the search for explanations for the causes of specific disorders or to evaluate the efficacy of new diagnostic techniques or therapy procedures.

Recall that the defining feature of a true experiment versus a quasi-experiment is that the former requires random assignment of subjects to different treatment conditions, whereas the latter simply involves classifying subjects on the basis of a particular characteristic (e.g., normal hearing versus hearing impairment). Following treatment, the groups are compared on some dependent variable or performance measure. Quasi-experimental designs are weaker than true experiments because of the potential for preexisting subject differences and other confounding variables to contaminate the results.

Subjects. There are several types of information pertaining to how subjects were chosen that an author should provide. This information should relate to three major factors that may be considered in selecting subjects. First, the subjects should be appropriate given the goals of the study. If an investigator's intention is to study syntactical errors in Florea's aphasia, the induction of Wernicke's aphasics or other types of aphasics must be avoided. Ultimately, the goal of any research study is to assure the internal validity of the results, or the degree to which they can be directly attributed to the effect of a chosen independent
variable as opposed to some unwanted extraneous variable. A confounding effect owing to selection can result if subject characteristics in one group differ from those in a comparison group. The old adage that "apples and oranges can't be compared" summarizes well this particular problem. In the subject section of the methods portion of the research article, the characteristics of all participants, including age, gender, intelligence, type of disorder if present, and any other relevant identifying information should be listed.

A second issue is the degree to which subjects in a study are representative of the population from which they were selected. This concern relates importantly to the establishment of external validity or the degree to which the results can be transferred to the population from which the sample was originally drawn. If a sample of subjects is not highly similar to the parent population from which it was selected, then the results will be of little or no value as they may apply to other cases under comparable conditions or circumstances. Although random selection of a sample of subjects does not assure that the sample will be representative of the population from which it was drawn, it is the best means available for accomplishing this goal (see Chapter 5).

A third issue in subject selection pertains to the number of subjects to be used. Decisions as to the number of subjects (denoted as N for the population and n for the sample) to be used in an investigation are complex. From a pragmatic perspective, the investigator will include whatever number of subjects is appropriate and available, given the particular aims of the experiment, keeping in mind that the problem of generality cannot be disposed of simply by employing large numbers of subjects. Nevertheless, it is also the case that, for purposes of detecting significant between-group differences, large samples generally lend greater power to a statistical test than do small samples. If the sample size is too small, there is a risk of failing to detect the true effect of an independent variable on a dependent variable—the main purpose of the experiment.

Apparatus and Materials. The apparatus used in presenting stimuli and recording responses, test materials, questionnaires, and related measurement tools must also be described. All identifying information including names of manufacturers, model numbers, publishers, calibration procedures for electrical or mechanical equipment, and evidence of the reliability and validity of such instruments should likewise be included.

Procedures. It is necessary that the procedures used in conducting an experiment be precisely delineated. This is important for at least two reasons. First, research procedures reflect the plan for the actual steps to be followed in carrying out the investigation. As far as possible, the following issues should be clearly described:

1. The manner in which the independent variable was administered
2. The way the dependent variable was recorded
3. The instructions given to subjects
4. The nature of the test environment

A second and equally important reason for carefully documenting research procedures is to allow for replication by other investigators. For this to occur, the essential conditions of the original experiment must be reproducible. Unfortunately, in communication disorders and other behavioral fields, replication is not yet given sufficient emphasis as a part of the scientific method as it is in many of the physical sciences. Although replication experiments in several fields, including our own, do not appear to be highly rewarded, the ability to substantiate research findings through experimental replication ought to be an integral goal of all
scientific studies irrespective of the nature of the problem. Perhaps greater value will be placed on such research by future investigators and the editors of professional journals as we are increasingly required to justify, through empirical means, the efficacy of our clinical programs.

Statistical Analysis. Often, the types of statistical analyses used and their manner of application are described toward the end of the method section. The type of statistical methods selected will vary according to the purposes they are intended to serve but will essentially, consist of one of more types of three major techniques. If the aim of the statistic is only to describe the features of a set of measurable observations, descriptive statistics will be used to summarize, conclude, and organize such observations into a more convenient and interpretable form of data. Tables and graphic figures may be used to display the data in a 'pictorial' manner. Such descriptive statistics are also used to derive what are called measures of central tendency (averages) and the way in which individual scores are dispersed around such averages (measures of variability).

A second major type of statistic is based on investigations to describe an apparent association between two or more sets of data. For example, one might wish to know the degree to which academic performance measures in children are related to various aspects of language expression and/or comprehension. Statistical tests of correlation may be used to describe the degree of relatedness between these or other sets of data. However, it is impossible to derive causal relationships on the basis of such comparisons alone.

A third type of statistical techniques goes beyond the mere description of variables or their association, to making statistical inference about the degree to which a particular sample of subjects is representative of the population from which it was drawn. In clinical science fields, such as communication science and disorders. sampling or inferential statistics are commonly used to study specific disorders or disabilities in a specified number of individuals. Subsequently, by means of inductive reasoning, inferences about the general nature of such conditions in the population at large may be drawn. Typically, we do not investigate specific groups of aphasic patients, people who stutter, dysarthric or hearing impaired individuals, or persons with voice disorders for their own sake but to learn more generally about how to explain or modify such problems, as found in similar persons from the same population.

Essentially, we want to know the extent to which a "true fact," derived from a small number of observations, approximates a "true fact"—the fact that would have been obtained if we examined the entire population. In applying the techniques of statistical inference, we are able to determine how confident we can be in generalizing our findings to large groups or populations based on small sample results for individuals believed to represent those populations. Such confidence is based on the tolerance for making certain kinds of sampling errors in terms of chance factors beyond the investigator's control. In addition to the need for determining, prior to initiating a study, what type of statistical procedures can be used. the risk tolerance for sampling errors should likewise be decided beforehand if the results are to be fairly evaluated. Such risk is conventionally set at either a .05 (5%) or .01 (1%) chance of error (see Chapter 12). In the first case, the researcher can be at least 95% confident that no error has been made in interpreting the results. In the second case, the researcher can be at least 95% confident in his or her conclusions. Unfortunately, too many researchers are negligent in deciding such matters in advance of conducting a study. In our opinion, this practice is just waiting for the last bounce of the ball at the roulette wheel before finally placing your bets.
Perhaps the best way to conceive of statistics is as an implicit logical reasoning system made explicit in quantitative terms. Statistical probabilities are not to be confused with certainties in the sense that a consequent event will always follow a given antecedent cause or condition. More accurately, the "laws of statistics" can be better conceived in terms of the "likelihood" of a particular event occurring a certain percentage of time under highly defined conditions and within specified confidence limits (see Chapter 12). Furthermore, although a distinction may be able to predict with 95% confidence that some hypothetical number of cases similar to one's own will improve in response to treatment X under certain conditions, which particular cases might do so cannot be determined. Because statistical methods do not lead to invariant answers, they are best viewed as general guides rather than precise maps in the search for new knowledge and understanding.

Results

The primary goal of the results section of a research article is to provide a straightforward presentation of the relevant data. Some research publications include not only a detailed explanation of the empirical data within this section but also a discussion of their theoretical implications. However, it is common practice within the results section to present and explain the data only in terms of the research hypotheses, interpretations, and findings should be avoided. The latter task is reserved for the discussion section of the research article.

Within the results section, a systematic presentation of the data should be included beginning with a precise summary of the evidence and then proceeding to a point-by-point report of each statistical analysis. Figures or graphs may be used to illustrate relevant research findings in pictorial form. Tables provide a convenient format for condensing data according to such average measures as the mean and measures of variability (the dispersion of scores around the mean) such as the standard deviation. Based on the comparison of such composite measures, which reflects differences in tests of size between or within groups of subjects, statistical formulae can be used to calculate the significance of the results expressed as a probability value or p (see Chapter 12). For example, the notation p < .05 would be interpreted to mean that one could expect his or her hypothesis to be true at least 95% of the time with less than a 5 percent chance of error (i.e., one chance in 20 of drawing an incorrect conclusion).

As noted previously, a combination of descriptive and inferential methods, rather than a single statistical technique, is usually employed in the area of communications sciences and disorders. Although descriptive statistics permits observed variables to be specified in mathematical terms, it is only through the use of inferential statistics that generalizations are made from a selected sample of subjects to a larger population.

Discussion

After objectively presenting and explaining the results of a study in relation to the hypothesis under test, the next step is to interpret this factual information in terms of the overall efforts that served as the original impetus for the investigation. In essence, the task requires looking for meaningful patterns in the data to see how they might fit within the larger framework of knowledge (i.e., preexisting theories, conceptual models, and other research findings as reviewed in the introduction).

Whereas the form of scientific reasoning leading up to the results of an experiment was largely deductive in nature, the researcher is now required to inductively draw inferences from the real-world based on the specific data obtained. In more specific statistical terms, the degree to which the sample data can be generalized to the population from which it was drawn is carefully evaluated. This requires a rigorous analysis of the strengths and weaknesses
of the current research design with respect to such matters as the effectiveness of the sampling procedures and the adequacy of experimental controls in dealing with the unwanted effects of extraneous variables.

In a figurative sense, the discussion section of a research article requires using data not only to look back at "things as they have been" in the past but also forward as to how things might be in the future. Practical recommendations for improving various aspects of the methodology may be offered. Even new hypotheses may be advanced along with suggestions about the types of experiments needed for their testing. Thus, the discussion section of a study provides a mechanism for engaging scientific reasoning processes in ways that foster continuity of knowledge and new understanding.

References
All citations of previous studies must be listed in a reference list at the end of the research article. The references used need not be exhaustive but should reflect the work of previous investigators that are clearly related to the problem under investigation. The specific manner in which references should be cited within text and the reference list is discussed in Chapter 13.

ETHICS OF RESEARCH
We will end this chapter by briefly mentioning the importance of ethical practice in research (see Chapter 5 for a fuller discussion of ethical guidelines for protecting human subjects). In the field of communication science and disorders, researchers and clinicians might believe that questions pertaining to the research hold less importance than for professional-like other fields, such as medicine, where violating the rights of human subjects has been severely documented. Consider, for example, the abhorrent practices of Nazi Germany that used Jews, gypsies, the mentally ill, and other segregated minorities as laboratory specimens to study posture and reaction to various diseases and untreated drugs (Polier et al., 2001).

More recently, in the United States, we are aware of similar violations that are equally horrifying. Beginning in the early 1930s and continuing until 1972, a study sanctioned by the U.S. Public Health Service examined the influence of syphilis on men from a black community that comprised a control group (treatment was intentionally withheld).

Although the vast majority of studies undertaken in the communication sciences and disorders do not place participants at physical risk, researchers nonetheless are often confronted with important ethical questions such as:

• When a treatment is suspected but not yet proven to have value, is it ethical to assign participants to a control group, thereby denying them a potentially beneficial exposure?
• What are the ethical implications of withholding treatment information from participants (keeping them unaware as to what group they have been assigned, i.e., experimental group, placebo group, or control group)?
• What is appropriate to publish information obtained from participants when aspects of the physical or mental state have been compromised by a disorder or disease despite having obtained permission from them or their families to do so?
• Are personal questions designed to uncover people's fears, failures, weaknesses, and so on, identifiable justifiable when it is not possible to provide therapeutic assistance?

There are few of the ethical dilemmas that researchers frequently encounter. To the genuine extent possible, participants in research should be protected from harm. As we shall discuss further in Chapter 3, codes of ethics have been adopted and public laws enacted to provide such protection.
SUMMARY

In this chapter, you have learned that research in the field of communication sciences and disorders is a broadly based enterprise that arises naturally out of the need to describe or explore the associative or causative relationships among variables. You also learned that various types of research are used as appropriate for the question asked or level of understanding that a researcher might wish to achieve. Fundamental to all of these approaches are the thinking processes and actions inherent to the scientific method. The importance of the scientific method is that it allows a researcher to transform hunches or questions into testable hypotheses. You learned that this is actually a highly focused step-by-step process whose ideas are sharpened and subjected to investigation as reflected in the various sections of a journal article. All of this must proceed within ethical guidelines designed to protect human participants to the greatest extent possible from physical or emotional harm.

KEY TERMS

qualitative variable

dichotomous qualitative variable

polynominal qualitative variable

quantitative variable

nonmanipulated variable

quantitative research

significant result

nonsignificant result

applied behavior analysis

baseline period

qualitative research

ethnography

grounded theory

phenomenology

discourse analysis

temporary experimental research design

quasi-experimental research design

constructed control group

nonexperimetal research

applied research

basic research

research process

N

measures of central tendency

measures of variability

correlation

statistical inference

risk tolerance

confidence intervals

SELF-LEARNING REVIEW

1. Major objectives of most scientific investigations are to _______ variables, the _______ relations among them, and the _______ of altering their relations.

2. Phenomena that are observed to vary are called _______.

3. _______ methods are commonly used by clinicians to _______ or _______ phenomena.

4. Relationship questions ask about the degree to which certain classes or categories of _______ change in _______ with other variables.

5. When the measure of one variable is found to be statistically related to the measure of a second variable, they are said to be _______.

6. Answering questions pertaining to differences among phenomena is generally recognized as the best means of determining _______ _______ _______ _______.

7. Two types of difference questions pertain to the search for _______ differences and _______ differences.
8. Establishing the cause(s) of variation of a phenomenon is necessary for establishing the conditions for its future.

9. Studies involving difference questions tend to restrict the interpretation of group differences in the systemic influence of the treatment condition, called the variable, as the target of such manipulation, called the variable.

10. The research approach involves the study of groups, whereas the research approach is best adapted to the study of single

11. The primary criterion for any study is the of findings based on

12. A classic example of research is embodied in the work of .

13. The study of customs, social patterns, and rule-governed interactions of a culture or group of individuals is termed research.

14. Phenomenology is a method that attempts to understand people's experiences from their own

15. Qualitative studies concerned with the analysis of and text messages is called analysis.

16. Qualitative researchers are likely to eschew the use of of data analysis.

17. True experimental designs can be distinguished from all others on the basis of two major factors: (1) random of subjects to at least two groups and (2) some type of active to be performed on an experimental group of subjects who are then compared with a group.

18. Experimental designs are generally selected when true experimentation isfeasible or impossible to perform.

19. With the exception of experiments, quasi-experiments are like experiments.

20. As opposed to a randomized control group, a group generally requires careful of subjects in order to control for the influence of variables.

21. Nonexperimental research makes no effort to achieve in the assignment of subjects to groups; nor are procedures used in an effort to achieve between groups.

22. Instead of using a randomized control group and actively manipulating an independent variable, many nonexperimental studies rely on interpretations of existing data or observations.

23. Virtually occurs when an answer is based on a question and a question on the answer.

24. A correlation used to express the degree of association between two variables.

25. The method entails certain and processes designed to produce better and more representative solutions to problems.

26. The introductory section of a research article can be seen as the structural for the investigator.

27. The rationale for a study ought to evolve naturally in the section of a paper.

28. The degree to which the results of an experiment are directly attributable to the influence of an independent variable pertains to their validity; validity concerns the degree to which the results are
29. ______ statistics are used to summarize, condense, and organize data. ______ statistics are used to draw inductive inferences from a ______ to a ______ fact derived from a sample of observations. A ______ fact would require that we examine the entire population.

30. Statistics are concerned with determining the ______ of certain observations or events within specified ______.

31. The results section of a research article is generally restricted to ______ and ______ in relation to the research ______ of data usually reserved for the discussion section.

32. To the greatest extent possible, ______ in research should be protected from ______.

QUESTIONS AND EXERCISES FOR CLASSROOM DISCUSSION

1. What are the three major objectives of most scientific investigations? Give a clinical example of each.

2. Distinguish between qualitative and quantitative variables. Provide an example of each type as it might be investigated in a research study.

3. Distinguish between a nonmanipulated and manipulated independent variable. Provide a clinical example of each.

4. Why is quantitative group research called the extensive research model?

5. What are the essential features of the extensive research model? Identify a study with these features.

6. What is ethnographic research? Give at least two examples.

7. What kinds of data recording techniques are used in qualitative research?

8. What are quasi-experimental designs? Identify an experiment and a quasi-experimental design selected as alternatives to true experiments. What are the major features of each design? What common features do quasi-experiments share with true experiments given the goals of their respective prototypes?

9. What kind of studies are called "ex post facto" and why? Give an example.

10. Provide an example of a clinical research question and identify the antecedent treatment conditions and subsequent effects to be assessed.

11. Distinguish between applied and basic research. Is one type of research of greater value than the other? Justify your answer.

12. Describe the scientific method and evaluate its clinical utility.

13. Describe the components of a typical research article.

14. What three major elements are included in the introduction section of a research article? What type of reasoning is involved in this section?

15. Why is the method section of a research article considered the "structural blueprint" for the investigation? Identify and briefly describe the four major factors to consider within the method section.

16. What are the four major factors to consider within the method section?

17. Distinguish between the concepts of internal validity and external validity. What is meant by a "confounding effect"?

18. What is the essential requirement for this to occur?
19. Describe the statistical meaning of the term probability.
20. What is the main goal of the results section of a research article?
21. How can single-subject designs attempt to bolster external validity?
22. How does the discussion section of a research article differ from the results section?
23. How does the discussion section of an article provide a mechanism for integrating inductive and deductive reasoning?
24. Of what practical value are ethical considerations in planning a research study?
25. Based on the following examples, identify the independent and dependent variables:
   - A clinician wishes to determine the effect of speaking rate on the frequency of dysfluency in children who stutter.
   - Use of grammatical morphology was examined in two groups of children as a function of lexical diversity. One group had been diagnosed with specific language impairment (SLI) and the other group had normally developing (ND) language.
   - The ability of children with and without a hearing loss to correctly identify sequences of various types of acoustic stimuli was examined.
   - Vocabulary development was examined in two groups of children using cochlear implants in relation to two different types of educational exposures, one that had used an oral communication approach (focused on spoken language) against another that had used a total communication approach (focused on both signed and spoken language).

26. For each of the research problems in Question 25, identify a possible extraneous variable that might confound a researcher’s ability to validly interpret the influence of the independent variable on the dependent variable.