

2

THE RESEARCH PROCESS AS A SCRIPT

Douglas A. Hershey, Joy M. Jacobs-Lawson and Thomas L. Wilson

Two questions often arise near the beginning of any course on research methods: Why is it important to have sound research skills? How are research skills acquired? Answers to both questions are multifaceted, a point that will be reinforced throughout the opening chapter of this handbook. Before attempting to answer those two questions, however, imagine the following scenario:

Two first-year graduate students were talking about psychology late one evening. During the course of their discussion, the two came up with what they believed to be a fascinating research idea, so they designed an empirical study to explore the topic. Over the course of the following year, they collected and analyzed data and prepared a manuscript for publication. The day they submitted the manuscript to the journal editor, the two were overjoyed by the fact they had accomplished this major task without assistance from their advisers. They were certain the paper would be published, and they could hardly wait for the editor's confirmation. When the email containing reviews of their manuscript arrived 8 weeks later, imagine their surprise when they read the opening sentence of the editor's letter: "We regret to inform you that after soliciting three different reviews of your work, we find your manuscript unsuitable for publication." Enclosed with the letter were three detailed sets of comments pointing out numerous critical flaws in their work. One reviewer pointed out that a number of studies had already been published on the same topic, and the students' findings failed to offer new insights. Another identified methodological flaws in the design of the study that failed to rule out alternative interpretations, thus calling into question the authors' conclusions. And all three reviewers mentioned that the statistics used to analyze the data were inappropriate given the nature of the research questions that had been asked. Furthermore, in her cover letter, the editor indicated that the manuscript was a poor fit given the interests of the readers of the journal. Seriously disappointed, the two students went to see their advisers to discuss what they should have done differently.

Before reading further, take a minute or two and think about what the students might have done differently. What additional steps could they have taken to help ensure a successful outcome? The students spent a year working on the project, but from the gist of the reviews, it was clear that several important steps of the research process had been overlooked. It appears that not only did they fail to conduct a thorough review of the literature before beginning the project, but they also failed to critically evaluate the design for weaknesses or flaws. Moreover, the students would have been well served by consulting with a quantitative specialist (or their adviser) about the analysis plan, and they would

have benefited by contacting the editor of the journal (or looking through back issues) to determine whether their paper represented an appropriate “fit” in light of the journal’s audience.

In answer to the first question posed at the beginning of this chapter, it is important to possess a sound understanding of the research process because it allows us to work more efficiently. In conducting their study, the two students learned important lessons about the research process, but at what cost? Think of the hundreds of hours that were wasted: time contributed by members of the institutional review board, the participants, the journal editor, reviewers, and the graduate students themselves. Think of how just a bit more knowledge and assistance from others might have led to a different, more positive outcome.

Most veteran researchers would not have experienced the same level of difficulty our two hypothetical graduate students encountered. However, errors, flaws, omissions, and conceptual gaps are not uncommon when it comes to conducting research in the social sciences. Even experienced researchers make critical errors, as suggested by the high rejection rates among top journals (in some instances greater than 90%). One key to avoiding mistakes is to develop a strong understanding of the complex set of steps involved in the research process, which, from the perspective of the novice investigator, may initially seem relatively straightforward.

Some of you may now be thinking, “Okay, so learning about the research process will help me to earn my degree and publish scientific papers, but will I benefit in other ways?” The answer is a resounding *yes!* First, strong research skills will allow you to better understand and evaluate the work of others. Second, from a more applied perspective, a good working knowledge of research methods will help you become not only a better scholar but also a better mentor, practitioner, or professor (depending on your career goals). Third, a solid set of research skills will help you to contribute quality scientific findings to the cutting edge of the psychological literature. Finally, a thorough grounding in research methods will make you a more careful and critical observer of the world around you. That is, knowledge of the scientific method will allow you to more accurately evaluate advertising claims, critically evaluate stories that appear in the press, and separate fact from fiction when participating in an intellectual debate. For these reasons (and many others), it is strongly in your best interest to actively work at developing your skills as a methodologist, not only during your graduate school years but on an ongoing basis throughout the remainder of your career.

SCOPE OF PRESENT CHAPTER

The primary goal of this chapter is to introduce you to the concept of a research method script. In its most basic form, a script is a series of ordered steps or events that occur when completing a task. More specifically, one can think of a script as the mental representation of an event sequence, containing those activities typically associated with a routine event. Research has shown individuals possess psychological scripts for a variety of real-world events such as preparing the evening meal (Blake, Bisogni, Sobal, Jastran, & Devine, 2008), solving financial planning problems (Hershey, Jacobs-Lawson, & Walsh, 2003), attending a lecture, going to a restaurant, visiting the dentist (Bower, Black, & Turner, 1979), sexual encounters (Lenton & Bryan, 2005), romantic attachments (Erickson & Dal Cin, 2018), and making career decisions (Laudel, Bielick, & Gläser, 2019). More recently,

there has been a focus on life scripts, or the normative sequence of landmark events in life, and their influence on plans and autobiographical memories (Grysmen, Prabhacker, Anglin, & Hudson, 2015; Scherman, Salgado, Shao, & Berntsen, 2017; Singer, Blagov, Berry, & Oost, 2013; Wolsey, Clark, van der Mark, & Suggs, 2017). Similarly, psychologists possess a script in memory for conducting a psychological study (Hershey, Wilson, & Mitchell-Copeland, 1996). The research script dictates the various stages of work that will take place and the sequence in which those stages should be completed. As will be discussed below, research scripts tend to evolve slowly over time, becoming more detailed as we receive formal research training and become avid consumers of the scientific literature. Therefore, the script that currently guides your research efforts will likely be far less nuanced than the one you are likely to follow 5 years from now. At this point, it is recommended that you turn to the end of the chapter and complete the first exercise, which is designed to elicit your current research script.

A second goal of this chapter is to provide a general overview of the procedures involved in a typical psychological research project. The processes and concepts presented in this chapter will be amplified and discussed in greater detail in subsequent chapters. This handbook is organized into a five-stage framework that includes (a) research planning; (b) design, instrument selection, and sampling; (c) data collection; (d) data analyses; and (e) research presentation. It is no coincidence that these five stages correspond to the major goals of a psychological research project. Also note that the model introduced later in this chapter is organized around these same five general topics. This handbook concludes with a section on special topics not typically considered part of the research process per se, such as working as part of a research team (Chapter 30), grantsmanship (Chapter 33), and the role of theory in research (Chapter 36). Although these topics may not be central to the empirical research process, they are, as you will see, important areas to understand for those who aspire to become productive psychologists.

As will be revealed throughout this book, computers have become an indispensable tool in the research process, and as such, computer-based tasks are prominently represented in the research methods script. Long gone are the days when researchers manually searched through dusty paper files and bound journals to locate articles, wait for hours (or even days) for the results of statistical analyses, or use manual typewriters to prepare manuscripts. We can now conveniently locate, download, and print articles from the comfort of our offices; we obtain statistical findings at the click of a mouse; and we can edit, submit, and revise manuscripts working from a laptop at the local coffee shop. Although technological advances have unquestionably improved the quality of our science, learning how to effectively use technologically based tools can be difficult and can try one's patience. Take, for example, the fairly common experience of getting 1,000 or more hits when conducting a literature review while using PsychINFO or Google Scholar, both of which are search engines that allow one to access psychological research papers. You revise your search by adding one or two additional constraints, only to receive the frustrating message "No articles could be found—try broadening your search." Learning the tricks of the trade when it comes to getting computers and high-tech laboratory devices to do what you want, whether it involves conducting a literature review, collecting data, specifying a complex statistical analysis, or drawing a figure that conforms to APA style, will necessarily take time and practice. As you read the chapters that follow, you will not only increase your knowledge of research methods, but you will also come to better appreciate the integral role technology plays in each stage of the research process.

In the following section, the psychological research process is described in further detail. It is characterized as a complex, highly varied, and extended problem-solving task that requires the application of specific and effective solution strategies. One such strategy, an empirically derived *expert script* of the psychological research process, is introduced. Presentation of this script is accompanied by a discussion of what it means to be an “expert” research psychologist. The script presented in this chapter is intended to represent the basics of a quantitative research investigation. Scripts for conducting qualitative research—which admittedly contains many of the same activities as a quantitative study (e.g., data collection; interpretation and presentation of findings)—goes beyond the scope of the present chapter.

EXPERTISE AND THE RESEARCH SCRIPT

Psychological Research as a Problem-Solving Endeavor

From an information processing perspective, the act of engaging in scientific research can be thought of as a complex problem-solving endeavor (Hunt, 1991; Shaughnessy, Zechmeister, & Zechmeister, 2014). In a problem-solving situation, the task is to transform an initial state into a qualitatively different goal state through the application of a series of steps leading to a solution (sometimes referred to as *operators*). In a psychological research context, the *initial state* often consists of an existing theory and its base of empirical findings. The *goal state* is typically some extension of that theory based on findings from a new investigation. From this perspective, the ability to reach one’s research goal depends on the selection and application of an appropriate set of operators (Lovett & Forbus, 2017; Newell & Simon, 1972; Novik & Bassok, 2005; Vangeness & Young, 2017). Stated in terms of the empirical research process, conducting a proper experiment involves making a series of critical decisions about *how* your study should be carried out. When the research process is considered from this point of view, it almost goes without saying that one’s methodological knowledge will determine, to a great extent, whether or not those critical decisions will be made in an intelligent fashion.

In discussing the concept of a research methods script, it is useful to distinguish between a *structural model* of the research process and an individual’s *mental representation* of that same process. A structural model is a veridical and relatively complete representation of the various solutions that are applicable in a particular problem-solving context (Merriënboer, Clark, & Croock, 2002). Thus, a structural model of the research process would represent the various investigative approaches one might adopt, different data analytic strategies, methods used to disseminate findings, and so on. Mental representations (which are often referred to as mental models) of the research process, in contrast, almost always fall short of a structural model. Mental representations in all but the simplest of domains tend to be incomplete or contain misspecifications, perceptual biases, or other types of distortions. One key objective of this handbook, therefore, is to help the reader develop his or her mental model of the research process into a reasonable approximation of a structural model. The structural model presented in this chapter is derived from the combined mental models of expert researchers. Of particular relevance to this chapter is the fact that structural models have been shown to be valuable tools for training individuals to become more efficient and competent problem solvers (Hershey & Walsh, 2000/2001).

Copyright ©2024 by Sage Publications, Inc.

This work may not be reproduced or distributed in any form or by any means without express written permission of the publisher.

In one empirical investigation, Hershey et al. (1996; see also Wilson & Hershey, 1996) examined the research scripts of 49 “expert” psychologists, each of whom held appointments at major academic institutions. Participants were considered experts by virtue of their high level of training in research methods and the fact that all were actively engaged in research as a condition of their employment. As characterized in the article, a *psychological script* is a specialized type of procedural knowledge representation containing an ordered set of actions that are linked together in long-term memory (Abelson, 1975; Schank & Abelson, 1977). In the Hershey et al. (1996) study, participants were asked to “list about twenty actions or steps that characterize the process psychologists go through when working on a research problem.” In order to establish common anchor events (across individuals) at the two ends of the event sequence, the phrase “Get Idea for Project” was printed at the top of the response form, and “Publish the Research Paper” was printed at the bottom.

A composite research script based on the individual scripts of the 49 psychologists is shown in Table 2.1. This composite representation contains 23 of the most commonly mentioned events that occur over the course of a psychological investigation. Five different high-consensus events (printed in all capital letters in the table, mentioned by more than 60% of respondents) were identified: read literature, design experimental methods, data collection, data analysis, and write a draft of the paper. Notably, this set of events forms what might be thought of as a “meta-script” of the research process. That is, there is evidence to suggest that scripts are hierarchically organized, with major events representing superordinate procedural goals (Abelson, 1981; Farag, Troiani, Bonner, Powers, Avants, Gee, & Grossman, 2010; Galambos, 1986), and minor events representing subgoals. Presumably, when a superordinate goal is triggered, the scripts for various subordinate goals are activated in a prespecified order until the entire subroutine of constituent tasks has been carried out (Merriënboer et al., 2002). At that point, the next superordinate goal is activated, and a new series of steps in the overall event sequence is enacted.

TABLE 2.1 ■ Composite Research Script Based on Responses from 49 Psychology Professors

Get idea for project (anchor)	DATA COLLECTION
READ LITERATURE ON TOPIC	<i>Code and organize data</i>
<i>Discuss idea with colleagues</i>	DATA ANALYSIS
<i>Conceptualize project</i>	<i>Determine if hypotheses were supported</i>
<i>Determine appropriate subject population</i>	<i>Make a conference or brown-bag presentation</i>
Formulate Hypotheses	<i>Conduct a final literature review</i>
DESIGN EXPERIMENTAL METHODS	WRITE DRAFT OF PAPER
<i>Obtain available materials and measures</i>	<i>Get feedback on paper</i>
<i>Construct experimental materials and measures</i>	Submit Paper for Publication
<i>Obtain research assistants</i>	<i>Make post-review revisions</i>
Pilot Test Procedures and Measures	Publish the research paper (anchor)
<i>Refine experiment based on pilot results</i>	
Obtain Subjects	

NOTE: High-consensus events (mentioned by more than 60% of professors) are shown in capital letters. Moderate consensus events (mentioned by 40–59% of professors) are shown in upper and lower case. Low-consensus events (mentioned by 20–39% of professors) are shown in italics.

SOURCE: Hershey, D. A., Wilson, T. L., & Mitchell-Copeland, J. M. (1996). Conceptions of the psychological research process: Script variation as a function of training and experience. *Current Psychology: Developmental, Learning, Personality, Social*, 14, 293–312.

Copyright ©2024 by Sage Publications, Inc.

This work may not be reproduced or distributed in any form or by any means without express written permission of the publisher.

The “Expert” Researcher

One of the hallmarks of expertise in a problem-solving domain is possession of a well-specified semantic and procedural knowledge network (Ericsson & Smith, 2002; Glaser & Chi, 1988; Thevenot, Dewi, Bagnoud, Wolfer, Fayol & Castel, 2019). This does not suggest there is a single best solution for every problem or a “gold standard” against which one’s problem-solving efforts can be compared. This is because when dealing with ill-structured problems (such as how to conduct a psychological investigation) there are many different methodological approaches from which to choose, a myriad of ways to examine the data, countless ways to communicate the results, and so on. This last point suggests there is no single research methods script that will *always* lead to an optimal outcome. Rather, the knowledge structures of experts are dynamic and contextually organized and thus able to accommodate subtle differences in environmental and situational demands (e.g., the purpose of the research, resource availability, participant considerations, ethical concerns) when the goal is to select and apply an appropriate solution strategy.

As you may recall, at the beginning of the chapter we posed two questions. The second question was “How are research skills acquired?” Although the foundation of knowledge comes largely through coursework and hands-on research experiences, an expert’s knowledge base is constantly growing and changing to accommodate new advances in the field. To that end, a well-qualified empiricist must stay abreast of methodological developments, read about new data collection and analysis techniques as they become available, and learn about new and different ways to communicate findings to peers. That said, it is worth pointing out that expert status is not a goal state in and of itself. Rather, it may be better conceptualized as a life-long attitude toward learning. Certainly, possessing a large body of knowledge about research is a prerequisite to being considered an expert, but the humble and accomplished investigator realizes that the sine qua non of expertise involves a sincere commitment to a never-ending learning process.

As mentioned above, one of the chief objectives of this chapter is to present a detailed structural representation of the psychological research script. This structural script expands on the 23-item expert script shown in Table 2.1 to include a much broader set of issues involved in conducting a psychological investigation. One caveat should be raised, however, before proceeding. Until this point, it has implicitly been suggested that the research script is based on a linear process, a process in which one activity naturally and logically follows from the one that precedes it. Unfortunately, the sequence of steps involved in conducting real-world psychological research is not always unambiguous and straightforward. There are instances when two or more tasks within a script may be simultaneously enacted. For example, one might choose to pilot test a new measure while concurrently developing an application for the institutional review board. There may even be times when an investigator might need to leave a step out of the research process, such as the task of debriefing participants when working with animals or recruiting participants when conducting naturalistic observations. To further complicate matters, in some studies, certain stages of the research process may be carried out in a recursive fashion. For instance, if during the data analysis stage one finds a statistical test has yielded insufficient power, then the investigator may return to the data collection phase of the process to test more participants in an attempt to increase power.

As you read about the elements of the research process described on the following pages, it is important to recognize that the condensed structural model presented is not intended to be prescriptive in all cases. The structural model of the research script is

designed to have heuristic value as a foundation for the set of activities associated with most empirical investigations. Therefore, deviations from the structural model that appears on the following pages might not be unreasonable if particular methodologies are adopted.

STRUCTURAL ELEMENTS OF THE RESEARCH SCRIPT

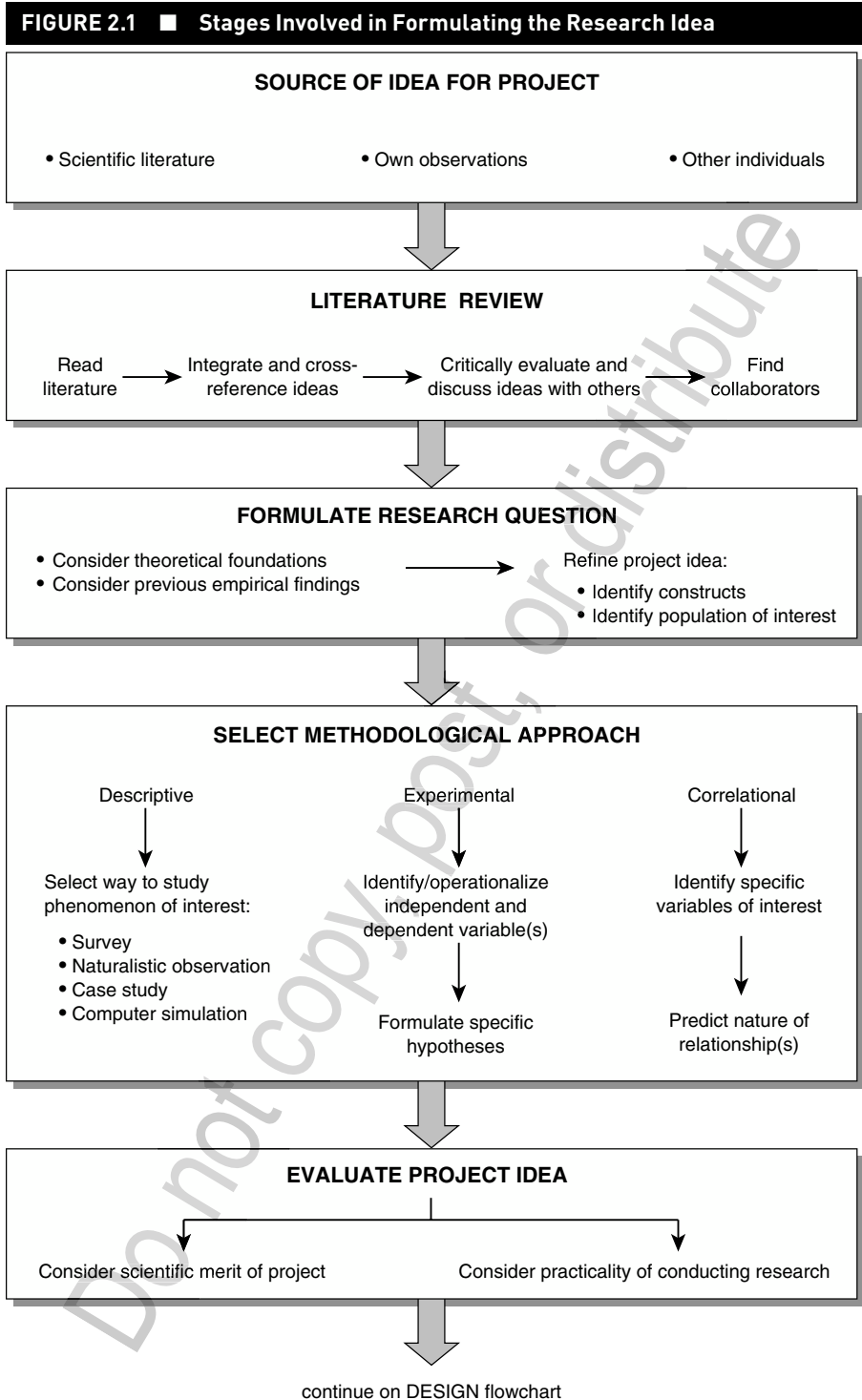
Let us walk through the research methods script and focus on each of the higher-level event sequences, or phases of research, in logical order. As a generalized event sequence of the scientific process, the research script begins with a representation of the scientific problem and ends with the goal of publishing the results of the investigation. Alternatively stated, the scientific process typically begins with an idea or question that requires an empirical answer, and in most cases ends with the scientist publicly disseminating major findings at a conference or in writing (Chapters 26–28), and pointing out their implications.

As indicated earlier, the research events that transpire between a script's beginning and ending can vary depending on purpose, methodology, and resources. Very often, a single project intended to test one or more hypotheses is part of a larger program of research that includes multiple projects that are either planned or simultaneously underway. Thus, most research projects do not end with the publication of one's data; rather, public presentation starts the script all over again, as the investigator continues on to another project and then another within the same general research program. For much of the remainder of this chapter, a structural model of the research process will be presented. In the section that follows, the five major stages of the research process are described, with each stage represented by a corresponding figure. Let us now turn to the first stage of the process, which involves formulating a viable research idea.

Formulating the Idea

For any given research project, the process begins when the researcher entertains a question to be put to scientific test (see Figure 2.1). At that point, an investigation has been launched. Sources for research ideas include one's specific knowledge of the scientific literature in a given domain and one's general knowledge of the ideas of other theorists. In terms of modern philosophy of science, the researcher is aware of the theoretical network within which the initial question resides. Experienced researchers know that each project begins at this rather broad conceptual level. There are often significant unanswered questions related to currently held theories and novel hypotheses that may be proposed to account for specific effects. In fact, the true source of research ideas—that is, the source of one's scientific inspiration—is considered by some to be an area of research in and of itself. Many original ideas come from scientists' private observations of phenomena in the world; others frame scientific questions by attempting to extend existing knowledge. Whether a researcher's project idea grows out of contradictions in the scientific literature, incredulity regarding the conclusions drawn from another study, the need to replicate previous findings, or private experience, the original project idea is the starting point that will largely determine the scripted events that follow.

Before selecting an appropriate methodology to address the research question of interest, it is necessary to be familiar with the body of work concerning the domain one plans to investigate. Most researchers tend to work in one or two specific domains, so they may already possess this knowledge. In fact, it may have been one of the investigator's previous findings that led to the new project idea in the first place. However, irrespective of the source



of the inspiration, even leading theorists in a field must review the relevant and current literature. Others, in contrast, including a majority of students, may be preparing to conduct research in an area that is unfamiliar. To a large extent, when one is working in a novel research area, a thorough literature review should reveal to the investigator dominant paradigms and possible methodologies. In Chapters 3 and 4, information is presented about how

Copyright ©2024 by Sage Publications, Inc.

This work may not be reproduced or distributed in any form or by any means without express written permission of the publisher.

one might arrive at project ideas, how to conduct literature searches, and how to effectively evaluate the existing body of scientific work.

One benefit of representing research activities as a carefully planned script is that it increases the likelihood of producing high-quality results, and thus, the likelihood of findings that will be valued by the scientific community. Therefore, reading the literature, integrating results across laboratories and studies, and critically evaluating the work of others will all help the researcher to determine whether a project idea has merit. Often the literature review leads one back to a new starting question, or it may even lead to relationships with others who will contribute valuable ideas and refinements to the project.

With a project idea and the pertinent literature now in hand, it is time to shape the original research question into a clearly specified hypothesis. In order to take this step, a few specific activities are in order. First, the researcher must identify two or more theoretical constructs that take center stage in relation to the original idea. Second, the researcher attempts to specify *how* these constructs are related to one another in order to answer the original research question. Is a difference among groups expected on the dependent measure? Is a linear relationship anticipated, or will a quadratic trend emerge? Are there assumptions regarding the direction or magnitude of effects?

Identification of constructs at this point is not yet definition at the empirical level (i.e., at the level of an operational definition); the researcher simply wants to formulate an empirically verifiable proposition regarding the theoretical constructs. That is, at this stage the researcher should be able to make a purely conceptual statement about one possible answer to the original research question, and that statement should be able to be specified at the empirical level. The proposition must be, according to the principles of the scientific method, testable. In addition, this “conceptual hypothesis” should provide clues about the population to which the eventual findings will generalize. By this stage in the process, the researcher has identified the central constructs, predicted relationships, and the population of interest. Much development takes place at a purely conceptual level, perhaps leading the researcher back to the literature for further review, or additional discussions with colleagues. Formulating the research question is, therefore, a critical step that precedes the selection of a method and the formation of operational definitions.

The task of selecting a methodological approach may be rather straightforward at this point in the research process; it certainly must be accomplished before consideration of the study’s practicality and merit. Whether the question is best addressed with a descriptive approach, using survey methods, questionnaires, observations, or simulations, or best answered by experimental manipulations and controls, the conceptual work of selecting a scientific approach is clearly crucial for the remainder of the enterprise. Often, researchers focus attention on the variables of interest in order to select the approach, by considering how constructs may be operationalized to address the project idea.

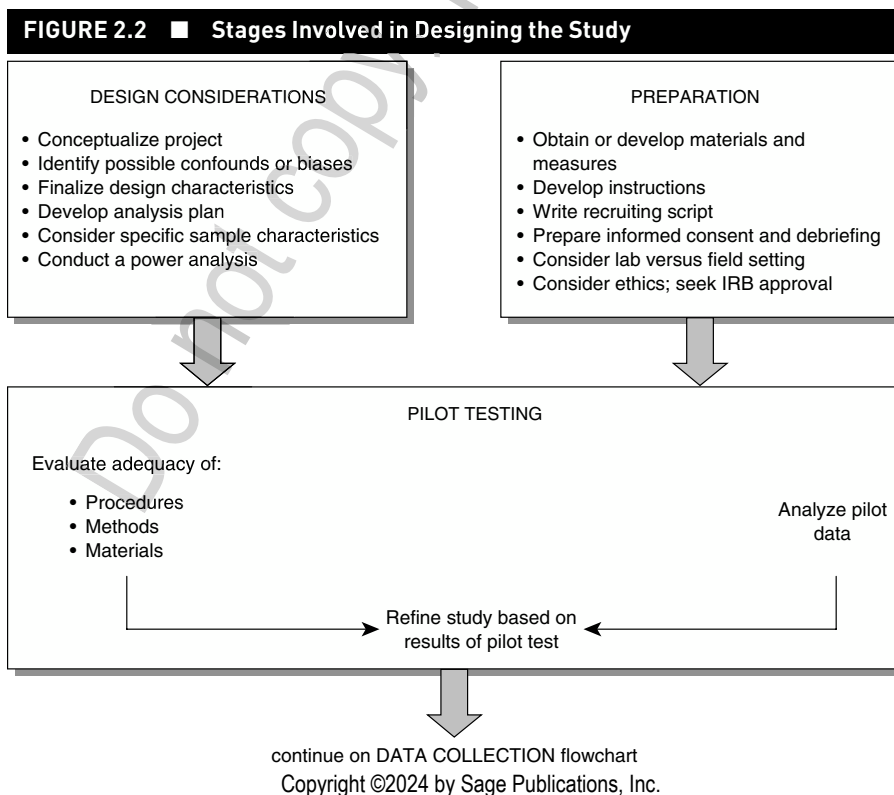
As every student of research methodology learns, the approach one takes will determine the kinds of inferences one will be able to draw from the study. Perhaps this is why most researchers include this conceptual step of method selection in their script, prior to the formal design and preparation of materials. The typical result of method selection is the transformation of conceptual hypotheses into specific hypotheses or predictions that will later be empirically tested. With a decision made regarding the methodological approach, one can begin to evaluate whether the project idea is developing appropriately in light of specific working hypotheses, the ultimate purpose of the research, and previous empirical findings.

Experienced researchers often engage in a predesign stage during which the project idea is evaluated along two dimensions: merit and practicality. Considerations of merit include, among

other things, whether one will be able to draw valid conclusions, whether the study will have external or ecological validity, and ultimately whether the findings will contribute to the scientific literature. With respect to practicality, it is clear that most research is neither cheap nor easy to conduct. Therefore, investigators must evaluate the project idea in terms of existing resources, potential sources of funding, equipment, and laboratory costs. Concerns about practicality may also include ethical considerations: Does the project idea pose any significant ethical dilemmas? Do the potential benefits of the study outweigh any anticipated risks? Thus, before moving on to the design stage, the researcher must balance the contributive value, resource value, and ethical value of the study in order to determine the best possible course of action.

Formulating the Design

Once one has done the conceptual work and thoroughly considered the potential of the project in terms of merit and practicality, it is time to move on to more formal aspects of the research design (see design flowchart, Figure 2.2). At this stage of the research process, there is often a second level of project conceptualization, but this time at a more concrete level. In the design stage of the research methods script, questions regarding treatment groups, the appropriateness of the experimental task, and a variety of procedural details are addressed. (Chapter 7 presents a thorough look into the formal designs used in research studies.) Furthermore, there are two essential types of variables that are evaluated at this time: independent variables (IVs, or *predictors*) and dependent variables (DVs, or *criterion measures*). When considering IVs, it is necessary to identify all possible confounding variables and experimental biases that could reduce the internal validity of the investigation. In terms of DVs, for the research to pass any form of peer review, the measures must be both *reliable* and *valid*. It also behooves the investigator to use measures that are sufficiently *sensitive* to reveal



This work may not be reproduced or distributed in any form or by any means without express written permission of the publisher.

meaningful relationships in the data. Often, researchers address these issues under a separate “preparation” period. For example, developing standardized procedures and writing survey questions are represented in the preparation phase of the method. Many of the considerations dealt with at this stage are treated in Chapters 8–10 of this handbook.

When the specific design characteristics of the investigation are clear (including decisions about variables, measures, and the sequencing of experimental events), then researchers can determine the number of participants to recruit for the study. Most investigators make preliminary specifications regarding the sample long before the recruiting process begins. For example, researchers typically develop a plan for their analyses that corresponds to the hypotheses they intend to entertain. These decisions regarding statistical procedures will help to inform decisions regarding the number of participants in the study and any special characteristics of the sample that will ultimately be drawn. It is common to conduct an a priori statistical power analysis to help determine the size of the sample in relation to the magnitude of the anticipated effect. Such an analysis is a particularly important step for those who seek external funding inasmuch as review panels have come to expect this information in major grant applications. Chapter 20 guides the reader through the statistical planning process, and Chapter 12 presents ways to conceptualize and maximize statistical power.

Note the activities researchers engage in as part of the preparation phase. In addition to developing materials and making logistical arrangements for the work, the investigator must submit a plan of the proposed research for review by the institutional review board (IRB) to ensure adequate protections are met. A good description of this approval process and suggestions for preparing a successful IRB proposal are given in Chapter 13. With IRB approval and materials ready, the research script indicates one other activity prior to data collection. Very often a period of preliminary research takes place that is designed to fine-tune measures and try out experimental procedures. This step is commonly referred to as “pilot testing.” During this process researchers carefully evaluate the appropriateness of their method and the adequacy of the procedures they plan to employ. Often a small (and perhaps known to be biased) sample is used solely for purposes of timing experimental events, testing for instruction comprehension, and identifying undesired demand characteristics. Although pilot testing involves the collection of data, this step is not generally recognized by investigators to be part of the data collection process. Rather, it is conceived of as a preliminary step aimed at refining elements of the materials and procedures.

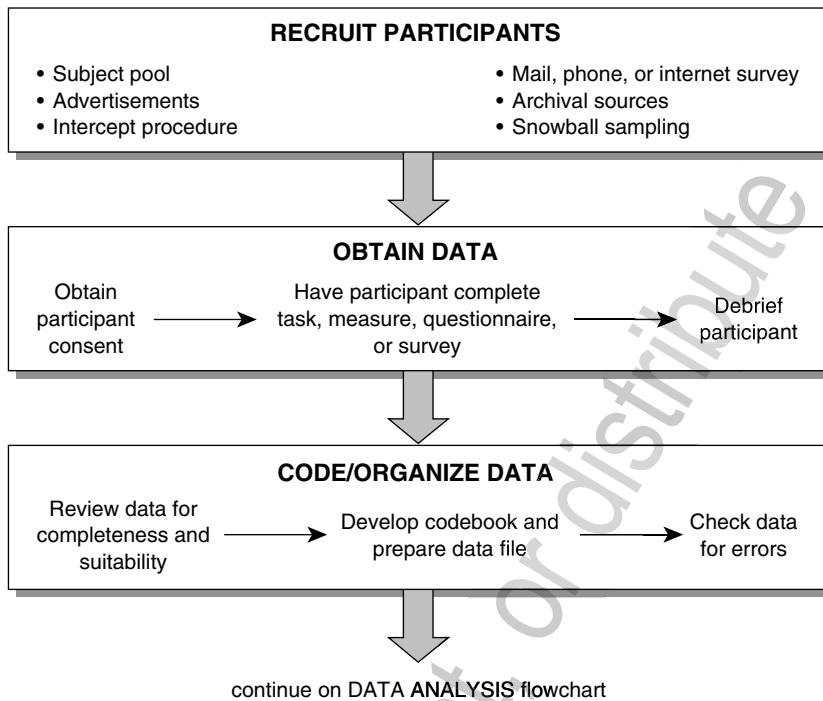
Data Collection

Once the measures are refined, pilot data have been collected, and IRB approval has been received, the research is ready to move to the next stage—data collection. The research methods script places the participant recruitment process squarely within the data collection phase. Applications of sampling procedures are the topic of Chapter 11. As seen in Figure 2.3, the period of actually collecting the data and the stage at which the data are coded and organized logically follow the recruiting phase. Chapters 14, 15, 16, and 17 present a variety of considerations related to the data collection process. Whatever method of sampling is used, be it naturalistic observation, surveys, phone calls, or use of a participant pool, the event is clearly represented as part of the general data collection process. Researchers almost always have specific subgoals nested within the act of observation, such as obtaining informed consent, checking to see that participants complete the task, and ensuring that all participants are treated fairly and ethically.

Once sufficient data have been obtained, they can be coded and entered into a database for analysis. Responses to surveys, questionnaires, verbal protocols, tests containing subscales,

Copyright ©2024 by Sage Publications, Inc.

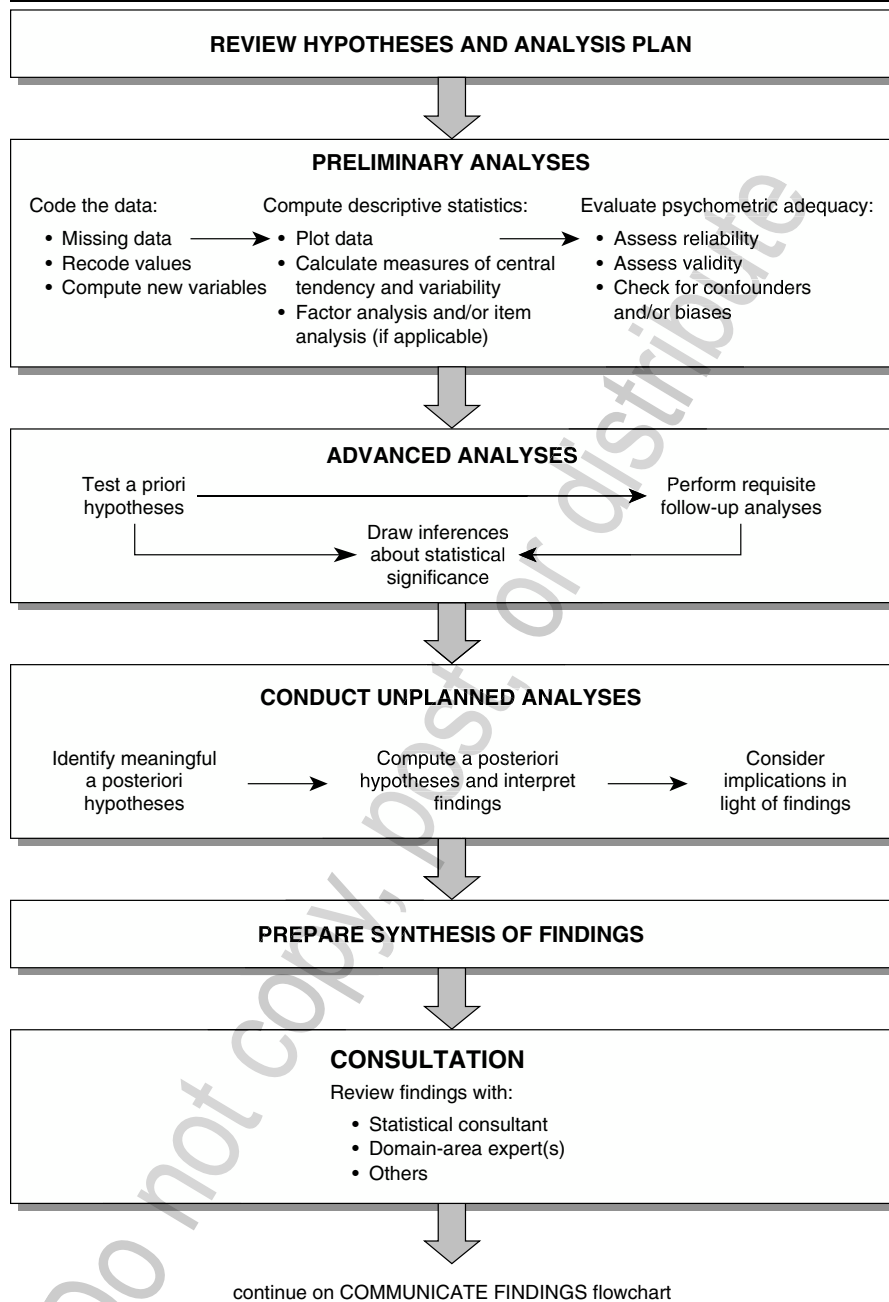
This work may not be reproduced or distributed in any form or by any means without express written permission of the publisher.

FIGURE 2.3 ■ Stages Involved in the Data Collection Phase of a Project

and data collected using a computer interface, often must be coded for analysis. Developing a well-organized codebook for a project that specifies variables, their database names, and how they have been aggregated or recoded can be a particularly valuable resource. Kept in the lab, the codebook serves as a key reference that can be consulted over the course of a long project. Once the coding process is complete, the experimenter examines the data, checking for any input errors or unintentional mistakes in the assigned values. If the data are “hand entered” into a database, double data entry procedures may be used (in which two different individuals code and enter the same dataset) to help ensure the reliability of the data entry process. Chapter 18 presents ways in which data can be cleaned and refined; Chapter 19 introduces the reader to various qualitative research techniques.

Data Analysis

Researchers often begin the data analysis phase by familiarizing themselves with the original hypotheses and the general data analysis plan (see Figure 2.4). The formal analysis begins with the computation of descriptive statistics (which may include computing measures of central tendency and variability and graphing scatterplots and frequency distributions). This step is carried out not only to determine whether there are outliers among the data but also to ensure that the skew and kurtosis of the data distributions are not unreasonable. A discussion of these basic analyses can be found in Chapter 21. Most of these preliminary computations are intended to evaluate the adequacy of the method, and they may include assessments of reliability, cross-validation of measures, and analysis of manipulation check items. Thus, a significant part of the process at this stage is to verify that the method and procedures were, in fact, successful in terms of their intended purpose. At this point, measurement weaknesses in the study can be identified and addressed,

FIGURE 2.4 ■ Stages Involved in the Data Analysis Phase of an Investigation

including problems brought on by low levels of interrater or observer reliability, selection biases, and order effects.

Following the preliminary analyses, advanced statistical analyses are carried out (see a discussion of advanced analyses in Chapter 22). Most investigators perform *planned* tests first, after which any number of follow-up tests may be performed. Examples of follow-up tests include post hoc comparisons, trend analyses, and residual analysis. At this stage, the researcher may seek to determine power levels and effect sizes for individual tests,

assess whether the Type I error rate may be inflated, and evaluate whether key statistical assumptions have been met. Chapters 20 through 22 address the variety of tests and mathematical models available to researchers in the formal analysis stage of the research process. Information on more specialized analytic approaches including structural equation modeling, meta-analysis, and the use of archival data is covered in Chapters 23–25, respectively, and multilevel research is discussed in Chapter 32.

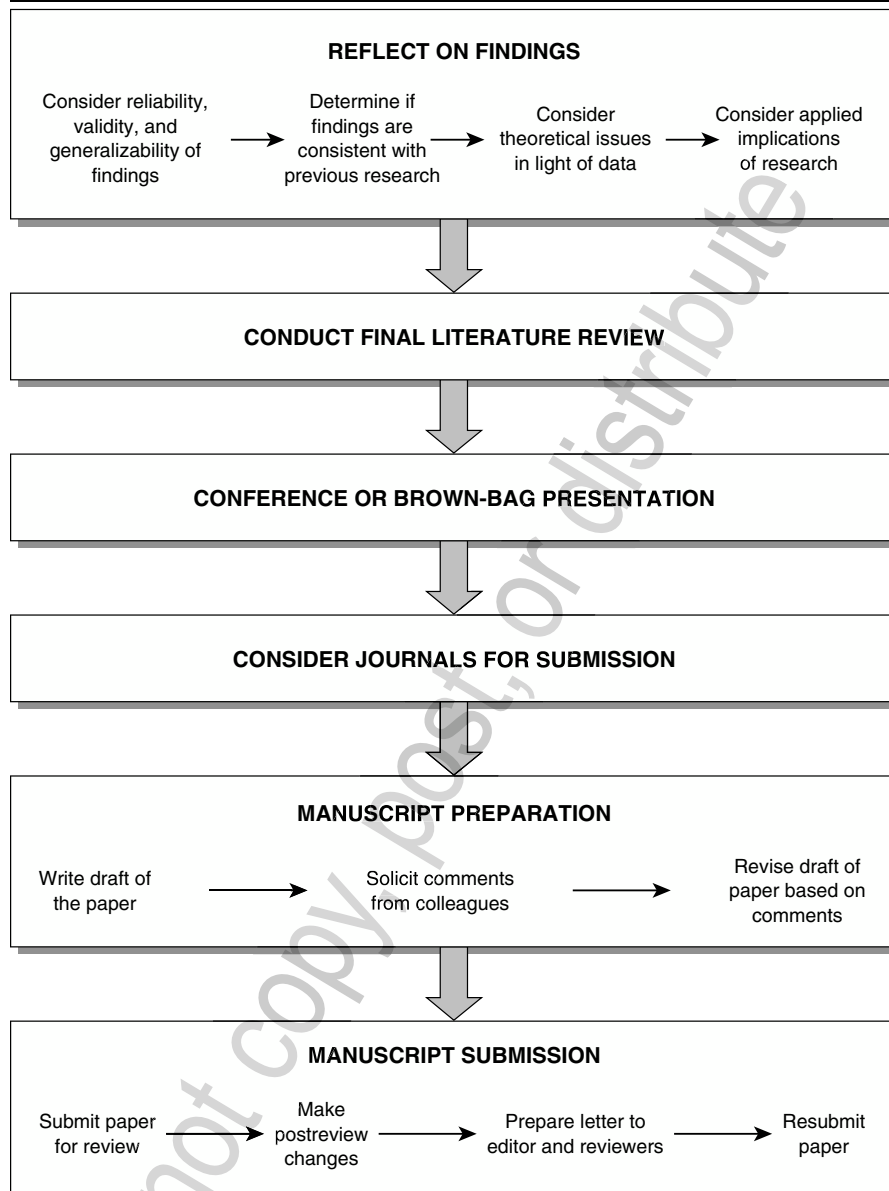
Unplanned or a posteriori hypotheses are tested when appropriate. In the research script, it is clear that investigators often discover new hypotheses suggested by the results of the advanced analysis. Students are often taught to avoid “hypothesis myopia” and encouraged to examine the data beyond their primary hypotheses. This is done to reveal other potentially interesting aspects of the study that have not yet been brought to light. The results of such ancillary analyses may reveal implications about the a priori hypotheses and suggest new hypotheses for future research. However, novice researchers are often cautioned to avoid going on “fishing expeditions” with their data, testing all possible relationships between constructs because it is easy to do so. Some methodologists have also raised concerns about so-called “p-hacking” at this stage of the research process. P-hacking, which has become much easier in recent years due to the advent of point-and-click statistical programs, involves the opportunistic search for significant effects in the absence of theory. This typically occurs in cases where the primary hypothesis has failed to be confirmed. The number of unplanned analyses one may reasonably carry out should be determined, in part, by the richness of one’s theoretical framework and on the theoretical plausibility of the test(s) being considered.

The sequence of preliminary analysis, advanced analysis, and unplanned analysis often produces such a mass of results that there becomes a need to synthesize and cross-reference findings (organizationally, diagrammatically, or in written form) in order to return the focus of one’s attention back to the question or questions that originally inspired the research. This particular step in the data analysis process can often yield “big-picture” insights about the work not previously recognized when one is in the midst of analyzing the data. The data analysis phase often ends with some informal sharing of the results of the study with consultants, peers, and other experts in the theoretical domain.

Communication of Findings

It is wise to begin the communication phase of the work by reflecting on the results of the study on a number of different levels (see Figure 2.5). Both depth of thought and integrative conceptual analysis are critical at this stage of the process, as both are necessary in order to tell an accurate and interesting “story” about the research. It is incumbent on investigators to critically evaluate their own studies and report any known difficulties or limitations to the consumers of the research. Considerations here may include the level of reliability of observations, the strength of treatment and control, and the generalizability of the findings. In addition, it is important for investigators to describe their work in relation to the existing body of research. Other reflections may include thoughts regarding the implications of the findings at the theoretical and applied levels. Engaging in reflective thought at this stage of the research process will serve to improve the quality of one’s discussion when findings are communicated to members of the scientific community.

A year or more may elapse between the time an investigation is launched and the time one seeks to formally communicate the findings. In light of this fact, many researchers include a final literature review step in the final stage of the research process. The ability

FIGURE 2.5 ■ Stages Involved in Communicating One's Findings

to discuss your work in relation to the most recently published findings will help to locate your efforts on the cutting edge, and at the same time, help advance scientific research at a more rapid pace. One may choose to share findings orally with a small group, such as at a brown-bag presentation, or in a larger, more formal setting such as at a regional or national conference. For most investigators, however, the ultimate goal of the research is publication of a peer-reviewed manuscript. To accomplish this goal, the author must decide which journal or periodical would serve as the best “home” for the work. This includes considering not only factors such as the scope, quality, and focus of different journals but also any special editorial objectives a journal may have (e.g., an upcoming special issue on your topic), unique manuscript preparation guidelines, the quality of the editorial board, or the availability of an open access publishing option.

Copyright ©2024 by Sage Publications, Inc.

This work may not be reproduced or distributed in any form or by any means without express written permission of the publisher.

The chapters in the last section of this handbook contain valuable information about manuscript preparation in the final communication phase. Generally speaking, the manuscript preparation phase entails developing a draft of a paper that is then shared with collaborators, and in some cases, colleagues. The manuscript is then typically revised based on the comments and suggestions of others, at which point it is ready for submission and peer review. Following that review, the best-case scenario would be one in which the paper is accepted by the journal editor; however, acceptance letters following first-time submissions are rare, and they generally should not be expected. If the peer review process results in a rejection, the researchers are then faced with a choice. They can **decide to scrap** the project, choosing to start the process again from scratch, or they **may attempt** to publish the paper in a different journal (sometimes without making **substantive** changes). Alternatively, the editor may return the manuscript following peer review requesting that revisions be made prior to it being reviewed a second (or even **third**) time. In this case, the authors make post-review changes to the manuscript and **include with** the second submission a detailed letter to the editor outlining specific **modifications** that were made to address reviewers' concerns. Valuable information on **strategies** for dealing with editors and reviewers can be found in Chapter 29, and **tips for reviewing** and evaluating a research article are covered in Chapter 5. Secondary (or **tertiary**) review of the manuscript will almost invariably result in either the disappointment of rejection or the satisfaction of reading an editor's letter of congratulations. **In either case**, the research methods script begins all over again with a search for new **project ideas**.

This concludes the structural description of the research methods script. In the next section, the issue of how one learns the **research script** is addressed, with a focus on how instruction and practice influence the development of methodological expertise.

INSTRUCTION, EXPERIENCE, AND THE DEVELOPMENT OF EXPERTISE

At the beginning of this chapter, the notion of a research script was introduced, followed by a discussion of the research scripts of experts. Next, a structural model of the research process was presented, which outlined key events that are part of a typical psychological investigation. Inasmuch as this handbook is intended as a primer for graduate students and research assistants, it is worth discussing how individuals learn about the research process. This **brings us to** the second question raised at the beginning of the chapter—how do individuals **acquire** scripts of the research process? Specifically, what are important sources of **instruction** when it comes to learning about the research process? What effect will **hands-on** experience have on the development of individuals' research scripts? And by what **mechanisms** do the scripts of novices develop into those of experts? Each of these **questions** will be addressed in this final section of the chapter.

Learning and Instructional Support

Fortunately, none of us start from scratch when it comes to learning many of the fundamental principles of the research process. Long before our first formal introduction to the topic, we develop rudimentary schemata (i.e., knowledge structures) about science, and represented within those schemata are ideas about how research is typically conducted. By

the time students enter college, noticeable differences in scientific skills and aptitudes are evident from one individual to the next (Hill, McQuillan, Spiegel, & Diamond, 2018). At the collegiate level, the chief goals of research methods instruction are to fill in “gaps” in knowledge, correct mistaken ideas, foster critical thinking abilities, and connect scientific questions with solution paths. Taken together, this will serve to broaden the student’s base of thinking about the workings of the investigative process.

Perhaps the most readily thought of source of instructional support is classroom instruction. Those reading this book will probably have completed at least one course in research methods and a second in introductory statistics. Both of these courses help to lay the groundwork for the acquisition of a detailed psychological research script. Those who have taken research methods at the graduate level are likely to have gone well beyond this basic stage of knowledge acquisition. At the graduate level, students have undoubtedly read journal articles that focus on specific methodological paradigms and have been privy to stimulating discussions about the philosophy of science. Methods courses at this level of education go well beyond fact-building to forge deep conceptual linkages that cut across designs, empirical objectives, and sometimes even academic disciplines.

Numerous additional sources of learning about the research process can be found beyond the classroom. One source of learning is from role models, such as an instructor, adviser, research mentor, or peer. The importance of the quality of mentor/mentee relationships in graduate school and the style of interactions can be crucial (Berman & Smyth, 2015; Turner & Crane, 2016) to learning about the research process, as is the investigative context (individual or team-based) in which one works (Detweiler-Bedell & Detweiler-Bedel, 2013). By observing the research practices of others, we can discover much about the specifics of the process, such as how to properly debrief a participant, how to develop a codebook, or how to make an effective brown-bag presentation. It can be particularly beneficial to talk with more advanced investigators about the obstacles and opportunities associated with the research process. A second source of learning beyond the classroom involves hands-on research experiences. This may involve working in an established psychological laboratory or testing a research idea of your own. From a learning perspective, working in an academic lab can be a uniquely valuable experience because research activities are often well structured and clearly defined. Lab manuals are sometimes provided that describe critical project-related tasks and responsibilities and give the student a big picture of where the research program has come from and where it’s headed. One other valuable source of learning about the research process comes from observing formal presentations made by one’s peers in a research methods course or by professionals at a colloquium or a regional or national psychological conference. By fostering an interest in a wide range of research topics, you increase your breadth of knowledge not only about the field but also about the variety of methods and procedures that are available to you as an investigator.

Most undergraduate psychology programs and the apprenticeship model of research training at the graduate level have been designed and refined over the years to facilitate the acquisition of the research script. From an instructional design perspective, cognitive learning objectives are typically “scaffolded” (i.e., sequentially ordered into what educational psychologists refer to as “zones of proximal development”) so as to build on themselves (Goldman, Petrosino, & Cognition and Technology Group at Vanderbilt, 1999; Peffer, Beckler, Schunn, Renken, & Revak, 2015). The goal of this progressive set of learning experiences is to ensure that one acquires the competence to conduct independent research by the time graduate school is completed (Spencer & Molina, 2018).

In most cases, the uninitiated first-year psychology major transitions into a skilled and proficient researcher over a 7- to 10-year period. To maximize the success of this training objective, specific procedures associated with clearly defined research tasks are presented at precisely the right time in the student's cognitive development (Kester, Kirschner, van Merriënboer, & Baumer, 2001). Provision of this procedural information, coupled with supportive assistance during the student's practice of the new skill, appears to lead to the most efficient learning (Kester, Kirschner, & van Merriënboer, 2004). Often, a "fading" process is built into the educational experience in order to facilitate the transition toward independence (Hsu, Wang, & Zhang, 2017). This means that many sources of instructional support (e.g., formal coursework) are gradually phased out over time (Merriënboer, Kirschner, & Kester, 2003) in favor of more individualized types of research experiences. Consequently, sources of learning about the research process normally change or shift in import as the student progresses through an extended program of studies.

Experience and Script Development

As the old story goes, a New York City tourist asked the violin virtuoso, "How do you get to Carnegie Hall?"

"Practice, my good man, practice!" he was advised.

The story may be hackneyed, but the take-away message is clear: The skill acquisition process is rarely, if ever, easy. In most real-world problem-solving domains, practice is the key to learning a complex set of procedures, based in large part on the principle of learning by doing (Anzai & Simon, 1979; LaCosse et al., 2017). Moreover, the constructivist learning perspective suggests that individuals' schemata are built-up through the process of induction (Halford & Busby, 2007), which in the psychological research context suggests students cull general lessons from the range of different problems they encounter. Mindful abstraction of the salient elements of different psychological studies results in the differentiation of one's research scripts. This, in turn, leads to the formation of specialized scripts, each with its own unique triggering conditions and application. Also, with practice, declarative elements of scripts that occur frequently with one another become bundled into a unit or compiled, so that they may be efficiently retrieved from long-term memory as a procedural set (Anderson, 1996; Ritter, Yeh, Cohen, Weyhrauch, Kim, & Hobbs, 2013). Moreover, repetitive application of a particular script leads to the strengthening of that procedural representation, thus increasing the probability that script will be appropriately applied in the future.

Any discussion of the role of experience in acquiring the research script would be incomplete without also discussing the importance of performance feedback. Feedback, whether it comes from an instructor, peers, or perhaps a review panel, can help shape an individual's thinking about the research process. Constructive criticism, in particular, can sometimes broaden, other times fine-tune, or fill in gaps in one's mental model of the scientific method. At this stage, however, two problems may arise. First, sometimes feedback is overly negative; second, performance feedback on one's research is often delayed. This can make it difficult to evaluate the quality of one's project-related decisions when one is immersed in the research process. The difficulties associated with making the right decisions when designing (and, for that matter, carrying out) psychological investigations has been referred to by Jung (1971) as "the experimenter's dilemma." Fortunately, acquiring expertise in the scientific process will help one meet the challenges that we all face as researchers.

The Development of Expertise

Early in this chapter an “expert script” of the research process was introduced, although relatively little was said at that point about what it means to be an expert from an information-processing perspective. What *does* it mean to be an expert? There seems to be no debate on one key point, and that is that experts possess a larger declarative knowledge base than novices, and they perceive and represent problems in their domain at a deeper (more principled) level (Goldman et al., 1999; Hoffman & Lintern, 2006, 1988). Moreover, relative to novices, experts have the ability to think creatively (Kleinmintz, Ivancovsky, & Shamay-Tsoory, 2019; Weisberg, 2006). This flexibility in thinking benefits experienced researchers in two different ways: It allows them to construct and apply new scripts as needed (Merriënboer et al., 2002), and it allows them to adjust existing problem-solving strategies to adapt to the unique demands of the situation (Endsley, 2006; Gobet & Chassy, 2009).

Not only do experts process information differently than novices when solving a problem, but there is evidence that they learn differently as well. In a study of the acquisition of scientific knowledge, Heckler (2011) argued that non-experts make heavy use of bottom-up processing mechanisms when acquiring knowledge relative to individuals with superior knowledge in a domain. Flawed domain-specific mental models, he posited, lead novices to make patterns of error in thinking that need to be remediated through instruction. Yet not all learners are equally prepared to acquire knowledge. In addition to the importance of deliberate practice in a domain, expertise is facilitated by a learner’s innate abilities, including cognitive aptitudes such as working memory capacity (Kulasegaram, Grierson, & Norman, 2013), attentional focus, and intellectual endowment (Horn & Masunaga, 2000). To best facilitate the development of expertise, Schmidt and Rikers (2007)—in a study of the medical knowledge acquisition of physicians—suggested that theory be supplemented by the presentation of real-world scenarios (i.e., case studies) as a way to create veridical psychological scripts of illness processes. Also consistent with the notion of expert/novice differences in knowledge acquisition, Daley (1999) found that novices prefer more passive approaches to learning (e.g., learning from textbooks and lectures), whereas experts, in contrast, were more likely to engage in self-initiated learning approaches (e.g., making direct contact with other experts, actively seeking out information at conferences). Taken together, the studies cited above suggest that in order to optimize the instruction of research methods content, educators should carefully select educational approaches that best match the aptitudes, prior knowledge, and experiences of their students.

By all accounts, the development of expertise in the psychological research arena is not something that comes quickly. Moreover, the research method script is something that evolves over the course of one’s career as science advances and new techniques and methodologies emerge. Contemporary views of expertise suggest that the learning process is nonmonotonic with respect to time. That is, as individuals’ knowledge structures grow and change, they pass through a series of qualitatively different developmental stages, each characterized by different skills and abilities (cf., Clark, 2008; Krampe & Charness, 2006).

CONCLUSION

In this chapter, we presented the psychological research methods script and its specific components. Our goal was to characterize the research process as a coherent and coordinated set of activities. Ideally, you will read this chapter and complete the accompanying

Copyright ©2024 by Sage Publications, Inc.

This work may not be reproduced or distributed in any form or by any means without express written permission of the publisher.

exercises before exploring other parts of this handbook, as it was designed to lay a foundation for the sections that follow.

Any psychologist-in-training who is reading this handbook is already well on the way to becoming a skilled researcher. As you develop your investigative skills, we trust you will find the research process provides excitement, challenges, and intellectual rewards. By way of closing, we encourage you to reflect on the changing nature of your research scripts as they grow and expand over the years. Doing so will not only provide you with an appreciation of milestones in your own development but, at the same time, provide insights into where your scientific thinking may lead.

EXERCISES

Exercise 1

Write at the top of a blank sheet of paper “Get Idea for Project,” and at the bottom write the words “Publish Paper.” Then list as many activities involved in the research process as you can think of that occur between these anchors, placing them in what you believe to be the correct serial order. Make this list now, before reading further.

Next, reflect on the nature of your mental representation of the research process. Can you group events in your research methods script into general categories, in much the same way the flowcharts in this chapter are organized? Are all superordinate events in the process (e.g., design, data collection) represented in your script? Compare your research methods script with the empirically derived expert script presented in Table 2.1. Are there differences in the ordering of the scripts? Do the scripts differ in terms of their level of specificity?

Exercise 2

Look through the previous pages of this chapter and write down 20 or so research script events on separate slips of paper. Fold the slips and place them in a bowl or hat, shake, then withdraw them one at a time at random. For each event, write down the event in the research methods script that immediately precedes it and the event that follows. Check your answers against the structural script presented in the five flow diagrams. Compared with the serially ordered script generation task in Exercise 1, did you find it easier or more difficult to generate elements of the script when they were taken out of order?

Next, reflect on *why* it is important for the earlier event to precede the event drawn from the hat, and *why* it is important for the later event to follow.

Exercise 3

Visit with colleagues, professors, or researchers in your field to discuss the idea of research as a form of scripted knowledge. Informally interview the individual to discover elements of his or her research script. Ask the person to describe the activities a researcher goes through for one or more of the higher-level event sequences, such as data analysis or communication of findings. For instance, one might ask, “What have you found takes place during the data analysis phase of research? What do you do first, and what goals are you trying to accomplish?” Notice the extent to which there are commonalities across individuals in terms of the big-picture dimensions of the script and how differences begin to

emerge when it comes to specifying the individual elements that make up those major dimensions.

RECOMMENDED READINGS

A variety of both basic and advanced readings on the research methods process can be found in the literature. For a more detailed discussion of the research methods script, see Hershey et al. (1996) and Wilson and Hershey (1996). A classic and lucid discussion of the procedural aspects of the research process can also be found in Runkel and McGrath (1972). There is a cyclic model of the research process that includes a number of major steps that overlap with those outlined in this chapter. Moreover, most undergraduate-level, experimental-methods textbooks contain good basic coverage of many elements of the psychological research process. At the more technical end of the spectrum, Kirk's text, titled *Experimental Design* (2013), provides an excellent treatment of the topic, as does Maxwell and Kelley's book titled *Designing Experiments and Analyzing Data: A Model Comparison Perspective* (2018). In contrast, a highly readable introduction to the research process is found in the text *Experimental Psychology* by Kantowitz, Roediger, and Elmes (2015). The book *Experimental and Quasi-Experimental Designs for Research* by Campbell and Stanley (1963), considered by many to be a classic primer on research design and threats to internal validity, is still well worth reading in spite of its age. An updated version of many of the key ideas outlined in Campbell and Stanley (1963) can be found in a book by Shadish, Cook, and Campbell (2002).

In addition to the readings on the topic of research methods listed above, numerous informative websites exist. Four of the better sites include the *Web Center for Social Research Methods* (Trochim, 2008) (<https://www.socialresearchmethods.net/kb/index.php>); *Centre for Psychology Resources*, maintained by Athabasca University (<https://psych.athabascau.ca/>); and the Purdue University Online Writing Lab (OWL), which provides detailed information about how to prepare research reports and presentations using a variety of different writing styles (<https://owl.english.purdue.edu/owl/>).

Do not copy, post, or distribute

Copyright ©2024 by Sage Publications, Inc.
This work may not be reproduced or distributed in any form or by any means without express written permission of the publisher.