

processes. McGuire (1964), for example, was interested in the problem of how to prevent people from being influenced by attempts at persuasion and hit on the analogy of inoculation: If injecting a person with a weakened version of an infectious agent can prevent infection by the agent, can presentation of weakened versions of persuasive arguments prevent persuasion when the full-strength arguments are presented? (It can.) One can also take accepted principles and look at them in reverse. For example, primary care physicians list behavioral factors as the primary cause of obesity and stigmatize their overweight patients who do not modify these behaviors (Foster et al., 2003). However, research suggests that weight stigmatization itself increases the likelihood of engaging in unhealthy behaviors, such as bingeing or failing to exercise (Puhl & Heuer, 2009). Lastly, one can look at the “mirror image” of prior research. For example, if people self-disclose personal information to someone they like, do they also like a people who self-disclose to them? Research suggests they do, even if that person is a new acquaintance (Vittengl & Holt, 2000).

Finally, don't overlook your everyday experience as a source of research ideas. Every time you ask yourself, “Why do people act that way?” you have a potential research question: Why *do* people act that way? Singer and Glass (1975), for example, got started on their research on the relationship between perceptions of personal control and stress because they were struck by what seemed to them to be a curious phenomenon: People who experienced the same urban environment (New York City) reacted in very different ways—some developed stress symptoms and hated the city, whereas others found the city exciting and loved it.

Reviewing the Literature

Once you have formulated your research question on the basis of your general background on the topic, it is time to conduct *focused research*; that is, you now should begin to read and evaluate sources that relate to your focal question. When doing so, you should read sources carefully and keep detailed notes, including keeping track of citation information for those sources (Beins & Beins, 2012). This process is called the literature review. The term *literature review* requires a little clarification because researchers use it in three ways. First, it is used to refer to the focus of this discussion, the process of collecting theoretical, empirical, and methodological information on a topic. The term is also used to refer to two products of that process: a comprehensive summary and analysis of theory and research on a topic (see Chapter 19) and to the part of the introduction section of a research report that presents the background of the study (see Chapter 20).

Purposes of the literature review. When used to develop the background for a study, the **literature review** has three purposes. The first is to provide a scientific context for the research and to validate it against the three criteria for a good research question. You want your research to be well grounded in the body of existing scientific knowledge so that it both ties in with and extends what is already there. The literature review helps you generate this context by bringing to light the theory and research relevant to your question. The literature review also lets you determine the important theoretical, practical, and methodological issues that surround your research question. When you report on your research, you will begin by showing the reader why your research was important to the scientific understanding of your topic; this aspect of the literature review gives you that information. Although your formal background in the topic will be helpful, the information in that background might not be specific or current enough to provide an appropriate context for your research question.

The second purpose of the literature review is to avoid duplication of effort. If you find your research question has been addressed a number of times using a variety of methods and has a reasonably firm answer, further research may not be productive. Although replication is important in establishing the reliability and validity of research results, eventually we have enough information to draw firm conclusions, at which point further research may be a waste of effort. However, new perspectives on old questions, such as applications to new settings or populations, can provide new information and so should be pursued. The issue of replication is discussed in detail later in this chapter. Reading major review articles on your topic of interest, if available, can help you answer the question of whether new research is warranted.

The third purpose of the literature review is to identify potential problems in conducting the research. Research reports contain information on the effectiveness of operational definitions, potential alternative explanations that must be controlled, and appropriate ways to analyze the data. Knowing in advance the problems that can arise in your research will help you avoid them. Creating theory and research maps (see Figure 5.3) can assist you with all three goals of a literature review.

① look for relevant theories

Types of information. The purposes of the literature review imply that you should be looking for four types of information. First, you should be looking for relevant theories. Although your background in the topic will make you aware of some of the theories related to your question, make sure you know about all the relevant theories. This knowledge can help you in two ways. First, it may let you reformulate your research question into a comparison of theories, thereby providing more information than if you simply set out to test a single theory. Second, if your results are not consistent with the particular theory you favor, they may be consistent with another theory, which will provide your results with a niche in the knowledge base.

②

The second type of information to look for is how previous researchers have addressed your question. This information lets you know three things. First, you will know what has been done, allowing you to avoid unproductive duplication. Second, you will know what has not been done; to the extent that your research question—or your approach to answering that question—is novel, your research increases in importance. Third, you will know what still needs to be done to answer the question fully. The results of research studies often leave parts of their questions unanswered or raise new questions; to the extent that your research addresses such questions, it increases in importance.

③

The third type of information to look for concerns method: how prior research was carried out. This information includes settings, characteristics of participants, operational definitions, and procedures. This knowledge lets you anticipate and avoid problems reported by your predecessors. It can also save you work: If you find operational definitions and procedures that have worked well in the past, you might want to adopt them. There is nothing wrong with borrowing methods used by other researchers; in fact, it is considered a compliment, as long as you give credit to the people who developed them. In addition, using the same or similar methods in studying a phenomenon makes it easier to compare the results of the studies and to draw conclusions from a set of studies.

The fourth type of information to look for concerns data analysis. Research design and data analysis go hand in hand. It is both frustrating and embarrassing to collect data on a question and then realize you have no idea about how to analyze the data to find the answer to your question. Whether your analysis is statistical or qualitative, you must plan it in advance so that your analytic technique matches the type of data you collect (the next chapter touches on this issue again). Clearly, seeing how other researchers have analyzed

their data can help you decide how to analyze yours. If you don't understand the statistical techniques used in a study, consult a textbook or someone who has experience using the techniques. Huck, Cormier, and Bounds (1974) have written a very useful book about how to interpret the statistics used in research reports.

Primary versus secondary sources. Information about research can be found in either primary sources or secondary sources. A **primary source** is an original research report or presentation of a theory written by the people who conducted the research or developed the theory. A primary source will include detailed information about the research or theory laid out in complete detail. Research reports published in professional journals are examples of primary research sources. They provide complete explanations of why the research was conducted, detailed descriptions of how the data were collected and analyzed, and the researchers' interpretations of the meaning of the results. Original presentations of theories can be reported in books, as Locke and Latham (1990) did with their goal-setting theory of work performance, or in professional journals, as Abramson, Metalsky, and Alloy (1989) did with their attributional theory of depression.

A **secondary source** summarizes information from primary sources. Examples of secondary sources include the introduction and discussion sections of research reports, journal articles and book chapters that review what is known about a topic, and textbooks. Secondary sources can also include nonprofessional publications such as newspapers, websites, and television programs. Secondary sources are useful because they provide information from primary sources in concise form, compare and contrast the strengths and weaknesses of studies and theories, and point out gaps in the research literature and topics for future research. Because secondary sources are summaries, they necessarily omit information from the primary sources. As a result, secondary sources sometimes provide inaccurate descriptions of the research results and the meaning of those results. For example, Friend, Rafferty, and Bramel (1990) describe the ways in which the results of Asch's conformity study have been incorrectly described in secondary sources and Sackett, Hardison, and Cullen (2004) discuss how research on stereotype threat, which addresses how awareness of one's own group's stereotypes can hinder performance, has been oversimplified in the popular press. Therefore, when you find an interesting study described in a secondary source, you should go back to the original research report to see what it actually says.

Where to find information. Sources of information for literature reviews can be classified as published or unpublished. Published sources consist of professional journals and books and receive wide distribution to academic libraries. Most research and much theoretical work in behavioral science is published in professional journals. An important characteristic of most articles published in professional journals is that they have undergone peer review. **Peer review** is a process in which an article is evaluated prior to publication by experts on its topic and, in the case of research reports, the methodology it uses. If the article does not meet the quality standards set by the journal editor and evaluated by the reviewers, the report will not be published. Chapter 20 describes the review process in more detail; for now, let's view it as a quality check.

Books are used to publish research reports in many areas of behavioral science, such as sociology and anthropology, especially reports of long-term field studies. In other areas, such as psychology, professional books are used primarily for literature reviews, the presentation of theories, and methodological issues, usually on a single topic or set of related topics. Books can be classified as either monographs or edited books. Monographs are

written by one author or a team of authors; in edited books, each chapter is written by an author or a team of authors, with an editor or a team of editors contributing opening and closing chapters that provide a context for the other chapters. Textbooks, of course, provide overviews of topics at various levels of detail and sophistication. Introductory-level texts provide only broad and often highly selective pictures of a field, designed for students with little background on the topic. Specialized graduate-level texts, in contrast, go deeply into a topic, analyzing the theories and research methods used. Professional books and textbooks are usually, although not always, peer reviewed, but the review criteria are often less stringent than those for journal articles.

Unlike published research, unpublished research reports receive only limited distribution. This *grey literature* includes conference presentations, technical reports, white papers, standards, policies, and newsletters from professional associations. The PsycEXTRA database, maintained by the American Psychological Association (apa.org), has over 100,000 such records. Reports of research given at conventions and other professional meetings are also available through the Educational Resources Information Center (ERIC; www.eric.ed.gov). Programs from major conferences are often archived on the association's website; conference papers not archived at PsycEXTRA or ERIC may be available from the authors. Research presented at a conference also may later be published, so you should search a database such as PsycINFO by author and topic to check this possibility. Rothstein and Hopewell (2009) provide detailed information about searching this literature.

Technical reports are summaries of research done under contract to a business or government agency; these may be available on the agency's website. For example, an annual report on crime in the United States can be found on the Federal Bureau of Investigation website (www.fbi.gov/research.htm). The *Catalog of U.S. Government Publications*, which lists and indexes publications from U.S. government agencies, including research reports, is available at catalog.gpo.gov. Reports completed for private industry and foundations are increasingly available on the Internet; for example, the Education Testing Service website (www.ets.org) has a report on identifying reading disabilities in English language learners (Shore & Sabatini, 2009). Some technical reports are also available from PsycEXTRA and this site archives older reports that may have been removed from an agency's website. Master's theses and doctoral dissertations are normally held only at the library of the university where the work is done, but copies may be available on the university's website or through Interlibrary Loan. *Dissertation Abstracts International* indexes doctoral dissertations. Digital or microfiche copies of dissertations can be purchased from ProQuest/UMI, the company that publishes the index.

Authors of research reports are a resource for obtaining information that was not included in the original report, such as a copy of a measure or a set of stimuli. The author may also be able to provide information on the topic of the article that has not yet been published and with advice on other sources of information that are available. The first page of most journal articles includes a footnote giving the postal and electronic mail addresses of one of the authors (usually the first author) and contact information for researchers is typically available on their institution's website. Be aware, however, that the ready availability of author contact information has resulted in researchers being inundated with requests for research assistance. Before you write an author, be sure to check their website and/or their published articles to determine whether the information you need is already available. Do not expect an established researcher to do your work for you; for example, we have had requests for copies of our research articles simply because the student could not find a copy in her library—that is what interlibrary loan is for. We have also had students ask us to explain commonly used statistical analyses or to offer recommendations about the literature

they should read. Be respectful of a researcher's time and ask only those questions you truly cannot find the answer to using local resources or professors at your own institution.

Library research tools. It used to be that the physical holdings of one's university library were crucially important. Today, of course, an astonishing amount of information can be accessed from electronic devices and the line between resources available from specific libraries or from the broader World Wide Web is difficult to draw; indeed, you may give little thought to where information is housed. Search engines allow you to readily access information; typing in an author's name and article title, for example, will often lead you directly to a published manuscript. Most journals now also appear in both print and electronic form, although your access to these journals will depend on the services to which your university or local library subscribes. If you personally subscribe to a journal, you may also have electronic access through the publisher; this access may be extended to other journals offered by that publisher. There are also peer-reviewed journals which publish only electronic manuscripts (see www.psycline.org/journals/psycline.html, for a list of electronic journals in psychology and the social sciences by title, topic, and key words). Books are also increasingly likely to appear in electronic form through sites such as Google Scholar.

This easy access makes literature searching seem seductively simple: sit down at the computer, type in what you are looking for, and sources come up. Unfortunately, there are clear limits to this approach and it may not be the most effective way to locate information. Be aware that "Googling" a topic will provide links to frequently accessed articles and websites, but this is not the same as identifying the most relevant or most important research in an area. Which items come up first depends on how a particular search engine ranks the content; the result is that irrelevant articles may appear first and relevant articles may not be captured by your search. Similarly, Wikipedia provides overviews of countless topics in the social sciences, but the quality of this information depends on the expertise of the people who created the entry; "Googling" and Wikipedia might be a good place to begin one's *preliminary* search, but should not be relied on for the focused stage of research (and the primary research sources cited in sites such as Wikipedia should definitely be verified).

To be an effective researcher, you must take the time to learn the tools that will help you find the best scholarly information about your topic of interest. One such tool is the library's online catalog, which indexes the library's holdings in the form of books, periodicals, government documents, dissertations and theses written at the institution, audio and visual records, and other materials. The catalog can be searched by authors' names, titles, subjects, and key words. Most universities offer online access to databases, such as *PsycINFO*, *PsycARTICLES*, *Academic Search Premier (EBSCOhost)*, and *Sociological Abstracts*. You may be able to access these databases both on and off campus; some libraries also partner with other universities and you may be able to access the resources of those institutions.

The mechanics of searching a computerized index vary depending on the particular software a library uses. Constructing a good search strategy requires knowledge both of the topic you are researching and of the way the search software operates, including the list of terms that you tell the program to look for in the index. As Durlak and Lipsey (1991) described their experience using a psychological database: "We discovered ... that only one of every three entries appearing in our computer-generated study lists was relevant [to our research] and approximately two thirds of the relevant studies were not picked up via the computer search" (p. 301). Kidd, Meyer, and Olesko (2000) review 20 databases that are relevant to psychology and offer tips on how to use them; Beins and Beins (2012) provide detailed information about how to effectively search these sources. Library instruction is also likely available at your institution.

Because research reports, theoretical articles, and literature review articles cite the studies on which they are based, a second source of studies is the bibliographies of these publications. If one or a few articles are central to the topic under review, you can conduct a citation search. *Social Sciences Citation Index* (SSCI) indexes all the sources cited in articles published in major journals in the social and behavioral sciences. Therefore, if Nguyen and Jones have written a particularly important article on a subject, you can look up all the subsequent journal articles that cited Nguyen and Jones's work; these articles probably deal with the same topic and so are probably relevant to your literature review. Reed and Baxter (2003) explain how to use SSCI. PsycINFO also includes information about how often an article is cited, but only in other articles in its database.

What should you do if you conduct a literature search and cannot find information relevant to your topic? Your first step should be to think about the search you conducted. If you conducted a computer search, did you use the correct search terms? Each index has a thesaurus that lists the terms the index uses to categorize articles; if you don't use these "official" terms, you might not find what you're looking for. If you are confident that you've used a correct search strategy, you must then ask how researchable your topic is. If no one has ever conducted research on your question before, it might be because no one has been able to find a way to do so; alternatively, you might be breaking new ground and therefore be dealing with an especially important question. Also, keep in mind that journals are reluctant to publish research results that do not support the hypotheses tested (Greenwald, 1975); consequently, other people may have done research on a topic and have been unable to find support for their hypotheses, so their research has not been published. One way to check on this possibility is by using the grey literature, as discussed above, or accessing the so-called invisible college: informal networks of people who conduct research on a topic. These people may be able to provide information about research that hasn't made it into print. Websites such as the Community of Science (www.cos.com) and the Social Psychology Network (www.socialpsychology.org) allow you to search for experts by your topic of interest.

Evaluating information. Once you've completed your search, much of the information you will review will be from research reports. Novice researchers often tend to accept the information in these reports, especially those published in professional journals, rather uncritically. Because these reports appear in peer-reviewed journals, the reasoning goes, they must be correct; who am I to question the judgments of experienced researchers, reviewers, and editors? However, as noted in the previous chapter, no study is perfect. Therefore, read research reports critically, keeping alert for factors, such as alternative explanations of results, that might lessen the validity of the conclusions. Take these validity judgments into consideration when formulating your hypotheses, giving the most weight to the information that you judge to be most valid. The factors that contribute to the validity of research are discussed throughout this book, and Box 5.2 lists some questions you should bear in mind while reading research reports.

To give you practice in applying such questions to research reports, Huck and Sandler (1979) have compiled summaries of problematic studies. Working through their book will help you develop the critical sense you need to evaluate research reports. An astonishing amount of information is now readily available on the Internet but evaluating the accuracy of this information requires due diligence. As Driscoll and Brizee (2012) note, the ready availability of such information makes it tempting to accept whatever you find. Rather than succumb to this temptation, develop the skills you need to evaluate the information on the Web. In Box 5.3, we offer strategies for effectively doing so.

Box 5.2 Criteria for Evaluating Research Reports

When evaluating a research report, ask the following questions. These questions are phrased primarily in terms of experimental research, but the same principles apply to other research strategies.

1. *Internal validity*: Might differences between groups be accounted for by something other than the different conditions of the independent variable?
 - a. Were research participants randomly assigned to groups so that there was no systematic bias in favor of one group over another? Could bias have been introduced after assignment of participants because of different dropout rates in the conditions?
 - b. Were all the necessary control groups used, including special control groups in addition to the baseline group to account for possible alternative explanations? Were participants in all groups treated identically except for administration of the independent variable?
 - c. Were measures taken to prevent the intrusion of experimenter bias?
 - d. Were measures taken to control for possible confounds, such as history, statistical regression, order effects, and so forth?
2. *Construct validity*: Did the researchers use appropriate operational definitions of their independent and dependent variables?
 - a. Is there evidence for the validity of the operational definitions?
 - b. How good is that evidence?
3. *Statistical validity*: Were the data analyzed properly?
 - a. Was the statistic used appropriate to the data?
 - b. Were the proper comparisons made between groups? For example, were follow-up tests used in multigroup and factorial designs to determine which differences in means were significant?
 - c. Were the results statistically significant? If not, was there adequate statistical power?
4. *Generalization*: Did the research have adequate external and ecological validity?
 - a. Research participants: From what population was the participant sample drawn? Is it appropriate to the generalizations the authors want to make?
 - b. Experimental procedures: Did the operational definitions and research setting have adequate realism?
 - c. Did the researchers use enough levels of the independent variable to determine if there was a meaningful relationship with the dependent variable?
 - d. Are the necessary independent variables included to detect any moderator variables?
5. *Going from data to conclusions*:
 - a. If the study was designed to test a theory, does the theory clearly predict one experimental outcome over another? Do the researchers state an explicit hypothesis? If not, is one easily identifiable?
 - b. Can all the steps and all the assumptions from theory to prediction be clearly stated?

- c. Can all the steps and assumptions from data to conclusions be clearly stated? Are all the conclusions supported by data?
- d. Are the conclusions consistent with the research strategy used? For example, are causal conclusions drawn only when a true experiment is conducted?
- 6. *Of what value is the research?* (No attempt has been made to order the following list in terms of importance.)
 - a. Is the size of the relationship found large enough to have practical significance in terms of the goals of the research?
 - b. Does it provide an answer to a practical problem?
 - c. Does it have theoretical significance?
 - d. Does it suggest directions for future research?
 - e. Does it demonstrate previously unnoticed behavioral phenomena?
 - f. Does it explore the conditions under which a phenomenon occurs?
 - g. Does it represent a methodological or technical advance?

Source: Adapted from Leavitt (1991)

In closing this section on literature reviewing, we note that although Figure 5.1 shows literature reviewing and the next element in the hypothesis formulation process, formulating hypotheses, as separate elements, they are actually concurrent, interdependent processes. You will use the information from the literature review to help you refine your general research question into a specific hypothesis. Simultaneously, as your hypothesis becomes more specific you will find yourself in need of more specific information from the literature review, such as the advantages and disadvantages of different operational definitions and variables that you must control in order to rule out alternative explanations for your results. You may also need to continue your literature review after you have analyzed your data as you search for possible explanations of unexpected findings and look for the ways in which those findings fit in with what is already known about your topic.

Formulating Hypotheses

Once you have formulated your research question and refined it based on the information derived from your literature review, you must formulate one or more specific hypotheses to test in your research. Each hypothesis you formulate will take two forms: a narrative research hypothesis and a statistical hypothesis.

Research hypotheses. The **research hypothesis** states an expectation about the relationship between two variables; this expectation derives from and answers the research question, and so is grounded in prior theory and research on the question. For example, for the research question "Is self-esteem related to premarital romantic jealousy?" the research hypothesis (based on a thorough literature review) could be stated as "Unmarried members of romantic relationships who have low self-esteem will exhibit more romantic jealousy than will unmarried members of romantic relationships who have high self-esteem."

Notice that the hypothesis specifies that a negative relationship exists between self-esteem and jealousy—low self-esteem is associated with high jealousy—not just that

Box 5.3 Information from the Internet

Because there are no controls, such as peer review, over the quality of the information posted on most Web pages, there are additional factors to consider when evaluating research reports posted on the Internet. Some factors to consider include the following:

1. *Evaluate the Accuracy of the Web document.*

- a. Is the author of the page listed and, if so, what are his or her credentials or level of expertise regarding the topic of the page? As Beck (1997) notes, answering this question can be surprisingly difficult because, even if the author is listed, her or his qualifications often are not. Moreover, the name listed on the page may be a Web master rather than the page author (Kapoun, 1998). Make sure you can distinguish between the two and, more generally, take the time to determine whether the author is a well-known, respected researcher on the topic.
- b. Who is sponsoring the Web page? As Henninger (1999) notes, you should look for sponsors who are from reputable organizations that do not have a financial interest in the topic; examples include well-known colleges, universities, research institutes, or public service organizations. She further points out that college or university Web sites may contain both official pages and unofficial personal pages; unofficial pages should be evaluated with greater scrutiny to ensure they reflect the most up-to-date scholarship.

2. *How Objective is the Information Provided?*

- a. There are several questions you can ask to determine whether the information provided on a Web site is objective. Look for information about the Web page's sponsor and whether contact information for that sponsor is listed. Then, ask for whom the site was written and for what purpose (Kapoun, 1998). Was the Web page designed to sell a product or service or to advocate a particular position on a political or social issue? If so, does the sponsor have a vested interest in selling a product or service and is the provided information biased toward doing so? If the site is sponsored by an advocacy organization, are the described research results biased toward their position on the issue and/or are studies with a different perspective downplayed or omitted (Henninger, 1999)?
- b. Another factor to consider is whether the information provided on the page is based on scholarly research or the authors' opinion. Use only those pages that include citations that you can verify in the scholarly literature on your topic. Look for sources that offer a good balance of primary and secondary sources. Avoid sources that make broad generalizations or that overstate or oversimplify the topic (Driscoll & Brizee, 2012).

3. *Is the information up-to-date?*

There are several clues you can use to evaluate whether a page is current, including the date it was posted, when the page was last revised or edited, and whether provided links are current (Kapoun, 1998). Be careful about relying on pages that appear to be out of date.

some unspecified type of relationship exists. Because of this specificity, the results of a study can unambiguously support or refute the hypothesis: Any outcome other than one in which low self-esteem is related to high jealousy means the hypothesis is wrong. An ambiguous research hypothesis, in contrast, can render the results of the research ambiguous. Consider the hypothesis "There is a relationship between self-esteem and jealousy" and this empirical outcome: High self-esteem is related to high jealousy. In one sense, these results support the hypothesis: There is a relationship between the variables. Yet the results directly contradict the relationship suggested by the results of the literature review. What are we to conclude? In this example of a single simple hypothesis, we can, of course, conclude that the research hypothesis "that we really meant to test"—the unambiguous hypothesis—was not supported. However, in research that tests multiple complex hypotheses, the conclusions may not be so clear-cut (Wampold, Davis, & Good, 1990). It is therefore always best to state research hypotheses in terms of specific relationships.

Statistical hypotheses. The **statistical hypothesis** transforms the research hypothesis into a statement about the expected result of a statistical test. The research hypothesis "People low in self-esteem exhibit more romantic jealousy than people high in self-esteem" can be stated as either of two equivalent statistical hypotheses: (1) "There will be a significant negative correlation between scores on a measure of self-esteem and scores on a measure of romantic jealousy" or (2) "People classified as low on self-esteem will have significantly higher mean scores on a measure of romantic jealousy than will people classified as high on self-esteem." The results of the appropriate statistical test can be compared to the statistical hypothesis to determine its validity.

The statistical hypothesis must accurately represent the research hypothesis. If the statistical hypothesis is not congruent with the research hypothesis, then the results of the statistical test will not provide accurate information to use in drawing conclusions about the validity of the research hypothesis. Consider the following example from Huck and Sandler (1979): Two educational researchers were interested in whether giving students classroom instruction on material covered by a textbook in addition to having them read the textbook would improve their scores on a test of the textbook material. Students were divided into three groups: Group 1 read the textbook and received classroom instruction on the material covered by the book, Group 2 just read the book, and Group 3 received classroom instruction unrelated to the topic of the book. At the end of the experiment, all the students took a 30-point test on the material the book covered; the groups' mean scores are shown in Table 5.1. The researchers statistically tested their hypothesis that additional instruction would improve learning by comparing the mean score of Group 1 to the combined means of the other two groups. Notice the following:

1. The research hypothesis was that students who both received classroom instruction and read the textbook (Group 1) would do better than students who only read the textbook (Group 2).
2. The research hypothesis transforms into the statistical hypothesis that the mean score of Group 1 would be greater than the mean score of Group 2. Group 3 is irrelevant to the research hypothesis, which does not say anything about students who have had no instruction (although the other groups could be compared to Group 3 to see if instruction had any effect at all on students' knowledge of the topic).
3. The researchers *tested a different statistical hypothesis*: that the mean of Group 1 was greater than the average of the means of Groups 2 and 3. Consequently, the results of the statistical test told the researchers nothing about the validity of their research hypothesis.