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## **How to Read, Critically Evaluate, and Write Research Papers**

Science is a community effort. Only through the cooperation (and competition) of many people does scientific knowledge inch forward. Both to get a sense of what's happening at the cutting edge of the science of psychology and to learn how to write better research papers yourself, you need to read articles published in psychology journals. These articles report new findings and theories and document the latest progress in the field. At first glance, a journal article may seem hopelessly dense and difficult to understand. One goal of this appendix, therefore, is to give you a brief guide to reading such articles, as well as to provide you with pointers on how to evaluate them. In addition, this appendix gives you background and resources that will help you write your own research papers.

### Using the APA Format

Most articles published in psychology, and most of the papers you will be asked to write in psychology classes, are organized according to guidelines provided by the American Psychological Association (APA) in the *Publication Manual of the American Psychological Association* (4th ed., 1994; you can find more detailed information about these guidelines at <http://www.apa.org/apa-style/homepage.html>). This standardized format not only ensures consistency across the scientific community but also helps authors to include all of the crucial information and allows readers to know what to expect. A paper that reports new research findings using the APA format follows this structure:

**General Introduction.** The General Introduction provides the context for the research. It consists of an overview of the topic being researched, describing previous studies on the topic, analyzing their flaws, pointing out gaps in what they examined, and noting contradictory findings. In this section, the authors introduce the general purpose of the study.

**Study Introduction.** Here, the study is introduced more narrowly, with background information supplied for the particular technique being used. If only one study is reported, this material is presented at the end of the General Introduction.

**Method.** The Method section explains, in detail, what was actually done. The type of method used, of the sort summarized in Chapter 1 (case study, quasi-experiment, and so on), and the specific details of how the study was conducted are provided. The goal is to describe the methodology in enough detail that someone else could repeat the study in precisely the same way. The Method section often has distinct subsections:

**Participants** (or subjects) describes the nature of the people or animals that took part in the study.

**Materials** describes the stimuli. For example, a questionnaire, words read aloud, pictures shown on a screen—all of these are typical materials in psychology studies.

**Apparatus** describes the physical props or instruments involved in the study (for example, the type of computer and monitor used to present stimuli, as well as the monitor settings). The apparatus is used to present the stimuli (described in Materials) and to record responses.

**Procedure** describes exactly how the study was conducted, step by step.

**Results.** The Results section reports what happened. This section includes descriptive statistics (such as means and standard deviations, as described in Appendix A) and inferential statistics (tests to determine which differences in and patterns of responses should be taken seriously; see Appendix A).

**Discussion.** Whereas the Results section provides just the bare facts, the Discussion section seeks to interpret them, often referring to previous studies or theories.

**General Discussion.** One journal article may report several studies. After one General Introduction, separate sections ranging from Study Introduction to Discussion—as described above—are included for each study. After the last study is reported, a General Discussion ties them all together. A General Discussion typically begins with a brief summary of the sum total of the results and often ends with suggestions for additional research that would answer new questions raised by the results.

## How to Organize and Evaluate What You Read and Write

Once you understand the structure of a journal article, you will find it useful to approach reading and writing such articles armed with what we call the QALMRI method. This method provides a means for critically evaluating a study in the literature, as well as for organizing your own study, and will help you see the connection between theory and data. That is, it will help you to be clear on what question is being asked, how to answer it, and whether the results really do support the preferred answer. In brief:

**Q** stands for the question. All research begins with a question, and the point of the research is to answer it. For example, we can ask whether a placebo is better than no action in curing depression. The first few paragraphs of the General Introduction should tell the reader what question the article is addressing. In addition, the context provided by the General Introduction's review of previous studies should explain why the question is important, why anybody should care about answering it. The General Introduction should provide the general context, providing the reasons why the question is worthy of consideration.

**A** stands for alternatives. A good report describes at least two possible answers to the question and explains why both are plausible. For example, the possibility that the placebo is better than doing nothing is plausible because beliefs arise from the brain, and brain activity can in turn affect the endocrine system—which could in turn affect mood. And the alternative possibility, that a placebo is no more effective than doing nothing in combating depression, is also plausible.

The General Introduction should also explain what alternatives are being considered. When reading or writing the General Introduction, identify the question and then the alternative answers that will be considered. If the alternatives in a study you read are not spelled out, try to figure out for yourself what they might be; if the study is simply seeking to confirm a theory's prediction, try to get a sense of whether other theories (or just common sense) would make the same prediction. If all the theories make the same prediction, it probably isn't worth testing. When writing your own reports, clearly describe the alternatives and why they are plausible.

**L** stands for the logic of the study. The goal of the study is to discriminate among the alternatives, and the logic is the general idea behind the study—the way the study will distinguish among the alternatives. The logic is typically explained toward the end of a study introduction and has the following structure: If alternative 1 (and not alternative 2) is correct, then when a particular variable is manipulated, the participant's behavior should change in a specific way. For example, the logic of a study of placebo effectiveness would rest on comparing a group receiving a placebo with a group receiving nothing. (In all other respects, the groups would be treated the same.) The logic would sound like this: If the placebo has a curative effect (and doing nothing doesn't), then the people receiving it should report fewer symptoms than the people receiving nothing. Notice that the logic depends crucially on the question and alternatives. For example, if we had asked a different question, such as whether a placebo is as effective as antidepressant medication, then the logic would require that we include a group receiving medication—but given the way we have formulated the question, this isn't necessary.

**M** stands for the method, found in the Method section. When reading an article, or writing your own, consider the following. With regard to participants: How were they selected? Are they a representative sample of the population in general? If the study involves more than one group, are they equivalent on important variables, such as age and education? For the placebo study, participants in both groups should be of identical age, education, and health status. It is crucial that they have the same level of depression prior to the study and the same prior experiences with medication. Materials: If questionnaires are used in the study, have they been shown to be valid (that is, do they measure what they are supposed to measure)? Are they reliable (that is, do they produce consistent results)? Do the materials used in different parts of the study differ inappropriately in important ways? For the placebo study, one key would be the nature of the placebo itself: What did the pill look like? Did it resemble pills that the participants had already taken and knew to be effective? Did it taste like a sugar pill? Apparatus: Was a computer used? If so, exactly how did it present the stimuli? What other physical props

were used? In the placebo study, were the pills dispensed using a special machine or just given in a bottle? Procedure: Try to visualize yourself in the study. Is it clear exactly what was done? How were the pills produced? provided to the participants? Were there proper control groups? Were participants given appropriate instructions (clear, but not leading them on)? For studies using a placebo group, as in all studies, it is crucial that the investigator treat the participants in the two groups exactly the same way; if the investigator is cheerful and friendly to the people in the placebo group but distant and cold to those in the control group, it could be this treatment—and not the presence or absence of placebo—that affects the participants' feelings of depression. Such nuts-and-bolts concerns can make or break a study; if they are not properly handled, the results are ambiguous at best.

**R** stands for the results, found in the Results section. What happened? First, look for (when reading) or report (when writing) measures of central tendency (means, medians, modes) and some measure of the sampling variability (commonly, standard deviations; see Appendix A). The actual results are descriptive. For example, the ratings of depression might be lower for the group receiving a placebo than for the group receiving nothing. Second, not all differences and patterns in the results should be taken seriously—some differences are simply quirks due to chance. Inferential statistics are performed to determine which patterns of variation are unlikely to have arisen due to chance.

For most studies in psychology, inferential statistics are used to assign a probability value to a comparison, noted as  $p < .05$  (or  $p > .1$ ,  $p < .01$ , and so on). As discussed in Appendix A, this number indicates the likelihood that the difference occurred merely due to chance;  $p < .05$ , for example, means that the probability that the difference occurred due to chance is less than 5 in 100. Usually, any  $p$  value of .05 or less means that the result is considered "statistically significant"—you can be reasonably certain that the difference found in the sample reflects an actual difference in the population as a whole. For example, if an inferential test showed that the difference between the placebo and the control group was "significant at  $p < .001$ ," that would mean that the difference would occur by chance less than 1 time in 1,000 if the study were repeated over and over (see Appendix A).

Finally, **I** stands for the inferences that can be drawn about the question and alternatives, given the results. The Discussion section usually contains the inferences the authors want to draw from their results. If the study was well designed (the logic sound and the method rigorous), the results should allow you to eliminate at least one of the alternatives. For example, in the placebo study, the results might show that placebo really does help depression more than doing nothing. At this point, take a step back and think about potential confounds that could have led to the results. Were any alternative explanations not ruled out? And consider any loose ends. For example, perhaps the way the participants were treated when given the placebo is a major variable, and the effects of placebos can be enhanced or reduced by different social interactions with the caregivers.

Using Online Sources of Information

How do you find research or other relevant material about a topic when writing a paper? For that matter, how do you evaluate the references cited in journal articles? To take advantage of all that the research community has to offer, you should be seeking online as well as print sources of information. Much of this textbook was written using online sources. But as you probably know, the Web has at least as much misleading information as it has correct reporting. Nobody edits it, nobody monitors it, nobody certifies it. It's up to you to sort the wheat from the chaff.

How, then, can you find useful information on the Web, and how can you verify that it should be taken at face value? There are three general ways to use online sources.

### Databases

First, if you already know of a likely source of information or a particular article, you can go directly to a specialized database, such as PsychInfo or Medline. PsychInfo is offered through many college libraries, and Medline's search is publicly available at <http://www.nlm.nih.gov/medlineplus/searchmedlineplus.html>. At a database, you can usually retrieve abstracts of articles simply by entering key terms (including the author's name, if you know it). If you have access only to an abstract, beware: Abstracts sometimes aren't written by the authors themselves, and even when they are, they necessarily simplify the study and its findings. This simplification is sometimes so extreme that the results can be distorted. Thus, we urge you to use abstracts only as a "first pass," to narrow down likely sources. If the results seem important, get the actual paper.

Sometimes you can even obtain an entire paper online. The American Psychological Association offers a site where you can read complete versions of all papers published in APA journals since the late 1980s. The APA continues to enter earlier papers, so the database will have more older articles available over time. This site, however, is available only to members (including student members) of the APA and to schools or organizations that subscribe to the service.

### Organizations' Web Sites

If you don't know which database to check, you can try the Web sites of relevant organizations, such as the American Psychological Association ([www.apa.org](http://www.apa.org)). In this case, the challenge is to think of the most relevant organizations for your topic. In psychology, the two APAs (the American Psychological Association and the American Psychiatric Association) are good places to start. In fact, the American Psychological Association has a special online pamphlet for students—"Library Research in Psychology: Finding It Easily" (<http://www.apa.org/science/lib.html>)—and the American Psychiatric Association has links to many useful sources ([http://www.psych.org/libr\\_publ/index.html](http://www.psych.org/libr_publ/index.html)). You can also search the Web sites of other psychological organizations, such as the Society for Research in Child Development (<http://www.srcd.org/publica.shtml>) and the American Psychological Society

(<http://www.psychologicalscience.org/>). Similarly, for many subfields in psychology, there are relevant national organizations with Web sites, such as the American Association for Mental Retardation (<http://www.aamr.org>) and the American Society for Clinical Hypnosis ([www.asch.net](http://www.asch.net)). Links posted on such sites have more credibility than those found through a search engine, given the likelihood that they've been approved by the parent organization. However, the parent organization can't possibly ensure that all information on other sites is correct. So again, don't take what you find at face value. Look before you leap, and think before you quote.

## Search Engines

Finally, what do you do if you're forced to cast your search more widely and browse the whole Web? You can simply use a search engine, such as Google ([www.google.com](http://www.google.com)) or Excite ([www.excite.com](http://www.excite.com)). We've found that the best searches have as many specific terms as possible; the more terms you include, the more irrelevant sites will be weeded out. It's instructive to look at a dozen or so of the sites that turn up following a search. You may be shocked to discover how much inconsistency there is; not only can the summaries of the research differ but so can the evaluations and conclusions that are based on it. And sometimes the authors of the secondary sources (which summarize or discuss an original article) just get it wrong—they either describe the study incorrectly or misinterpret the implications of the results.

As a first step in evaluating a site, see whether five or six other researchers reach consistent conclusions. Moreover, evaluate the source of each site. Does it have a reputable host? Are you reading an actual published paper, an unpublished paper, notes used in lectures, or notes used by someone else in writing a paper? In general, the more evaluation that a given paper receives (as happens with published papers, but not student notes), the better. Also consider whether the material is up-to-date. Check the date to make sure that the work reflects the most recent research. This isn't to say, however, that time-honored and well-replicated older studies are any less credible because of their age.

## In Sum

### Reading Research

When you read a study, remember to read it in terms of both the big picture outlined above and the details. Figure out exactly what question the authors wanted to answer and what alternative answers they've considered. Can you think of others? Always be on the lookout for potential confounds and alternative explanations, and look for features of the study that limit how well its results can be generalized; for example, can you assume that the results necessarily generalize to other ages, races, or cultures? Be sure to read the footnotes. The single most important advice we can give about reading a study is to be an active reader: Think about what the authors are claiming, and think about whether it makes sense.

### Writing Your Own Papers

The same principles apply to writing your own research papers. Write the Introduction so that the reader clearly understands the question you are addressing, why it is important (in the context of the previously reported studies on the topic), the alternative possible answers you will consider (including, in most cases, your "favorite" one—often called simply the hypothesis), and the logic of the design (the basic idea underlying the study). In the Method section, be sure to include enough detail to allow another researcher to repeat, exactly, what you did. In the Results section, first present results that bear directly on the question and alternative answers. These results should be measures of central tendency and variability, which are often best presented in a graph. The results that address the question are most important—even if they are not as striking as some of the other findings. If your Introduction is clear, the reader is focused like a laser beam on the question and is waiting to find out which alternative answer is supported by the results. Don't keep the reader in suspense; present the results that speak to the question at the outset of the Results section. Finally, in the Discussion, return to the question and alternative answers, and discuss exactly what you can infer from your results. Have you shown that some of the alternatives must be discarded? Is only one viable? What should future research focus on to propel the field even further ahead?

When reading or writing a research report, always put yourself in the place of the intelligent reader. If a report has been written clearly, the reader will glide through it effortlessly, understanding what the author intended to convey, why the research was conducted in a particular way, what the discoveries were, and why the report is interesting and important.