

Examine the discussion and conclusions section(s) of a research report from your field or one of the sample articles in this text, for example, Chiba et al. (2002) in Chapter 9, or Etiopie et al. (2006) in Chapter 11. Look for instances of hedging in the text, particularly the three categories of qualifiers described above: verbs, adverbs, and modal auxiliary verbs. Look for other hedging devices as well. Would you propose any additional categories? What purposes do the hedges serve? How common are they in the sample articles you've chosen? Compare your findings with those of students examining other fields. Do you see any differences across fields in the use of hedges?

EXERCISE 4.16

The original title of the Burkholder team's letter to *Nature* (1992) was "New 'phantom' dinoflagellate is implicated as the causative agent of major estuarine fish kills." This title was shortened during the publication process (see page 268), much to Dr. Burkholder's dismay. What is the effect of the title change, and why do you think Burkholder was dismayed?

4.8 The Research Report Abstract

The abstract is a summary of a document's major points, typically appearing at the start of the journal article, and, as we saw in Chapter 2, accessible via online indexes and abstract databases. Along with the title of the report, the abstract helps readers decide whether the paper is pertinent to their research interests. The Council of Science Editors (CSE 2006) explains that "[b]ecause abstracts also appear in abstract journals and online databases, separated from the articles they describe, abstracts should be complete and understandable unto themselves, without reference to the full article" (p. 460). The abstract therefore must represent the full argument contained in the report: the topic and purpose of the study, the methods used, the results obtained, and the conclusions drawn from those results. However, this argument must be outlined in extremely condensed form, usually only about 5 percent of the length of the full paper (AIP 1990).

Given its role in representing a larger document, the abstract can be described as a "contingent" genre: its content and form are contingent on the content and organizational logic of the document being abstracted. We will talk about research report abstracts in this chapter and will provide guidelines for the conference presentation abstract in Chapter 6 and the research proposal abstract in Chapter 7. Abstracts will vary considerably within these categories as well, however, reflecting variations in purpose and logic across research fields, journals, and articles. Some journals provide formal guidelines for the abstract that

embody the standard research logic of their respective fields. *Annals of Internal Medicine*, for example, requires authors of research articles to follow a structured format for the abstract, as illustrated in the paper by Graham et al. (1992) in Chapter 9 (see page 247). This type of structure—in this case with separate sections for the study's objective, design, setting, participants, intervention, measurements, results, and conclusions¹¹—is used in other journals reporting clinical trials as well. (See Chiba et al. [2002], on page 251, for an illustration of the *British Medical Journal's* very similar form.)

Many journals, however, specify only a maximum length for the abstract (typically 150 to 250 words) and leave its structure up to the author. Because the abstract mimics the form and logic of the full report, the structure should be relatively straightforward. If the report follows the IMRAD form, the abstract is likely to include four basic moves representing the major parts of this pattern, and verb tense will shift accordingly (Olsen and Huckin 1991): the topic will be introduced in present tense, usually in a sentence or two; the background and/or need for the study will be outlined in another few sentences (but typically without references to prior studies [CSE 2006]); methods and results will be briefly described in past tense; and the major conclusions and implications of the study will be stated in present tense. Abstracts for IMRAD articles can be easily generated using this four-part structure. (See the Knutson et al. abstract in Chapter 13 for an example.)

If the report follows a logic other than the IMRAD pattern, however, the structure of the abstract will vary accordingly. For example, the abstract for Spiller et al.'s (2002) *Clinical Toxicology* paper defending the gaseous vent theory of the Delphic oracle (see page 330) begins with one sentence summarizing the historical claim that intoxicating gases inspired the oracle, followed by three sentences summarizing the geological and chemical evidence that supports this claim. The fifth and final sentence states the authors' conclusion that the priestess's trance was caused by ethylene inhalation. Thus, the abstract encapsulates the line of reasoning followed in this particular article.

The IMRAD and non-IMRAD samples mentioned above are all examples of *informative* abstracts, that is, abstracts that summarize the information in the larger text. This type is distinguished from the *descriptive* or *indicative* abstract often adopted for research reviews (Olsen and Huckin 1991; CSE 2006) and conference proposals. Indicative abstracts indicate what kinds of information will be contained in the paper, rather than providing a summary of that information. An example from the *Journal of Computational and Graphical Statistics* is presented in Figure 4.5. As this example illustrates, the descriptive approach is particularly appropriate when describing research involving mathematical procedures or models, which cannot be presented in condensed form. Rather than attempting to abbreviate these models, the authors in Figure 4.5 preview the basic steps or components of their model, telling readers what will be demonstrated in the paper. (Notice that this indicative approach previews the content of the paper in much

¹¹The full *Annals* guidelines now also include an initial "background" section and a "limitations" section following results (http://www.annals.org/shared/author_info.html).

Calculation of Posterior Bounds Given Convex Sets of Prior Probability Measures and Likelihood Functions

Abstract

This article presents alternatives and improvements to Lavine's algorithm, currently the most popular method for calculation of posterior expectation bounds induced by sets of probability measures. First, methods from probabilistic logic and Walley's and White-Snow's algorithms are reviewed and compared to Lavine's algorithm. Second, the calculation of posterior bounds is

reduced to a fractional programming problem. From the unifying perspective of fractional programming, Lavine's algorithm is derived from Dinkelbach's algorithm, and the White-Snow algorithm is shown to be similar to the Charnes-Cooper transformation. From this analysis, a novel algorithm for expectation bounds is derived. This algorithm provides a complete solution for the calculation of expectation bounds from priors and likelihood functions specified as convex sets of measures. This novel algorithm is then extended to handle the situation where several independent identically distributed measurements are available. Examples are analyzed through a software package that performs robust inferences and that is publicly available.

FIGURE 4.5 Sample descriptive abstract from the *Journal of Computational and Graphical Statistics* (Cozman 1999).

the same way as the previewing strategy that Swales found to be common in introductions to non-IMRAD articles [Figure 4.3].)

The indicative abstract is less appropriate for reports of experimental research, for this approach provides little information about the study itself or its results and is therefore less useful to readers (Olsen and Huckin 1983). For example, compare the following hypothetical indicative abstract with the informative abstract that accompanies Graham et al.'s (1992) paper in the *Annals of Internal Medicine*, contained in Chapter 9 (page 247):

The purpose of this report is to determine the effect of treating *Helicobacter pylori* infection on the recurrence of gastric and duodenal ulcer disease. Results of a clinical study of recent ulcer patients under two treatments are reported.

Though this hypothetical abstract does provide a general outline of Graham's study, it withholds critical information that the clinical audience of this journal would be interested in, namely the types of treatment tested and the outcomes of the tests. Given the type of research being reported, the extended informative abstract that this journal requires is much better suited to its readers' needs.

EXERCISE 4.17

Read the abstracts for the papers by Burkholder et al. (2005) in Chapter 10 (pages 307–312) and De Boer et al. (2001) in Chapter 11 (pages 326–329). Identify each as an informative or an indicative abstract. Identify the major moves in the abstract and corresponding verb tense shifts.

EXERCISE 4.18

Write a 100- to 150-word informative abstract for the research report by Chambers et al. (2007), reprinted on page 381.

The original titles are too vague to be compelling. Why go out of your way to give potentially interested readers an excuse to ignore your paper? Of more immediate concern in writing up laboratory reports rather than journal articles is this suggestion: Why not use a title that demonstrates to your instructor that you have understood the point of the exercise? Win your reader's confidence right at the start of your report. (By the way, the title should appear on a separate page, along with your name and the date on which your report is submitted.)

WRITING AN ABSTRACT

The Abstract, if requested by your instructor, is placed at the beginning of your report, immediately following the title page. Yet it should be the last thing that you write, other than the title, because it must completely summarize the entire report: why the experiment was undertaken, what problem was addressed, how the problem was approached, what major results were found, and what major conclusions were drawn. And it should do all this in a single paragraph.

Despite its unimpressive length, a successful abstract is notoriously difficult to write. **In compact form, your abstract must present a complete and accurate summary of your work, and that summary must be fully self-contained**—that is, it must make perfect sense to someone who has not read any other part of your report, as in the following example:

Because some wavelengths of light are known to be more effective in promoting photosynthesis than others, this study was undertaken to determine the wavelengths of light that are most effective for the aquatic plant *Elodea canadensis*. Rates of photosynthesis were determined at 25°C, using wavelengths of 400, 450, 500, 550, 600, 650, and 700 nm and measuring the rate of oxygen production for 1-h periods at each wavelength. Oxygen production was estimated from the rate of bubble production by the submerged plant. We tested 4 plants at each wavelength. The rate of oxygen production at 450 nm (approximately 2.5 ml O₂/mg wet weight of plant/h) was nearly 1.5-greater than that at any other wavelength tested, suggesting that light of this wavelength (blue) is most readily absorbed by the chlorophyll pigments. In contrast, light of 550 nm (green) produced no detectable photosynthesis, suggesting that light of this wavelength is reflected rather than absorbed by the chlorophyll.

Note also that the sample Abstract is informative. The author does not simply say that "Oxygen consumption varied with wavelength. These results are discussed in terms of the wavelengths that chlorophyll absorbs and reflects." Rather, the author provides a specific summary of the results and what they mean. Be sure that your Abstract is equally informative. **Clearly, this section of your report will be easier to write if you save it for last.**