CHAPTER 13

Scientific Communication in Geography

Learning Objectives:

- What are the purposes and major forms of scientific communication, including types of scientific literature?
- What are some recommendations for giving effective oral presentations?
- What is the peer review system for scientific literature, and how does it work?
- What is the structure of a one-study empirical research article?
- What are major library resources for scientific research, and how can they be found and used?

The results of research have little value if they are not communicated to people. These people are other researchers but also students, potential employers, journalists, administrators, business leaders, elected officials, and members of the general public. The act of conducting research itself necessarily involves sending and receiving communications—by reading the ideas of other researchers and the results of past research, by discussing ideas with collaborators and assistants, and by requesting financial support from funding agencies. Thus, scientific communication is critically important to the entire process of research, not just to its results, and it involves an assortment of communications that vary from the relatively formal to the relatively informal. Much scientific communication occurs in verbal form, both oral and written, but also in numerical and graphical forms.

In this chapter, we examine the various forms of verbal scientific communication; we discussed numerical and graphical communication in Chapters 9 and 10. We first look at the archive of written communications known as **scientific literature**. Perhaps the most important are scientific **journals**. These are serials published as frequently as once a week or as infrequently as once a year, but most often once every two or three months. Journals provide the primary forum for the communication of scientific ideas and empirical results. They are a bit like scientific magazines, except the editors of scientific journals are aided in their evaluation of manuscripts submitted for publication by a panel of peer experts; we discuss this peer review system below. And unlike the authors of magazine articles, authors of journal articles are not paid—they may even have to pay some charges for things like including color figures in their article. But scientists definitely get rewarded for publishing journal articles. There is an intrinsic value to having one's work put into print; most people find it quite satisfying for both egotistic and altruistic reasons. In addition, academic researchers, if not other scientists, must publish in order to get hired, promoted, and funded.

Journals vary in their topical domain, their intended readership, their methodological style, and their quality and status; status is largely a function of the number of subscribers and readers a journal has, and the rate at which it accepts submitted manuscripts for publication. Table 13.1 provides a list of some of the major English-language journals that publish research in geography and related fields. There are many other journals relevant to geographic research, however, and most geographers read outside the walls of the discipline of geography, strictly speaking. For instance, population geographers read journals in which mostly sociologists or economists publish, and biogeographers read journals in which mostly botanists or ecologists publish.

There are several kinds of journal articles. Some journals publish several of these kinds, whereas others primarily publish one or two. The most common kind of article reports one or more empirical studies; we discuss its basic structure in detail below. Another kind is the literature review, which summarizes all relevant articles presenting research on a particular issue; for instance, there are literature reviews on the interpretation of topographic symbols on maps and on the migration patterns of refugees. Ideally, authors of literature reviews do not just summarize, like a grade-school book report, but organize, evaluate, and synthesize the empirical results and ideas in the literature.[1] A third kind of article is the theoretical paper that presents new concepts, theories, or models but not new empirical results. The methodological/statistical article presents new methods for collecting or analyzing empirical data, or critiques existing ones. Finally, there are various short forms of journal articles, including research notes, commentaries, letters to the editor, and

[1] **Meta-analysis** is a quantitative review of research that makes conclusions about some phenomenon by statistically combining the empirical results of tens or hundreds of independently conducted studies on the phenomenon. State-of-the-art conclusions about the health effects of smoking, for example, are based on meta-analytic reviews of many independent studies of smoking. Meta-analysis is underused in geography.

Table 13.1 A Sample of Major English-Language Academic Journals in Geography

General Geography:

Annals of the Association of American Geographers
Applied Geography
Area
Australian Geographer
Canadian Geographer
Geoforum
Geographical Analysis
Geographical Journal
Geographical Review
Geography
Journal of Geography
The Professional Geographer
Transactions of the Institute of British Geographers

Physical Geography and Related Fields:

ASCE
Climate Research
Earth Science
Earth Surface Processes and Landforms
Geografiska Annaler. Series A, Physical Geography
Global Ecology and Biogeography
International Journal of Earth Sciences
International Journal of Environmental Studies
Journal of Biogeography
Journal of Climate
Journal of Geophysical Research
Journal of Hydrology
Journal of Soil Science
Physical Geography
Polar Geography and Geology
Progress in Physical Geography
Soil Science

Human Geography and Related Fields:

Antipode
Environment and Behavior
Environment and Planning A-D
Environmental Education and Information
Geografiska Annaler. Series B, Human Geography
Journal of Cultural Geography
Journal of Economic Geography
Journal of Historical Geography
Journal of Transport Geography
Location Science
Networks and Spatial Economics

(Continued)

Table 13.1 (Continued)

Political Geography
Population and Environment
Population, Space, and Place
Progress in Human Geography
Regional Studies
Urban Geography

Geographic Techniques:

Cartographic Perspectives
Cartographica
Cartography and Geographic Information Science
Computers & Geosciences
Geodesy, Mapping and Photogrammetry
Geographical Systems
GIScience & Remote Sensing
IEEE Transactions on Geoscience and Remote Sensing
International Journal of Geographical Information Science
International Journal of Remote Sensing
Photogrammetric Engineering & Remote Sensing
Remote Sensing of Environment
Spatial Cognition and Computation
The American Cartographer
Transactions in GIS

book and software reviews. Of course, these kinds are not pure; nearly every empirical report, to take an important example, contains a short review of literature and a discussion of theory.

Books are another form of written communication in science. Books contain some combination of concepts, theories, empirical results, literature reviews, and methodological discussions. They are less timely than journal articles (that is, they take longer to write and publish) and are less stringently peer reviewed, if at all. They may be written by one author (or one group of authors), or by several authors and an editor, in which case different authors write each chapter. The editor of a multiauthored **edited book** revises or organizes the chapters. Some editors write short overviews or commentaries for the book, based on the content of the various chapters; these overviews can help unify the chapters into a single book. Other editors do little more than remind authors of their deadlines and decide on the order of the chapters. This is typically what the editors of **conference proceedings** do; proceedings are collections of papers based on talks or discussions at scientific conferences.

Another important form of written communication is the **grant application**. A grant application is a request for research funding for a proposed program of research, made to sources such as public agencies and private foundations. The exact structure of a grant application depends on the particular source where the

money is requested. In general, grant applications consist of the following: a summary of the proposed research, a description of its benefits (both to a scientific area and to society), a review of relevant literature (with references), a detailed plan for what and how studies and analyses will be conducted, a plan for dissemination of the research in publications and conference presentations, a timeline for research activities, academic and research biographies of investigators, a description of research infrastructure and equipment available, and a detailed and justified budget.[2] The major differences between grant applications and journal articles are that grant applications must be especially concise and are written to persuade funding agencies to award money. Thus, even when an application proposes a program of basic research, it must attempt to describe possible applied benefits of the research to society. Instructions for preparing a grant proposal to the U.S. National Science Foundation, which are fairly typical for any grant proposal, may be found at https://www.fastlane.nsf.gov/fastlane.jsp.

There are a variety of other forms of written communication in scientific research. The Internet supports a variety of written communications, stored and sent digitally: electronic journals, discussion lists, Web sites, and so on. High school, undergraduate, and graduate students write research papers for classes, honors programs, master's theses, and doctoral dissertations. Student papers are typically styled like journal articles, with the exception that their major purpose is to demonstrate academic proficiency to instructors or advisors. As a consequence, they tend to be more didactic in their presentation of material (just as texts like this one are). That includes summarizing research literature more comprehensively and describing in more detail the research materials (such as the satellite imagery or entire survey instrument) and research results (such as detailed information about all of the sites where data were collected). However, doctoral dissertations in particular often become actual journal publications eventually; when this happens, the material in the dissertation is restructured and condensed for publication after the doctoral degree is completed, sometimes years after.

Oral communication is important in science too. Most notable here are talks given at academic and scientific conferences. These talks are commonly called

[2]Grant applications typically request funding to cover the costs of some or all of the following: partial or complete salary for lead investigators, graduate students, staff members, and postdoctoral research assistants; data collection or acquisition costs, including direct fees paid for data, research materials and equipment (including computer software and hardware), payments made to research participants, and travel expenses associated with data collection; travel expenses incurred by attending meetings and conferences; miscellaneous supplies; and "overhead." The last category refers to the (rather large) percentage of the grant that university and research laboratories require to support the infrastructure costs of doing research at their institutions—room rental, utilities, custodians, and so on. Although it is difficult to know exactly how institutions like universities actually spend overhead, because administrators generally do not reveal that to research investigators, they apparently use some overhead money to help support activities at the institution other than funded research.

Table 13.2 Recommendations for Giving Effective Oral Presentations

1. Content
   - Have a single theme or main point, even for a long talk
   - Think about your audience. What do they know? What do they need explained or defined?
   - Even for a sophisticated audience, it is always best to overview your talk briefly and define fundamental concepts clearly and unambiguously when first used. Explain acronyms and other abbreviations upon first usage

2. Presentation Style
   - Your goal is to inform *and* entertain. You want to hold your audience's attention. Interesting content, well organized, is a big part of this, but presentation style is critical too
   - Don't read your paper (although that is acceptable in some humanities disciplines).
   - Establish eye contact with the audience; speak to individual people (if you want to pretend some of them are naked, as is sometimes advised, be our guests, but we never found this to calm us down).
   - Speak loudly enough, vary your tone, and be enthusiastic and energetic. This may require that you fool yourself into believing you are fascinated by what you are discussing
   - It's OK, even good, to move around some (see previous recommendation) but avoid nervous movements.
   - Avoid defensive responses to questions or comments. Be comfortable saying "I don't know" or "that's a good point."

3. Appearance of Presentation
   - Use words *and* graphics (photos, graphs, maps, videos, animations). Presentation software like PowerPoint makes this easy to do. If sound recordings are appropriate for your topic, by all means use them.
   - Avoid overly complex or busy slides that include too much information, whether verbal or graphical
   - Use large font sizes. This is one reason to avoid overly complex slides. Some of your audience may have poor eyesight, but even those with 20/20 eyesight deserve to see your slides without straining.
   - Carefully proofread for typos and inconsistencies. The way you use words, symbols, and punctuation are sometimes less important than making sure to use them the same way each time.

4. General Recommendations
   - Stay within your allotted time. It is very hard to be adequately brief and concise, but very important. Leave enough time for questions—that time belongs to the audience, not to the speaker. Besides, speakers often learn from questions, and audience members usually enjoy listening to questions and their answers.
   - Know your room and audiovisual equipment beforehand. Be prepared for technical failures. Will the broken digital projector or Internet connection destroy your talk?

- Dress with an appropriate level of formality. This might be considered dressing for success. Or it might be dressing to conform, which not everyone considers a good thing. Either way, the need to appear casual or even radical, as admirably self-expressive as that might be, strikes us as a rather superficial reason for turning people off, having them ignore your brilliance, or having them refuse to hire you. Put another way, one dresses formally to communicate respect for the audience and the task at hand—it's a matter of etiquette.
- Practice beforehand for content, flow, style, and time (ask a friend or two to play the audience).

papers even though they are presented orally.[3] A **conference** is like an academic convention, where new and established researchers meet to present and listen to talks about research. Conferences are social events too; attendees meet and "network" with other members of the discipline, representatives of funding agencies, publishers and other sales representatives from relevant companies, and potential employers and employees. The largest geography conference in the United States is the annual meeting of the Association of American Geographers (AAG). About 5,000 members, affiliates, and guests of the AAG attend each year; as of 2005, the AAG had about 9,000 members. Something like 2,000 research presentations are given there.

Besides conference talks, other relatively formal examples of oral presentations include "job talks" given by candidates for faculty positions during job interviews and "colloquia" given by researchers visiting labs and departments. Of course, instructors lecture in class. In Table 13.2, we offer recommendations for giving effective oral presentations of a relatively formal nature. There are also a host of relatively informal oral and written communications among researchers, including e-mails, letters, phone calls, "hallway chats," and so on; although informal, they may be of great importance. Finally, one should not forget scientific communications with nonscientists (or scientists from other disciplines) that go on in various popular media, including TV, radio, newspapers, and magazines.

Peer Review System for Academic Publishing

In Chapter 1, we pointed out that science is a social activity and that social processes help reduce the potentially distorting effects that the human motivations of

[3]Although the orally presented paper is the primary format for formally communicating research ideas and results at conferences, there are other formats, such as panel discussions and **posters**. Posters are brief written and graphical presentations of research that are literally posted on bulletin boards (about 3 m^2 in area) and set up for a session of a couple hours in a room with several other posters. Conference attendees visit the poster sessions of their choice, walking around to view the posters and discuss the research with the poster authors. Although most senior researchers in geography avoid presenting in poster sessions, they do not avoid attending them. The poster session is a unique way to meet researchers at all career stages and discuss research more deeply and intimately than at a paper session.

Table 13.3 Issues That Reviewers and Editors Typically Consider When Reviewing Manuscripts for Publication

- Is the manuscript appropriate for the journal under consideration, considering the topical domain, target audience, and methodological style of that journal?
- Does the manuscript make an original contribution? Is the magnitude and relevance of the contribution sufficient to deserve publication?
- Is the appropriate literature cited and accurately described? Are appropriate links made with theory?
- Are the proper methods used? Are concerns about the validity of the methods addressed?
- Are the proper statistical or mathematical tests applied, and are they applied correctly? Are results interpreted correctly?
- Is the title appropriate and informative?
- Is the writing clear, unambiguous, and effective? Are punctuation and grammar correct?
- Can the manuscript be shortened without loss of important content, or does it need to be expanded in some places?
- Are the tables and figures necessary? Should there be additional ones? Are the tables and figures well designed? How could they be improved?

individual scientists can have on scientific beliefs. As we noted there, one of the most important examples of such a social process is the **peer review system** in academic publishing. The peer review system consists of authors, editors, and reviewers, and the process they use to determine whether a manuscript should be published in a particular outlet, and if so, what should be changed about the manuscript to improve it for publication. The criteria used to decide if a manuscript should be accepted for publication, and used as the basis for recommended improvements, include a great variety of issues concerning the way research studies were conducted, the way they were interpreted, the way the research was connected to other research that exists in the scientific literature, and the way the manuscript is written and otherwise communicated in tables and graphics (see Table 13.3). These criteria are more or less the same for every journal, although most journals have their own list of reviewer criteria that vary somewhat; the specific criteria are distributed to reviewers when their reviews are requested. These review criteria largely apply to the review of grant applications too. In addition, grants are reviewed for their potential benefits to a scientific area and to society, and for the likelihood that particular applicants can pull off approximately what they propose, given the particular timeframe and resources of the grant.

Peer review typically proceeds as follows. An author decides where he or she wants to publish the manuscript. This decision is ideally based on the topical domain and target audience of the journal. That is, one would hopefully not try to publish research on the diffusion of linguistic dialects in the *Journal of Retailing*, let alone the *Journal of Biogeography;* perhaps the *Journal of Cultural Geography*,

a general geography journal, or a linguistics journal would be appropriate. In addition to topical appropriateness, authors usually try to maximize the prestige of the journals in which they publish, both because articles in more prestigious journals are read by more people and will thus have greater impact and because publishing in more prestigious journals inflates one's career reputation, if not one's salary. It can even inflate one's ego (there's that human side of science again). Once the author has decided where to submit the manuscript, he or she follows the "Instructions to Authors" printed in occasional issues of the journal and on the journal's Web site. These instructions discuss stylistic rules to follow in preparing the manuscript, how many copies to send for consideration, in what form to send them, and to what person and address. The instructions usually also spell out an important general rule of publication: Authors may submit manuscripts *to only one journal at a time.*

When the editor receives the manuscript, he or she usually makes an initial decision whether it is, on the whole, appropriate for publication in that journal. The editor sometimes decides the submitted manuscript is *not* appropriate for that journal and informs the author of that; the author decides whether to submit it to a more appropriate journal. But more often than not, the editor proceeds with the review by sending the manuscript to reviewers.

Each manuscript is reviewed by between one and five **reviewers**; three is a common number. Reviewers are researchers and scholars at universities and research labs who have expertise in the specific topical area of the manuscript, often having published in that area, but who do not have any clear conflicts of interest (we discuss ethical issues in research in Chapter 14). Reviewers decide if they want to review the manuscript based on whether they have the time and expertise to do so. They are not paid for reviewing; rather, it is considered an act of service to the discipline that is appropriate especially if a reviewer later wants to have his or her own research manuscripts reviewed for publication. The review is usually carried out **blind** or **double blind**. In blind review, either the author is not informed of the identity of the reviewer or the reviewer is not informed of the identity of the author—the author's name is cut out or obscured in the manuscript; in double-blind review, neither author nor reviewer is thus informed.[4]

[4]There is an ongoing debate in the scientific community about the merits of blind and double-blind review, and some journals have stopped using it or at least give reviewers the option to reveal their identity or not. Blind reviewing is intended to reduce or eliminate any residual bias in a review that might occur as a result of a reviewer knowing the identity of an author or an author knowing the identity of a reviewer. For instance, the work of prestigious authors likely gets reviewed with a more positive attitude at the outset, and reviewers may hesitate to be honestly critical if they think the author will learn their identities. On the other hand, some critics of blind review believe it is futile because an experienced reviewer can often recognize the work of particular researchers, and in any case, it is difficult to fully expunge signs of who authored a manuscript just, for instance, by removing the name on the title page. Also, critics argue that the anonymity of blind review gives license to reviewers to be unnecessarily harsh, even hostile or sarcastic (some people we know don't require anonymity to get this license).

Whether blind or not, the reviewer reads the manuscript carefully, often more than once. He or she writes a review of the manuscript based on criteria like those in Table 13.3, and often fills out a short survey that requires the reviewer to rate the manuscript on the criteria. Most reviewers consider their task to be twofold: to advise on whether the manuscript should eventually be published in that journal, and to advise on how to improve the manuscript if it is to be published. To these ends, the reviewer makes a single summary rating of the manuscript as his or her recommendation to the editor. This summary rating scale varies somewhat across journals but usually includes something like the following choices:

(a) accept for publication without revision

(b) accept for publication with minor revisions

(c) revise extensively and resubmit for review

(d) reject the manuscript but encourage submission to a different journal

(e) reject the manuscript as not publishable in any journal.

Upon receiving reviews, the editor makes the decision and informs the author. The editor usually reads the manuscript too, basing the editorial decision on his or her own evaluation combined with the evaluations of the reviewers. Some editors follow the advice of the reviewers very closely, especially if the paper is outside the topical expertise of the editor (and no editor is expert in every topic). Other editors sometimes veer from the recommendations of reviewers, and especially when the reviewers disagree about the quality of the manuscript (not uncommon), the editor has to step in and make a more independent decision about the manuscript. The editor sends the decision to the author, along with copies of the reviews.

Receiving an editor's decision can be a joyous event for the author but is unfortunately often frustrating. Rejection rates at journals can be quite high, especially at very prestigious journals. Such journals may accept for publication no more than 5–20% of the manuscripts sent to them (by "accept," we mean *eventually* accept). Some revisions are requested for virtually all manuscripts, even very good ones by top researchers. A summary rating like (a) above is exceedingly rare, perhaps never to be gotten in the career of a competent geographic researcher. So a rating like (b) is excellent and even (c) should often be considered fairly positive. In the end, editors frequently decide that manuscripts may be accepted for publication if the author carries out relatively extensive revisions, sometimes including collecting more data or conducting new analyses. Thus, manuscripts often get published only after they have been reviewed and revised twice or more. Furthermore, if a manuscript is rejected at one journal, authors often attempt to improve it and send it to a different journal. This is not a sign of incompetence; as in many areas of life, such persistence is critical to eventual success. But resubmissions to multiple journals should include interim revisions that attempt to improve the manuscript on the basis of feedback from editors and reviewers—this feedback usually contains mostly good advice for improving the manuscript.

The Basic Structure of a Journal Manuscript: The One-Study Empirical Article

There is no single style dictating the structure of a journal manuscript in geography. As we stated above, every journal provides style instructions to potential authors. Some journals instruct authors to follow the style presented in one of the widely known style manuals, such as Strunk & White's *Elements of Style*, the *Chicago Manual of Style*, or the *Publication Manual of the American Psychological Association* (see the Bibliography at the end of the chapter). Style manuals like these have been revised and updated over many years; they contain a wealth of useful and interesting material about how to write a research manuscript, ranging from manuscript structure, citations and references, word choice, scientific abbreviations, punctuation, table and figure design, and more. They are essential reference books for the research author and surprisingly good reads.

We do not have space here to cover exhaustively the structure of all kinds of journal manuscripts. We focus on providing a blueprint for the most common kind, the one-study empirical article (Table 13.4). We recommend that new authors try to follow this blueprint rather closely. As you become more experienced, however, you can introduce variations that help tell the particular story better and allow for the creative expression that potentially makes any writing more engaging, even scientific writing. But until you master the standard format, your attempts at creativity are not likely to work well, because you will not clearly understand how to introduce variations meaningfully and effectively. It's like any artistic act: Novelty can work only when it is expressed judiciously and intentionally, not excessively or accidentally.

The first page is the **Title page**. It lists the authors' names and institutional affiliations. The list of authors usually includes everyone who contributed "substantially" to the conception or design of the research, the interpretation of its results, or the writing of the manuscript. Research assistants who merely helped with data collection or routine analysis are probably not authors, nor are people who helped with routine tasks such as typing, computer administration, and grant management (not to imply that "routine" means unimportant or valueless). Also, the order of authors' names matters, because the scientific community, including hiring and promotion committees, typically gives the first author major credit for the manuscript. A general rule is that the first author is the person who initiated the research and made the largest contribution to its conceptualization, theoretical analysis, and write-up in the manuscript. However, opinions of individual researchers (and disciplines) vary somewhat in who should be included as authors and the significance of first authorship. It is sometimes standard practice always to include a student's advisor as an author on anything published by the student, and sometimes the first author, regardless of the advisor's actual contribution. This is an issue of research ethics to which we return in Chapter 14. We will say here, however, that we do not endorse this practice and emphasize that students have the same ethical right to first authorship as anyone else (not to imply that students and other new

Table 13.4 Basic Structure of a One-Study Empirical Article

a. Title Page
   (1) author names (order matters and must be discussed ahead of time)
   (2) departmental or institutional affiliation

b. Abstract
   (1) short summary; as few as 100 words, rarely more than 300
   (2) what you did, why you did it, what you found, what it means

c. Introduction
   (1) topic (first sentence should not refer to researchers or to literature)
   (2) citations to relevant literature; put your problem in context
   (3) specific research question or hypothesis at the end

d. Method
   (1) cases (who or what, how sampled)
   (2) materials (including equipment, survey questions, computer displays, and so on)
   (3) procedures (narrative of what you did to get data, make model)

e. Results
   (1) descriptive (especially) and inferential statistics
   (2) concise interpretation—avoid broad conclusions here
   (3) most central question first, if possible
   (4) data treatments, transformations, data problems and how you dealt with them

f. Discussion
   (1) results restated and interpreted specifically
   (2) possible problems or threats to validity
   (3) results interpreted more broadly; future work that should be done
   (4) final conclusions (usually no need to say that "more research is needed"—tell us what research is needed)

g. References or Bibliography
   (1) list, usually in alphabetical order by first author's last name, second author's last name, and so on (sometimes in citation order)
   (2) list in chronological order if there are multiple references by same authors

h. Tables and/or Figures

i. Appendices (occasionally)

researchers always have an accurate view of what contribution deserves first authorship). In any case, authorship credit is one of those issues that can potentially cause conflict within the "relationship" that is scientific collaboration. If you and your collaborators want to maintain a harmonious relationship, you should discuss this well ahead of manuscript submission.

After the title page comes the **Abstract**, often on a separate page. The abstract is a short summary of what you did and why, what you found, and what it means. Writing an informative and complete abstract is quite challenging, as they are typically limited to as few as 100 words and rarely more than 300.

Next come the four major sections of the body of the manuscript: Introduction, Method, Results, and Discussion. The **Introduction** section is more substantial than its name suggests. It does introduce the topic of the manuscript in the first paragraph or so, preferably with a first sentence about the topic area or specific phenomenon of interest.[5] After this short topical introduction, narrow your focus by turning to the specific research issue or question addressed in the manuscript. Provide a review and discussion of relevant literature, making sure to cite it, in order to put your problem in context. This is a big part of scholarship, as we discuss later. The Introduction should end narrowly with a specific research question or hypothesis. This hypothesis is often a prediction about what you will find in the study, but a prediction per se is not necessary and should not be forced unnaturally. Another important point in this regard is that you do not need to write your research manuscript according to the actual temporal order of what you did and what you believed. Many new research writers assume, for instance, that their Introduction must be based on what they knew and thought *before* they did the study. This is not true; write the manuscript in a logical and engaging manner, given what you know having completed the study. Writing the Introduction so that it does not give away everything in the Discussion, however, can contribute a little suspense and does increase the engagement of your story. It's OK to offer a hypothesis in the Introduction that you know will be discredited by your Results.

The second major section is the **Method** section, in which you describe in detail what you did to obtain your data. Do not describe what your data show; those are results, and they go in the next section. As several chapters have shown, geographers who study different subject areas use fairly different sorts of data, obtained in different ways. But all Method sections must describe the nature and number of cases, how they were sampled and contacted, the variables that were measured and how they were operationalized, any materials used to measure the cases (including recording or sensing devices, survey questions, and so on), and the procedure used to collect data or construct a model. Describe the cases and materials in a static manner; describe the procedures as a temporally ordered narrative with a beginning and an end.

After the Method comes the **Results** section. Present your data and any analyses you have conducted. Make sure to focus on describing the pattern of results, not just their statistical significance (see Chapter 9). Inferential questions about statistical significance speak to what sample patterns probably indicate about population patterns, which is not the first thing a reader needs to know to interpret your results. The Results section should focus on a correct and complete presentation of your data, but in order to help the reader understand the meaning of your data, you should concisely interpret your data in words as you present them. The key word here is *concisely*—save broad interpretations and conclusions for the Discussion section. Engage the reader by trying to present those results that speak to your most central question first, if possible, followed by the second most central results and so on. However, it is often necessary first to discuss manipulations you may have

[5]The first sentence of the Introduction should *not*, however, refer to researchers or literature, as in "Geographers who study river channel development disagree about . . ." It is the topic area or phenomenon of interest that we care about, not what geographers do or think.

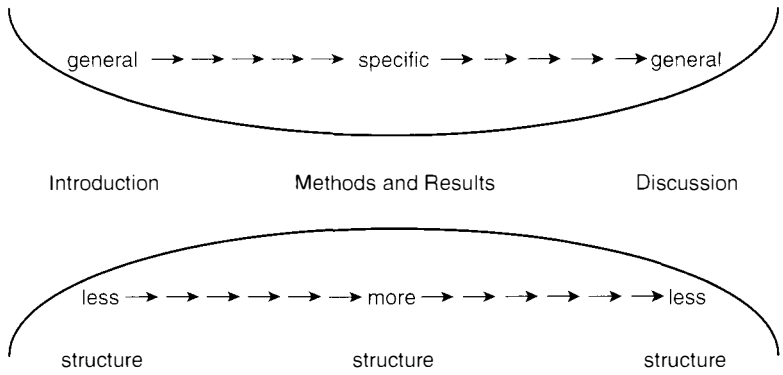

Figure 13.1 The "hourglass" structure of a one-study empirical research paper.

applied to your data (in the everyday sense of the word, not assignment control), such as omitting bad cases or variables, transforming or combining variables, or treating outliers. It is to be hoped that these manipulations are justifiable for a priori reasons, not because you find out afterward that the results fit your hypotheses better if they are manipulated. Always be forthright in describing data manipulations, a component of research ethics discussed in Chapter 14.

The final of the four major sections of the body of your manuscript is the **Discussion** section. Start narrowly by restating your major results, interpreting them specifically. Then broaden out by considering possible problems, limitations, or threats to the validity of your study (Chapter 11). Then interpret your results even more broadly, possibly suggesting implications they have for a research community, discipline, or even society at large. You can speculate a little more at this point. Recommend future research that should be done. However, there is little need to say that "more research is needed"; that's pretty much a foregone conclusion. Instead, say specifically what research is needed and why. Finally, you want to state your conclusions succinctly, often designating them with an explicit heading of "Conclusions" or "Summary and Conclusions."

To repeat, the four major sections of the body of the manuscript are the Introduction, Method, Results, and Discussion. You may have noticed that there is an "hourglass shape" to these four sections (Figure 13.1). That is, the two end sections, the Introduction and Discussion, are broader than the two middle sections, the Method and Results. Furthermore, the Introduction starts broad and narrows as it nears the Method section; the Discussion starts narrow at the Results section and broadens as it nears the end. Also, the Method and Results are fairly tightly structured, whereas the Introduction and Discussion are less structured—you have a little more creative leeway as to exactly how you structure these end sections.

After your concluding sentence comes the **References** section, usually starting on a new page. This is a list of your literature sources, occasionally including other types of sources such as data sets or media reports. Depending on the journal's particular style, references are listed in alphabetical order by the first author's last name

and initials; sometimes they are listed in the order in which they were cited in the manuscript, particularly if footnote citation is used. After considering the first author's last name, use the second author's last name, and so on, to determine reference order; a single-author reference precedes a reference by that same author and a second author. If there are multiple references by exactly the same author, list the earliest references first. Unlike a bibliography, which lists general source material, all of your references must be cited in the body of the manuscript at specific locations where they are relevant.[6]

Citations are done in one of two ways; every journal will specify this in their instructions to authors. The more common way in geography journals is to list the last names of the authors, followed by the year of the publication (with or without a separating comma). Here is a (fictional) example: "Retail location is strongly market driven, as compared to manufacturing (Garcia, 1994)" or "Garcia (1994) showed that retail location is strongly market driven, as compared to manufacturing." Many journals prefer that three or more authors be shortened to "et al.," a Latin abbreviation meaning "and others." So Ruocco, Konty, and Ishikawa (2001) would be cited as Ruocco et al. (2001). Multiple citations to the same author and year would be distinguished by the addition of lowercase letters, which are also added in the References: Lovelace and Cova (1999a), and Lovelace and Cova (1999b). Multiple citations at one place in the text are ordered alphabetically or chronologically. The second way of citing references is to use numbers or letters as footnotes, such as "Retail location is strongly market driven, as compared to manufacturing.[1]" Either the footnotes are in sequential order (1, 2, 3, . . .), which means the References are listed in the order they were cited, or the References are in alphabetical order, which means the citation superscripts are not in sequential order.

Most manuscripts will include one or more tables and figures, including maps (Chapter 10). These are either printed on separate pages following the References or placed in the body of the text at the location where you want them to appear. If located after the References, a note is placed in the text to indicate where the publisher should place the table or figure ("Insert Table 2 about here"). Either way, all tables and figures must be cited in the body of the manuscript at least once: "Figure 3 shows a model for climate variability in the Tropics." In addition to tables and figures, a few manuscripts also include one or more appendices at the very end that present technical details some readers may wish to skip. An appendix might show a proof, the derivation of some formula, or a computer algorithm, for example.

Two Aspects of Style in Scientific Writing

There are two important aspects of writing style for scientific manuscripts that we want to discuss briefly; you should definitely consult style manuals and guidebooks like

[6]There are a variety of software packages (for example, EndNote, PAPYRUS, ProCite) that store and organize references and support the creation of Reference and Bibliography sections for manuscripts. We recommend you start your own reference database as soon as you start writing manuscripts—that is, while you are still a student. Oh, and make sure to keep a backup copy.

those listed in the Bibliography for numerous additional aspects of style. The first is that scientific research should be expressed in precise and straightforward language. Avoid flowery prose—*say what you mean clearly and simply.* Term repetition is more acceptable in this type of writing than in some others; using the same word or words to express the same concept helps the reader easily know that you are talking about the same concept. Avoid stilted, pedantic writing, including the dreaded "scientese" that employs passive and jargony sentences in order to sound scientific.[7] Although jargon is to be avoided, certain technical jargon should be used because its specific meaning is recognized within a particular research community, and its use can communicate more efficiently; make sure to define such terms when first used. It may be hard for some newcomers to believe (and we regret that some old-timers don't seem to realize) that writing in an engaging style is a good thing even in scientific writing. Interesting and appealing writing is not just for novels and short stories.

The second aspect of writing style we want to comment on is that scientific communication should avoid **sexist language**. Some see this advice as political correctness, whereas others argue that it is social and even semantic correctness. Rather than try to defend one of these positions, we will simply observe that current usage recommendations in nearly every field (as explained in style manuals) require avoiding what we describe here as sexist language. Specifically, writers should not consistently use masculine singular pronouns in a generic or default manner, that is, when the sex[8] of the person referred to could be male or female and is otherwise

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[7] **Active** or **passive voice**—that is the question, at least with respect to writing style. We cannot fully treat this question here, but we note that you should not strictly adhere to the general advice "not to use passive voice" (the Microsoft Word grammar checker believes this). Passive voice, wherein the subject of the sentence expresses the goal of an action, does tend to reduce the flow and stimulation of writing; rewriting to reduce passive voice definitely tends to improve what is written. "We took samples from 56 vernal pools" is better than "samples were taken from 56 vernal pools." However, passive voice is appropriate when one wants to place focus on the goal of an action rather than on the agent bringing about the action. There are a few different situations when this might be true, including when the action and its target is important but the particular agent is not. "The vernal pool at the lowest elevation was found to have the highest concentration of organic solutes." We direct the reader to Williams (1990) for an excellent discussion of active versus passive voice, and in general, how to write for readability and engagement.

[8] People have both sex and gender. Sex is a dichotomous variable that corresponds to "female" and "male"; it is determined by genetics and biological development in the womb and after (actually, as we noted in Chapter 2, sex is not a perfect dichotomy). Gender is a continuous variable that corresponds to what is meant by "feminine" and "masculine" (gender is also applied to words; pronouns in some languages have gender rather than sex). Socialization and other experiential variables join with genetic and biological development to determine gender, a process that social scientists have studied extensively. We use the term "sex" rather than "gender" to refer to a person's membership in one of the two categories of female and male. This usage does not imply, however, that all variables correlated with a person's sex are caused by their biology. The income disparity between females and males working in the same profession is a sex difference, not a gender difference, but that doesn't mean it is necessarily caused by hormones or genitalia.

irrelevant. This poses a small difficulty for English speakers, as English has no gender-neutral singular pronouns for animate beings. Referring to a person as "it" generally does not fly. We recommend using the plural whenever possible, which is often. Make sure to maintain plurality agreement with verbs when you do this. Sometimes singular is appropriate, however, such as when you are making a point about the actions of a single person. Of course, if you are speaking of a particular person who is male or female, don't hesitate to identify the person's sex. It is correct to refer to the sex of people if that is known and relevant; don't write "Nearly every player on the Denver Broncos football team gives money to *his or her* favorite charity." If the person could be of either sex, but you want to write in the singular, we recommend "he or she" and "his or her" (the reverse orders sound less fluid in English). Some writers feel this is clunky, but we find it easily tolerable if done in small doses. Alternating the gender of the pronoun is another possibility, although we find it rather distracting. Besides pronouns, nonsexist language means referring to all people as "people," "humans," "humankind," or the like—not "man" or "mankind." Also avoid sexist assumptions about people's careers, traits, sexuality, and so on. For example, some engineers are women, and some nurses are men.

Using the Library for Scientific Research

In this final section of the chapter, we take a look at the major storehouse of scientific communication—the library. The library is not just the "brick-and-mortar" library building but increasingly refers to the incredible storehouse that is the Internet, including the World Wide Web. Libraries contain a variety of scholarly and research resources, including scientific literature, reference books, publicly available data sets (secondary data), maps and imagery, dissertations, newspapers, special collections, and more. Library resources are obviously invaluable for research in all areas. Most importantly, they provide the basis for **scholarship**. Scholarship is knowing what has and hasn't been said or done, what is and is not believed to be true, and so on. Scholarship is putting your research within the context of the history and intellectual development of your topical area. In addition to scholarship, library resources provide ideas that help you design and carry out your research, such as techniques you could use to collect or analyze data. Finally, library resources allow you to give recognition to people who have come up with new ideas or results, thus giving credit where it has been earned (see our discussion earlier about the rewards of publication). But more critically, this recognition allows you to avoid accidental plagiarism. It's up to you to know that someone has published a particular idea before.

The library is clearly the place to go to find relevant literature on a given topic. *Finding it* is the key. The library provides many tools to help find relevant literature. There are reference books and databases (almost exclusively electronic nowadays) built on journal and book titles, article titles, publication years, author names, abstracts, and citations.

There are a few databases specifically for geography and cartography, such as GEOBIB, GEOBASE, and Geographical Abstracts (in two parts: Human Geography

and Physical Geography). You can find literature in various generic databases (such as Web of Science) or in more specialized databases that deal with one of the many topical areas with which geography overlaps (urban studies, environment, geosciences). If, as a newcomer to literature searches, this seems daunting to you, ask a reference librarian for help. It may not sound fashionable in this day of digital automation and budget cuts, but flesh-and-blood librarians have training and experience that can be very helpful—even to experienced researchers and scholars.

We can offer some specific strategies for finding relevant literature. Word searches are the first place most people go, including keywords, title words, and author names. **Keywords** are words or short phrases that have been attached to pieces of literature in an attempt to represent their content concisely. Word searches are carried out within a database like we just discussed. Word searches are obviously powerful, but we want to emphasize that they are generally not sufficiently thorough and authoritative in and of themselves to find everything relevant (remember scholarship?). A straightforward reason for this is that some relevant literature may not be indexed in particular databases or even in any database. But the more interesting and profound reason that word searches are not wholly sufficient, and probably never will be, stems from the way words relate to meaning. This is the same issue we discussed in Chapter 5, where we pointed out the major reason that coding verbal records is so difficult. The many-to-many and contextual mapping of words to meanings makes word searches inadequate in and of themselves, at least if one wants a truly scholarly and comprehensive search. Try searching with the word "map" sometimes and see how many disparate topics your search finds. Word searches can thus be very inefficient, finding many things that are not relevant to your problem. What they do find is not sorted very well for relevance, importance, validity, and so on. By the same token, you can readily miss a relevant piece of literature during a word search because the semantic content of the piece is not labeled with the word you use but by some near or exact synonym.

These caveats about word searches are especially potent in the case of searches carried out directly within the entire Web, via a search engine. This is becoming increasingly common; many students and, we fear, many scholars and research scientists don't search any other way. The Web is an incredible tool, but it is not sufficient for academic research by itself, and it may never be. All relevant and important literature is definitely not on the Web, although the proportion of literature that is not mentioned by someone somewhere on the Web is clearly becoming smaller. What *is* on the Web is comically (or perhaps tragically) inconsistent; we have often been bemused if not annoyed by the number of different answers to factual questions one can find on the Web. The Web is mostly unchecked for quality control, with many things posted there that are not put through gatekeepers like editorial fact checkers or the peer review system discussed earlier. We don't know if anyone has reliably estimated how much sheer baloney and hogwash may be found on the Web, but it must be shockingly high. It reminds us of the old joke that "42.6% of statistics are made up." The Web is a great place to apply some of that scientific skepticism we discussed in Chapter 1.

We therefore recommend supplementing keyword and title word searches, not only if you want to increase your chances of finding what's really been written, but also if you want to increase the efficiency of your search and its focus on the most central pieces of literature. One of our favorite ways to track down literature is to look over the references listed and discussed in some relevant book or article we already have, including a textbook. You can then look at the references in the new literature you examine, and so on; this strategy will obviously produce an explosion of possible literature before too long. To acquire real expertise in some topical area, scan all years of a key journal, although this strategy is probably too time consuming to justify unless you are a doctoral student. Or search for all literature by the name of key researchers. Finally, there is always the shortcut of asking established experts in a particular area. Well, it's a shortcut for you anyway; maybe it's good etiquette to do some work on your own before you request that someone who might be very busy give his or her time to save yours.

Review Questions

- What are the various written and oral forms of communication in geography?
- What are some specific types of journal articles?
- What is some advice for giving an effective oral presentation?

Peer Review System

- What are typical steps in the peer review system for publishing research literature, and what are some aspects of this system designed to promote objectivity in geographic research?
- What are blind and double-blind review, and what are pros and cons for using these forms of review?
- What are possible outcome decisions of the publication review process?

The Basic Structure of a Journal Manuscript

- What is an Abstract, and why is it important to write good Abstracts?
- What content should generally be found in the four main sections of the body of an empirical article: Introduction, Method, Results, Discussion?
- How does an "hourglass" structure describe the basic components of a one-study empirical article?

Two Aspects of Style in Scientific Writing

- What is the appropriate style of writing for scientific communication, and what are some ways to achieve this style?
- What are some examples of sexist writing, and what are some ways to avoid them?

Using the Library for Scientific Research

- What are some ways the library (including the Internet) is used by scientific researchers?
- What are strategies for finding relevant literature for a research project or paper?
- What are some limitations of keyword or title word searches?

Key Terms

Abstract: very short summary appearing after the Title page in a research manuscript

active voice: style of writing in which the subject of the sentence expresses the agent of an action rather than the goal or recipient of an action; although increasing its use generally improves writing, it is not appropriate in all writing situations

blind or **double-blind review:** peer review in which an attempt is made to keep either the author or reviewer, or both, uninformed of the identity of the other person

citation: statement of a literature source at a particular place in a manuscript, meant to give credit to specific ideas or data

conference: regular gathering (annual or less frequent) of new and established scholars and researchers in a given discipline or topical area where research is presented and discussed, social networking occurs, and other activities take place—essentially an academic convention

conference paper: talk given at a conference that may or may not end up in written form

conference proceeding: edited book comprising a collection of papers based on talks or discussions at a scientific conference

Discussion section: fourth and final major section of a research manuscript, it narrowly restates major results, interpreting them both specifically and broadly, considers problems and limitations, and suggests future research

edited book: book with chapters written by different authors; the collection of chapters is organized by one editor (or one group of editors)

grant application: written request for funding for a proposed program of research, made to a funding source such as a public agency or private foundation

Introduction section: first major section of a research manuscript, it introduces the topic of the manuscript, discusses previous data and ideas relevant to the topic (including citations), and ends narrowly with a specific research question or hypothesis

journal: primary form of scientific literature, particularly for initial communication of research results and conclusions; serially published usually once every two or three months

keywords: words or short phrases that have been attached to pieces of literature in an attempt to represent their content concisely; they support computer keyword searches, a common technique for trying to find literature

meta-analysis: quantitative review of research that makes conclusions about some phenomenon by statistically combining the empirical results of many independently conducted studies on the phenomenon

Method section: second major section of a research manuscript, it describes in detail what was done to obtain the data or create the model, including how cases were sampled and measured; subsections typically include detailed descriptions of cases, materials, and procedures

passive voice: style of writing in which the subject of the sentence expresses the goal of an action rather than the agent of the action; although reducing its use generally improves writing, its complete elimination is inappropriate

peer review system: important social process that increases the objectivity and quality of scientific literature by subjecting it to a gateway process in which other scientists read and review manuscripts submitted for publication

poster: brief written and graphical presentation of research that is posted on a bulletin board for viewing and discussion at conferences

References section: list of literature sources for a manuscript placed at the end, including only those sources that are cited in the body of the manuscript

Results section: third major section of a research manuscript, it presents data and their analyses, including both descriptive and inferential analyses; only concise statements about the meaning of data analyses are included here

reviewers: researchers and scholars who serve as the peers in the peer review system; their job is to carefully read a manuscript submitted for publication, and offer reasoned arguments for whether the manuscript should be published and how it should be modified to improve it

scholarship: knowing what has and hasn't been said or done in prior scientific and academic work; allows authors to put their research within its historical and intellectual context, credit people for their prior contributions, and avoid plagiarism

scientific literature: the archive of written research communication that includes journal articles, books, and so on

sexist language: the use of masculine pronouns or terms such as "mankind" to refer by default to people of either sex; also assumptions about people based on their sex or sexual orientation that are at most *probably* true, not definitely true

Title page: first page of a submitted manuscript, it lists the authors' names and institutional affiliations

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