Japanese speakers by Kobayashi (1984). In apparent contrast, Huang (1985) seemed to show that at least good language learners in the People's Republic of China adopted similar strategies to those identified elsewhere (e.g., Rubin 1975). It is difficult to draw conclusions from these findings, except perhaps to speculate that background may affect performance but not learning style.

What are your preferences regarding these issues in table 16? And what are the preferences of your field?

TABLE 16. Analysis Chart

	A	B	C	D
Is the version general-specific (SG) or specific-general (SG)	GS	SG		
Is the main tense past or present?				
Are the citations by name or number?				
When citing by name, do the names occur (a) as subject, (b) as agent, or (c) in parentheses?				
Is the version a summary or a critique?				

Unit Seven
Constructing a Research Paper I

Units Seven and Eight consolidate many of the aspects of academic writing that we have stressed in earlier units. However, they also break new ground. They differ from the previous units in one important way. By this stage, we think it possible that you may now be carrying out a research investigation of some kind. The purpose of these units, therefore, is to prepare you for and help you with writing up your own research. In order to do this, we have made two further assumptions:

You will be using a typical organizational pattern for your paper—in other words, the IMRD format (Introduction, Methods, Results, and Discussion) or some variant of it;
You hope that your paper might be published.

So, where do we stand? As we can see from the following list, we have already made good progress toward carrying out the difficult task of writing a research paper.

Parts of the Research Paper	Contributions so far
Title	
Abstract	Unit Five, Summary Writing
Introduction	Unit Two, General-specific
	Unit Four, Problem-solution
	Unit Six, Critiques
Methods	Unit Three, Process descriptions
Results	Unit Four, Highlight statements
	Unit Four, Qualifications
Discussion	Unit Four, Explanations (of unexpected results, etc.)
	Unit Six, Literature comparisons
Acknowledgments	
References	

We can also see from the list that there is some more work to be done. The really difficult areas, especially Introductions and Discussions, need considerable attention. We also need to consider writing up Methods and Results for research papers (RPs), as opposed to, say, lab reports. There are some smaller bits of business, such as acknowledgments and titles to be discussed. Even so, enough has been done to make it possible.

When you read an RP, you may *think* that it is a simple, straightforward account of an investigation—indeed, RPs are often designed to create this impression. However, we believe that such impressions are largely misleading. Writers of RPs, in our opinion, operate in a *strategic* manner. This is principally because such writers know that RPs have to justify themselves. They need to establish that the research questions are sufficiently interesting. They need to demonstrate that the research questions are, in theory, answerable. And they need to compete against other RPs for acceptance and recognition. As a result, RP authors are very much concerned with *positioning*—with showing that their studies are relevant and significant and have some new contribution to make.

Overview of the Research Paper

The overall rhetorical shape of a typical RP is shown in figure 10.

This diagram gives a useful indication of the out-in-out or general-specific-general movement of the typical RP. As the RP in English has developed over the last hundred years or so, the four different sections have thus become identified with four different purposes.

Introduction (I)	The main purpose of the Introduction is to provide the rationale for the paper, moving from general discussion of the topic to the particular question or hypothesis being investigated. A secondary purpose is to attract interest in the topic—and hence readers.
Methods (M)	The Methods section describes, in various degrees of detail, methodology, materials, and procedures. This is the narrowest part of the RP.

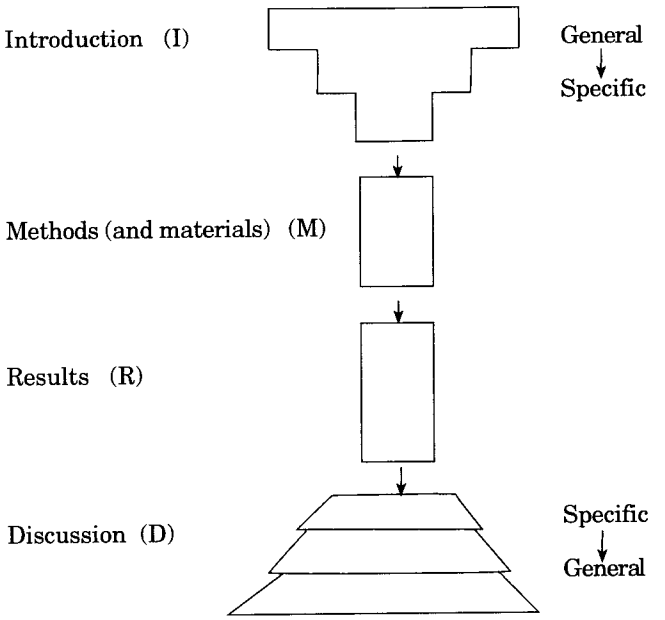

Fig. 10. Overall shape of a research paper

Results (R)	In the Results section, the findings are described, accompanied by variable amounts of commentary.
Discussion (D)	The Discussion section offers an *increasingly generalized* account of what has been learned in the study. This is usually done through a series of "points," at least some of which refer back to statements made in the Introduction.

As a result of these different purposes, the four sections have taken on different linguistic characteristics. We summarize some of these in table 17. The first line of the table shows, for instance, that the present tense is common in Introductions and Discussions, but uncommon in Methods and Results.

Task One

In 1993 Dorothea Thompson published a useful RP on Results sections in biochemistry articles. She was particularly interested in

TABLE 17. Frequencies of Selected Items in RP Sections

	Introduction	Methods	Results	Discussion
Present tense	high	low	low	high
Past tense	mid	high	high	mid
Passive voice	low	high	variable	variable
Citations/references	high	low	variable	high
Qualification	mid	low	mid	high
Commentary	high	low	variable	high

what kinds of comments researchers made in their Results sections and whether researchers followed the guidelines in manuals. Here are eight sentences from her paper. Based on table 17 and on your own knowledge, can you guess from which of the sections they come? Mark each one *I*, *M*, *R*, or *D*. There are two sentences from each section. Work with a partner, if possible.

— 1. Only further research can determine the applicability of this study's findings to scientific disciplines outside biochemistry.
— 2. The data were analyzed both qualitatively and quantitatively.
— 3. Short communications and mini-reviews were excluded from the sample because these publications have different objectives and use a different format from that of the experimental research article.
— 4. The assumptions underlying this study are grounded largely in sociological accounts of the scientific enterprise (Knorr-Cetina, 1981; Latour, 1987; Latour and Woolgar, 1979).
— 5. These style guides are, at best, superficial descriptions of the content of these sections.
— 6. In 15 of the sample articles, these methodological narratives included explicit justifications for the selection of certain technical procedures, laboratory equipment, or alternatives to standard protocols.
— 7. Scientific style manuals reinforce the conception that Results sections simply present experimental data in a "cold," purely objective, expository manner (Council of Biology Editors, 1972; Day, 1988; Mitchell, 1968; Woodford, 1968).
— 8. In 38% of the JBC Results sections sampled, Kornberg and his co-authors directly relate their findings to those of earlier studies, as the following illustrate: . . .

Methods

You might have expected us to begin our discussion of RP sections with the Introduction. Instead, we are beginning with Methods. This is usually the easiest section to write and, in fact, it is often the section that researchers write first.

In Units Seven and Eight, we will involve you in the writing up of a very small research investigation of our own. Among other things, we hope in this way to illustrate certain strategic aspects of RP writing. We summarize our miniproject in Task Two.

You will remember from Unit One that sentence connectors are words like *however* and *therefore*. We became interested in the *position* of sentence connectors in written academic English sentences. We became curious about this since we found that the standard grammars of English had little to say on this topic. We are currently writing up our small-scale investigation. Like many other academics, we started with Methods.

Task Two

Here is our draft. Please read it and answer the questions that follow.

Methods

[1]In order to investigate the position of connectors, we examined their occurrence in academic papers published in three journals. [2]The sample consisted of all the main articles appearing in the third issues of the 1992 volumes of *College Composition and Communication*, *English for Specific Purposes*, and *Research in the Teaching of English*. [3](See Appendix A for a list of the articles

studied.) [4]The sample amounted to about 230 running pages of text, comprising 12 articles (four from each journal). [5]Each occurrence of a connector was identified, highlighted, and then coded for one of three positions in a clause. [6]If the connector was the first or last word in the clause, it was designated "initial" or "final" respectively. [7]If it occurred in any other position, it was classified as "medial." [8]The following examples illustrate the coding system:

A t-test was run;

however, the results were insignificant.	Initial
the results, *however*, were insignificant.	Medial
the results were, *however*, insignificant.	Medial
the results were insignificant, *however*.	Final

[9]For the purposes of this study, the category of sentence connector was interpreted quite broadly. [10]We included items like *unfortunately* that are sometimes considered to be sentence adverbs. [11]We included such items as *as it were* and *in turn,* which have an uncertain grammatical status. [12]We also counted conjunctions like *but* as connectors when they occurred as *first* elements in sentences, because they seemed to be functioning as connectors in these contexts.

1. As is customary, the main tense in our Methods section is the past. In one sentence, however, the main verb is in the present. Which one is it and why?

2. Consider the following subject-verb combinations from sentences in our Methods section:

   1. we examined . . .
   5. each occurrence was identified . . .
   6. it was designated . . .
   7. it was classified . . .
   9. the category was interpreted . . .
   10. we included . . .
   11. we included . . .
   12. we counted . . .

These eight sentences describe what we did. As you can see, in four cases we used the past passive, and in four cases we used *we* and the past active. Is this switching acceptable to you? Could you do this in your field? What would your advisor or instructor recommend? Do you think we should have been consistent? In other words, do you think we should have used either the passive or *we* all the way through?

In a classic 1981 paper, Tarone et al. argue that the choice of passive versus *we* + active is not always a "free" stylistic choice. According to Tarone et al., the passive in the astrophysics papers they examined is used for standard procedures, while the use of *we* signals something new or unexpected. Do you think this might be true of your field?

3. Do you think the third paragraph should come before the second? What are the advantages and disadvantages of such a change?

4. As it happens, our account of Methods is not quite accurate. In actual fact, we conducted a pilot study on one journal. When that experience appeared to work out, we extended the sample. Is there any good reason for mentioning this part of the (true) story? When you write up a Methods section, is it appropriate to simplify or straighten out the actual process? Is it OK to "tidy up" in this way?

5. Finally, would you like to guess what our results were? What percentage of connectors were initial, medial, and final?

Language Focus: Imperatives in Research Papers

In the Methods section in Task Two, sentence 3 currently reads:

(See Appendix A for a list of the articles studied.)

We could, of course, have written:

(A list of the articles studied is given in Appendix A.)

Command-like imperatives are common in textbooks, manuals, lectures, and labs.

Analyze the results in figure 1.
Complete the following sentences.
Notice the relationship between A and B.
Prepare 5cc of distillate.
Carry this total *forward*.

In RPs, however, imperatives are less commonly used because they may be offensive. They may upset the fragile relationship between the writer and the reader, since the reader (instructor, advisor, or someone outside) can be expected to have a status comparable to or higher than the author.

However, one verb is widely used in many RP fields. Indeed, it may account for up to 50% of all the (occasional) uses of the imperative in research writing. As you may have guessed by now, that verb is *let*.

Let p stand for the price-cost ratio
Let N equal the number of consumers

A few other imperative verbs can be found in mathematical arguments, such as *suppose*, *substitute*, and *assume*.

A rather more difficult case occurs when you want to direct your readers' attention to some particular point, as we did when we wrote "(See Appendix A for a list of . . .)." We wanted the readers to know at this point in our paper that we have elsewhere provided full details of our data.

In RPs would you accept imperative uses of the following, and, if so, can you provide an example?

1. Notice
2. Consider
3. Imagine
4. Note
5. Refer
6. Compare
7. Recall

8. Observe
9. Take the case of, etc.
10. Disregard

If you think that an imperative might cause *offense* by being impolite, there are easy ways of escape.

Imperative	Now compare the results in tables 4 and 5.
Passive	The results in tables 4 and 5 can now be compared.
Conditional	If we now compare the results in tables 4 and 5, we can see that . . .

Writing Up a Methods Section

One of us (John) interviewed a student planning her first research paper for her masters in social work. Mei-Lan said that the provisional title for her research paper was "Chinese Elderly Living in the United States: A Problem-free Population?" She said that she had chosen this topic because of some "prevailing myths" that the Chinese communities would always look after their elderly and that such elderly would not accept help from outsiders. She believed that certain traditional Chinese attitudes, such as "filial piety," were beginning to change in U.S. communities. She added that all the research to date had been conducted in the large communities in big cities on the East and West Coasts. She wanted to study smaller communities in a midwest town. John then asked her about methodology.

John Swales: How are you going to collect your data?
Mei-Lan: By face-to-face interviews. I want to do one-on-one interviews because I think if other family members are there the interviewees will not reveal their deep feelings and real problems.
JS: How will you find your subjects?
ML: I'll use friends and acquaintances in the local Chinese community to introduce me.
JS: Will you record the interviews?

ML: Yes, but of course I will ask permission first.
JS: Will you use English?
ML: The interviewees can use any language they prefer—Mandarin, Taiwanese, or English. Whatever is most comfortable for them.
JS: How long do you plan the interviews to last, and do you have a fixed list of questions?
ML: About an hour. I have a list of questions but I do not want to follow them very exactly. I will use what sociologists call "semi-structured" interviews. Part planned, part "go with the flow," as the Americans say.
JS: Finally, how many people will you interview?
ML: Because of limited time and contacts, only about ten. So I will be doing a qualitative analysis. There will not be enough subjects for statistics.

Task Three

Now with a partner draft the *first* sentence of Mei-Lan's Methods section. Remember to use formal style. You may wish to consider which of the following elements should be included.

1. methodology
2. the purpose of the methodology
3. the sample

Task Four

Now write a Methods section of your own. If you do not have any suitable material, you could—as an alternative—complete Mei-Lan's Methods section for her. In this case, assume that she has now completed the work.

Methods Sections across Disciplines

The two Methods sections we have been working on so far would fall under the broad category of "social science." Studies show that most Methods sections in social science disciplines share a number of characteristics:

They are explicit about details and procedures.
They are slow paced since they do not presume much background knowledge.
They contain justifications, explanations, and (sometimes) examples.
The terminology is often repeated.

In social science, education, public health, and so on, methodology is often a very important and hotly debated issue. Indeed, in some cases in these areas, the main point of an RP will be to announce some development in method. However, in science, engineering, and medical research, standard practices and established methods are much more widely available. As a result, Methods sections in these fields may be very different.

Task Five

Read this opening to a Methods section and answer the questions that follow.

Methods for Analysis and Functional Properties

> The standard AOAC[1] methods (AOAC, 1975) were used for the determination of total solids, nitrogen, crude fat, ash, and Vitamin C. Total sugars were determined by the method of Potter et al. (1968), and the total carbohydrates (in terms of glucose) were assayed according to the procedure of Dubois et al. (1956). The method of Kohler and Patten (1967) was followed for determining amino acid composition.
>
> (Quoted by Knorr-Cetina 1981, 157)

1. What field do you think this extract comes from?

2. What differences can you note between this Methods section and the one given in Task Two? What evidence can you find here of shared background knowledge? What is striking about the ways in which the methods in this passage are described (or, more exactly, not described)?

[1]AOAC = Association of Operational Analytic Chemists

3. Would a Methods section written like this be possible in your field?

Task Six

We can conclude that Methods sections vary greatly in what we might call "speed."

Type 1	Slow (as in our own draft)
Type 2	Fairly slow
Type 3	Fairly fast
Type 4	Fast (as in the paper quoted by Knorr-Cetina)

Here is part of a Methods section written by one of our students. She is working on a Ph.D. in physiology. What "speed" would you give it?

Suppose Jun's advisor suggested that it could be "speeded up" a little. What advice do you have? There are also a couple of small mistakes toward the end. Can you correct those as well?

Binding Assay and Down Regulation Study

Cells were cultured in 24-well plates. Receptor binding was determined by incubating the intact cells with (3H)NMS in 1 ml buffer A at 4°C or 37°C. Non-specific binding was defined in the presence of atropine. Incubation was terminated by washing the cells with ice-cold saline three times. Cells were scraped in 0.5ml water and suspensions were put into 5mm bio-safe scintillation fluid and then counted in a Beckman liquid scintillation counter. For the study of down regulation, cells was pre-incubated with 10mm M CCh for different periods time and then washed with a buffer A three times. The binding assay was performed as described above.

(Jun Yang, unedited)

Where on the "speed" scale (Types 1–4) would you place your own methods descriptions and those typical of your field?

Language Focus: Hyphens in Noun Phrases

Notice that Jun's first sentence ends with the noun phrase "24-well plates." Hyphens are often used to clarify how complex noun phrases are to be interpreted. In Jun's case, her hyphen indicated that she was using plates containing 24 wells. Without the hyphen, the phrase could be interpreted as 24 plates containing an unspecified number of wells. What differences can you see between the following pairs of noun phrases?

small-car factory / small car factory
blue-lined paper / blue lined paper
university-paid personnel / university paid personnel

Read the above pairs aloud. Can you make a distinction between them in terms of stress and intonation?

Can you think of one or two similar pairs from your own field?

How would you indicate what you meant by the following noun phrases? All three are ambiguous, at least out of context.

artificial heart valve
rapid release mechanism
strong acting director

Results

The other section we will deal with in this unit is the Results section. Again we will begin by asking you to read the Results section of our own paper. As it stands at present, it is an incomplete draft.

Results

A total of 467 sentence connectors was found, averaging just over two per page. Eleven of the 12 articles used connectors with some frequency, with totals ranging from 24 to 58. The one exception was the only article in the sample that dealt with literary texts,

which used only nine connectors. The scarcity of connectors in this paper may be due to its heavy use of commentary on literary passages.

Seventy different sentence connectors occurred in the sample. This large number is somewhat surprising, even taking into account our broad interpretation of "connector." Those that occurred four times or more are listed in decreasing frequency of use in table 18.

TABLE 18. Frequency of Connectors

Rank	Item	Total occurrence
1	however	62
2	first, second, etc.	52
3	thus	33
4	also	30
5	for example	29
6	in addition	20
7	finally	19
8	therefore	16
9	on the other hand	14
10	then	12
11	nevertheless	11
	for instance	
	furthermore	
14	moreover	9
	in particular	
	but	
17	in fact	8
	yet	
19	that is	6
	in contrast	
	in other words	
22	further	5
	similarly	
	of course	
25	as a result	4

There are a number of surprises in the frequency data. There was unexpectedly heavy use of the "informal" connectors *but* (nine instances) and *yet* (eight instances). Although these are known to be frequent in newspapers and correspondence, we were somewhat surprised to find so many in refereed scholarly journals. In contrast, there was minimal use of "conclusives," such as *in conclusion*. Under 2% of all the connectors fell into this category. Finally, very uneven frequencies in certain other categories were noted.

Contrasts:	however, 62	nevertheless, 11	all the same, 0
Results:	thus, 33	therefore, 16	hence, 1

We now turn to the positional data. Of the 467 connectors found, 352 occurred in initial position (75.4%), 109 in medial position, and only six in final position. Clearly, final position is very rare in this kind of writing, and we will not discuss it further. If we now examine the positional data in terms of individual connectors, we find that different connectors behave somewhat differently. In table 19 all connectors occurring four times or more are categorized for percentage of occurrence in initial position. (Informal uses of *but* and *yet* have been excluded.)

TABLE 19. Positional Categories of Connectors

Category	Connectors	Occurrence
A	First, second, etc., in addition, nevertheless, finally, that is, as a result	100% in initial position
B	moreover, thus, in particular/in fact, in other words, of course	Between 75% and 99% in initial position
C	however, for instance, on the other hand, furthermore	Between 50% and 74% in initial position
D	also, for example, therefore, then	Between 25% and 49% in initial position

Task Seven

Go back and read through the Results section of our paper, underlining all the occasions where we have used numbers (ignore percentages). Can you determine the rules we followed for when to write numbers as digits (12, etc.) and when as words (twelve, etc.)? What are the rules you use in your field?

Task Eight

Notice that our Results section is not complete. Suppose we asked you what we could include in the concluding paragraph to our Results Section, based on the information in table 18? What highlighting statements would you suggest? Refer back to Unit Four if necessary. Give your suggestions in order, from the first statement to be included to the last.

Commentary in Results Sections

It is often said that the Results section of an RP should simply report the data that has been collected; that is, it should focus exclusively on the present results. Indeed, many of the books and manuals aiming at helping students and scholars to write research papers offer this kind of advice. These books argue, particularly, that all evaluation and commentary should be left until the Discussion. However, research shows that this distinction between Results and Discussion is not as sharp as commonly believed. For example, Thompson (1993) studied the Results sections from 20 published biochemistry papers. Table 20 presents what she found.

This is part of Thompson's conclusions:

> My research demonstrates that scientists—in this case biochemists—do not present results only in a factual expository manner; they also employ a variety of rhetorical moves to argue for the validity of scientific facts and knowledge claims.
>
> (P. 126)

TABLE 20. Commentary Found in Results Sections

Type of commentary	Number of papers (max. = 20)
Justifying the methodology	19
Interpreting the results	19
Citing agreement with previous studies	11
Commenting on the data	10
Admitting difficulties in interpretation	8
Pointing out discrepancies	4
Calling for further research	0

Authors often include commentary because they are aware of their audience. They can *anticipate* that their readers may be thinking, "Why did they use this method rather than that one?" or "Isn't this result rather strange?" For obvious reasons, authors may not want to postpone responding to such imaginary questions and critical comments until the final section.

Task Nine

Carefully read a Results section that you have written or read from your field and our draft on sentence connectors, marking any commentary elements. In your estimation, which of the following types are the passages most like?

Type 1 Gives straightforward description of the author's results; includes no commentary at all (no comparisons with the work of others, no justifications, no—or very few—obvious highlighting statements).

Type 2 Is mostly restricted to present findings, but includes a few minor uses of commentary.

Type 3 Consists of both description of findings and a number of commentary elements; uses several of the categories mentioned by Thompson.

Type 4 Makes heavy use of commentary; uses most of the categories found by Thompson; could almost be taken for a discussion.

Be prepared to discuss your findings in class. Bring the passage from your field with you.

Task Ten

Produce a Results section from your own work (or part of one if your work is extensive). If your results are not yet complete, create some findings on your own. Alternatively, you may complete the final paragraph of the Results section for the sentence connector mini-RP.

Unit Eight
Constructing a Research Paper II

In this final unit, we deal with the remaining parts of a research paper in the following order:

Introduction sections
Discussion sections
Acknowledgments
Titles
Abstracts

Introduction Sections

It is widely recognized that writing introductions is slow, difficult, and troublesome for both native speakers as well as nonnative speakers. A very long time ago, the Greek philosopher Plato remarked, "The beginning is half of the whole." Indeed, eventually producing a good Introduction section always seems like a battle hard won.

Writing the Introduction of an RP is particularly troublesome. In some kinds of texts, such as term papers or case reports, it is possible to start immediately with a topic or thesis statement

The purpose of this paper is to . . .
This paper describes and analyzes . . .
My aim in this paper is to . . .
In this paper, we report on . . .

However, this kind of opening is rare and unusual in an RP (probably under 10% of published RPs start in this way). In fact, statements like those above typically come at or near the end of an RP Introduction. Why is this? And what comes before?

We believe that the answer to these questions lies in two interconnected parts. The first half of the answer lies in the need to appeal to the readership. In a term paper assignment, the reader is set. (In-