3 The rhetoric of EST discourse

3.1 Introduction

This book examines the rhetorical elements in the discourse of scientific and technical English; it also examines the grammar and lexis related to these rhetorical elements. To many, the terms *rhetoric* and *discourse* are synonymous. However, as noted above in section 1.2, we use the term *rhetoric* to refer to one important part of the broad communicative mode called *discourse*. Rhetoric in this sense we define as follows:

> Rhetoric is the process a writer uses to produce a desired piece of text. This process is basically one of choosing and organizing information for a specific set of purposes and a specific set of readers. An EST text is concerned only with the presentation of facts, hypotheses, and similar types of information. It is not concerned with the forms of written English that editorialize, express emotions or emotionally based argument or are fictional or poetic in nature.

We can further define EST rhetoric by adding that it includes the ways in which information is organized when 'organization' means 1. the sequencing of the items of information in a piece of written discourse and 2. the expression of the kinds of relationships that exist between these items. Also, we can say that EST rhetoric is not concerned with isolated items of information but with the larger discourse units in which these items are found.

As the 'EST rhetorical process chart' (chart 3.1) shows, EST rhetoric exists at several levels in a piece of discourse. Both in our research and in our teaching we have found it convenient to divide the total discourse into the four rhetorical levels shown on the chart.

Level A gives the purpose of the total discourse, this information being usually found in the introductory section of the discourse (in, for example, a technical article). Level B consists of those major pieces of text which, when added together, make up the complete discourse. This level is usually marked in scientific and technical writing by section headings or sub-headings.

The rhetorical process is best seen operating at Levels C and D. Level C is made up of the specific rhetorical functions that are found most

commonly in written EST discourse: description, definition, classification, instructions, and visual–verbal relationships between a visual aid and its accompanying text. Most commonly the discourse at this level is presented either in groups of closely related paragraphs or in single paragraphs. A finite number of such paragraphs at Level C add up to one of the sections of Level B.

CHART 3.1 EST RHETORICAL PROCESS CHART

Level	Description of level
A.	*The objectives of the total discourse* EXAMPLES: 1. Detailing an experiment 2. Making a recommendation 3. Presenting new hypotheses or theory 4. Presenting other types of EST information
B.	*The general rhetorical functions that develop the objectives of Level A* EXAMPLES: 1. Stating purpose 2. Reporting past research 3. Stating the problem 4. Presenting information on apparatus used in an experiment – a) Description b) Operation 5. Presenting information on experimental procedures
C.	*The specific rhetorical functions that develop the general rhetorical functions of Level B* EXAMPLES: 1. Description: physical, function, and process 2. Definition 3. Classification 4. Instructions 5. Visual–verbal relationships
D.	*The rhetorical techniques that provide relationships within and between the rhetorical units of Level C* EXAMPLES: I. Orders 1. Time order 2. Space order 3. Causality and result II. Patterns 1. Causality and result 2. Order of importance 3. Comparison and contrast 4. Analogy 5. Exemplification 6. Illustration

Level D consists of one or more of the rhetorical techniques a writer chooses (or is sometimes required to use) as the most functional for presenting the framework into which the items of information given at Level C fit or the most functional for showing the relationships between these items. Frequently, one of the orders and one of the patterns will be found together, thus providing the reader with both a framework and a set of relationships. Although the markers showing the relationships between items of information can consist of paragraphs, as a rule they are found within paragraphs, in single sentences or clauses or phrases.

While the examples listed under each level on the 'Rhetorical process chart' are not exhaustive (particularly at Levels A and B), they do give us an idea of the kinds of information each level contains and how those various units of information relate to one another. For example, if we think of a scientific article – or a chapter in a scientific textbook – that has as its objective the detailing of an experiment (one of the objectives of the total discourse listed at Level A), we find that to achieve this purpose the discourse must include a description of the apparatus being used and a description of how that apparatus works. The writer, then, in developing his ideas is required to choose one or more of the general rhetorical functions listed at Level B in order to satisfy the objective of Level A. In this case, the required function is presenting apparatus used in an experiment: description and operation.

Information on the description and operation of apparatus can only be presented to the reader through the specific rhetorical function of *description* (Level C). Similarly, the use of the rhetorical function of description requires the writer to choose one or more of the rhetorical techniques listed in Level D. By its very nature, discourse concerned with the physical description of an object demands the use of the rhetorical technique of *space order*. And as our sample discourse is also concerned with the way in which the apparatus works, our writer must also choose the rhetorical technique of *process time* and, with it, the relational pattern of causality and result. In sum, the functions chosen at one level almost inevitably determine those to be chosen at the next level down.

Up to this point I have been using the terms 'rhetorical functions' and 'rhetorical techniques' with no attempt to define them or to distinguish them from one another. To clarify how these rhetorical elements work within a piece of total discourse, I define a rhetorical function as a name for what a given unit of the discourse (some finite piece of text) is trying to do and a rhetorical technique as a name either for the frame into which writers fit their information or for the way in which the items of information chosen relate to one another or to the main subject of the given unit of discourse. A rhetorical technique can also

show how the informational purpose of one unit of text (at Level C, let us say) relates to the informational purpose of units preceding or following. The rhetorical techniques are discussed in detail in chapter 6.

If the rhetorical function defined above is a 'general' function (Level B), the text covered by this function will be fairly extensive (a section or sub-section) and most frequently will be found under a heading or sub-heading that states the nature of the information that the section or sub-section is contributing to the total communication. If the rhetorical function is a specific one (Level C), then the unit of text will consist of a paragraph (or a series of closely related paragraphs) that contributes to the total communication by providing such information as definitions, descriptions, classifications, etc. The specific rhetorical functions are discussed in chapter 7.

Although it is necessary to discuss all four levels and their relationships to one another when teaching how a piece of discourse is organized (in terms of teaching reading) and how to organize one (in terms of teaching writing), not much class time need be spent on Levels A and B.[1] As noted above, Level A is usually expressed explicitly in the introductory section to a total text and Level B is usually marked by semantically functioning headings or sub-headings. Levels C and D, however, are seldom so explicitly marked; they often require the reader to find clues to grasp the informational purposes of the material. Also, research has shown us that we can best see the characteristics of written EST discourse at these levels (C and D). For these reasons we have concentrated on the specific rhetorical functions (Level C) and the rhetorical techniques (Level D), both in the classroom and in our papers and presentations at conferences and seminars.

For the same reasons, then, in this book we are also concerned primarily with these rhetorical functions and techniques. In addition we look at some of the grammatical areas that present the non-native learner with the greatest difficulties and also look at the special lexical problems inherent in the nature of written EST discourse.

In classroom application, this rhetorical approach has proved itself useful both in teaching reading skills to the non-native student and in teaching the types of writing that both school and professional work in scientific and technical English demand. A large amount of written EST discourse is dense in presentation of ideas, often heavy-footed stylistically, and frequently difficult in terms of grammatical and lexical elements. While we cannot change the style and language habits of past, present, and future generations of writers of EST prose, we can help our students cope with much of it. The rhetorical approach is one way that has, in our experience, proved successful in helping students handle the reading problems of this specialist discourse.

When we turn to teaching students to write scientific and technical English we need to provide additional help. The most persistent problems that we have encountered and their suggested solutions are treated in chapter 10. Here, I only wish to point out that we have found writing best approached as a transfer technique. That is, we have the students consciously practice the rhetorical concepts they have found in their reading by giving them writing exercises designed to make them choose those rhetorical elements most appropriate for a given purpose and a given level of reader. In requiring students to choose specific rhetorical functions and techniques for the presentation of their EST information, we also strengthen their recognition of these functions and techniques when they read EST discourse. In chapter 4, we point out how student reading assignments can lead to directed writing exercises.

3.2 Basic premises

The rhetorical approach to teaching non-native speakers how to read (and secondarily to write) scientific and technical English discourse is built around three main rhetorical concepts: 1. the nature of the EST paragraph; 2. the rhetorical techniques most commonly used in written EST discourse; and 3. the rhetorical functions most frequently found in written EST discourse. Related to these three concepts are the grammatical and lexical elements also prominent in this type of English discourse.

We define this type of written English as follows:

> EST writing is that type of discourse that has as its purpose the transmission of information (fact or hypothesis) from writers to readers; therefore it uses only a limited number of rhetorical functions. It does not, for example, make use of such rhetorical functions as editorializing, non-logical argumentation, poetic images, or those functions that create emotions such as laughter, sadness, etc.

With this definition in mind we can now look at the three main rhetorical concepts in the order given above.

3.2.1 The EST paragraph

We define the EST paragraph as follows:

> The EST paragraph is a unit of written English discourse that presents the reader with a selected amount of information on a given area of a subject. This information is so organized by the writer that the rhetorical concepts chosen and the relationships between these concepts are the most functional for both the rhetorical purpose of the paragraph and for the level of reader; that is, the reader's position in respect to the subject matter under discussion – beginner, expert, etc.

In working with the discourse of EST we found that the standard definition of 'paragraph' did not fit well with the way that scientific and technical English is organized and written. The 'standard' definition contains, as a rule, the following ideas: 'A paragraph is a group of sentences which express a complete thought and which are set off on a page of text by indentation or spacing.' The difficulty in applying this definition to written EST discourse is that it confuses two quite separate factors: the first half of the definition deals with concepts ('... a group of sentences which express *a complete thought* ...') while the second half deals only with the physical nature ('*... set off on a page by spacing or indentation*') of the paragraph. Thus, in a sense we have a dual definition.

The actual organization of a piece of EST discourse is more clearly seen if we accept that there are two types of paragraphs rather than insist that there is only one type. These two types we call the *conceptual* paragraph and the *physical* paragraph. Defining in EST discourse terms, we say that the conceptual paragraph consists of all the information chosen by the writer to develop a generalization, whether this is stated or only implied by the content. The physical paragraph, in contrast, takes over the second half of the definition above, and so is defined as that amount of information relating to the generalization which is set off from other parts of the discourse by spacing or indentation. Here '... other parts of the discourse' refers either to another physical paragraph which is part of the same conceptual paragraph or to the previous or following conceptual paragraphs.

This way of looking at paragraph structure and content also contains the ideas of 'correspondence' and of 'core generalization'. When a conceptual paragraph is developed by only one physical paragraph, we have a one-to-one correspondence. When a conceptual paragraph requires two or more physical paragraphs for its development, we have a one-to-more-than-one correspondence.

The idea of 'core generalization' is explained as follows. Frequently in written EST the generalization of a conceptual paragraph is developed by a rather complex organizational pattern that has the main idea divided into two or more 'sub-ideas', each represented in the text by a generalization on a lower level (that is, more specific) than the level of the main generalization. These lower-level generalizations and their

supporting information are indicated physically as well as semantically by being put in separate physical paragraphs. The rule is: *As long as information – whether it consists of lower-level generalizations or of details at various levels of specificity – is supporting the main generalization, it all belongs to the same conceptual paragraph.*

This concept of 'generalization' is basic to the rhetorical approach to analyzing written EST discourse. We call the main generalization the 'core' or the 'core generalization' when dealing with it in the abstract;[2] we call it the 'core statement' of the paragraph when discussing a concrete example. This concept and that of 'correspondence' are illustrated in examples 3.1A and 3.1B below.

EXAMPLE 3.1A ONE CONCEPTUAL PARAGRAPH COMPOSED OF THREE PHYSICAL PARAGRAPHS (ONE-TO-MORE-THAN-ONE CORRESPONDENCE)

The components composing the urban system can be categorized into two major categories. These *are the land use configuration and the transportation system.* These two categories interact with each other as well as with themselves.	Core of conceptual paragraph
Land use refers to the special configuration of supply and demand of opportunities: for instance, the demand for interaction of opportunities is located in institutional, commercial, and industrial areas. The supply side of opportunities is measured in terms of the intensity of attractiveness, which may be expressed by the number of jobs in the specific zone. The spatial location and quantities of these entities (supply and demand of opportunities) in relation to the others are the major attributes of the land use components of the urban system.	Sub-core no. 1
The transportation system determines the ease of interaction between the supply and demand configurations. The transportation system has two attributes. One is the transportation network, which determines the spatial coverage of its service, and the other is the level of service or quality of the transportation system. Both factors have an effect on the interaction between activities.	Sub-core no. 2

EXAMPLE 3.1B ONE CONCEPTUAL PARAGRAPH COMPOSED OF ONE PHYSICAL PARAGRAPH (ONE-TO-ONE CORRESPONDENCE)

The transportation system is not the only factor(2) *that influences the level of interaction among various activities,* though it is a very important one. (1) *Another factor* (3) *is the nature of the activities themselves.* Assuming that trip productions arise from the residential population and that trip attractions are primarily jobs offered to people, we notice that the qualitative attributes of population and jobs vary widely....	Core is composed of italicized part of sentence 1, which is embedded between the subject and predicate of sentence 2.

[Source: *The Trend In Engineering*, 22.2 (1970), 29–30]

In example 3.1A the writer has divided his discussion of this particular area of his subject into three physical paragraphs that add up to one conceptual paragraph. The first physical paragraph presents the major generalization, which is the core statement of the conceptual paragraph. The second physical paragraph picks up a key term in the core statement and expands on it, giving the reader the first sub-core. The second sub-core is in the third physical paragraph and is an expansion of the second key term in the core statement in the first physical paragraph. For the core statement to be adequately developed, three physical paragraphs are required. If the writer had put all his information into one physical paragraph, he would have failed to take advantage of the opportunity to use a one-to-more-than-one correspondence to emphasize the importance of each of his two major points (stated as the two sub-cores).

In contrast, in example 3.1B we have a one-to-one correspondence since the core statement is developed in a single paragraph; that is, the physical and conceptual paragraphs are the same and, of course, there are no sub-cores.

This concept of 'core' is of major importance to the understanding of the idea of 'paragraph' in our approach to the analysis of written EST discourse. Occasionally the generalization of a paragraph can be found stated neatly in the first sentence of that paragraph and so equate with the 'topic/thesis sentence' pattern discussed above. Our research, however, makes it quite clear that the generalization of an EST paragraph is not often stated so neatly in a single sentence placed appropriately at the beginning of that paragraph. We frequently find the core statement made up of parts of two or more sentences or consisting of a short phrase buried somewhere near, but not often at, the beginning. At times, the core statement is not

found expressed in words but is implied by the nature and organization of the information that makes up the paragraph; that is, the reader is expected to infer the core statement from the context.

Our examples above illustrate types of core statements that are found very often in EST discourse. In example 3.1A the core statement consists of the subject noun phrase (NP) of the first sentence of the initial physical paragraph and of the verb phrase (VP) of the second sentence in the same physical paragraph: 'The components composing the urban system are the land use configuration and the transportation system.' In the verb phrase we find the bases for the sub-cores that begin the second and third physical paragraphs. These sub-cores are stated as second-level generalizations (that is, they are statements which, although still general, are less general than the core – the governing generalization of the entire conceptual paragraph).

The core statement in example 3.1B is more complex than that of example 3.1A. It begins with the subject noun phrase of sentence 2 of the paragraph, goes back up the embedded restrictive relative clause in sentence 1, and then returns to add the verb phrase of sentence 2. The result is 'Another factor that influences the level of interaction among the various activities is the nature of the activities themselves'.

Because of this kind of complexity non-native learners whose exposure to the English paragraph has been through examples of 'topic sentences' placed at the beginning of carefully selected (or made up) paragraphs usually have difficulty in determining the generalizations which govern EST paragraphs.

A more extended discussion of the concept of 'paragraph' as found in EST discourse is given in chapter 5.

3.2.2 Rhetorical techniques

The rhetorical elements that bind together the information in a piece of EST text we call the 'rhetorical techniques'. The most frequently used of these are listed under Level D in the 'Rhetorical process chart', p. 11. All are found frequently enough in EST discourse for us to examine them in some detail.

While the examples listed under Level D in the 'Rhetorical process chart' appear to be discrete items (and sometimes are), actually the concept is somewhat more complicated. First, we are dealing with two quite distinct types of rhetorical techniques: 1. the 'orders' (also called 'natural patterns') that provide a framework for the items of information the writer is presenting, and 2. the 'logical patterns' that indicate the relationships between those items of information.[3]

The natural patterns (orders) are so-called because the nature of the material determines the framework that material is put into. In EST

discourse, the most frequent such patterns are 'time order', 'space order', and 'causality and result'. In contrast, the logical patterns are usually deliberately chosen by writers to make clear the relationships between the items of information they have chosen to present to their readers.

Second, the use of one rhetorical technique does not exclude the simultaneous use of others. In fact, it would be very difficult to find an example of one of the orders – time or space – that was not developed in conjunction with one or more of the logical patterns. For example, a paragraph using time order to describe a process requires the use of causality and result. We also find two or more logical patterns working together, with one usually being dominant. We may find a paragraph developed by putting details in their order of importance in such a way that they compare and/or contrast as well.

Several of the examples in chapters 5 and 6 will illustrate these points. Also chapter 5 discusses in detail the rhetorical techniques, which we can also think of as 'patterns of organization'. The discussion includes the criteria for the use of each of the patterns as well as the verbal markers that help the reader identify them.

3.2.3 Rhetorical functions

The rhetorical functions (listed at Level C of the 'Rhetorical process chart') are the foundation of the rhetorical approach to the analysis of written EST discourse. From our research, we have abstracted the five rhetorical functions that occur most frequently in EST texts. These are not treated here and in chapter 6 in any order of importance or frequency of occurrence; however, in both places the rhetoric of description is treated first as it is commonly found not only in isolation but also in conjunction with the other rhetorical functions.

This wide range of occurrence of description is due to the nature of EST material: a large amount of it is concerned with physical structures (physical description), with the purpose of a device and how its parts work (function description), and with processes and procedures (process description).

When we examine types of EST discourse in more detail we will see that, similar to the natural patterns of time and space (rhetorical techniques), certain types of discourse impose certain functions on writers' materials; that is, writers have no choice but to use a specific rhetorical function because the nature of the material requires it. An example is that of discourse written for students new to a field: this kind of discourse demands the frequent use of the rhetorical function of definition since the reader will be faced with new terms and possibly old terms with new meanings.

In chapter 6, the rhetorical functions are treated in detail in the following order:

1. *Description.* This rhetorical function is divided into three types, each of which has distinct characteristics and a clear-cut set of purposes. We call these three types a) physical description, b) function description, and c) process description. Physical description has to do with the physical nature of whatever is being discussed. Function description is concerned with the purpose of some device (usually machinery) and how the parts of that device work separately and with one another and with the whole. Process description deals with processes and procedures and is characterized by the detailing of a series of steps, each but the first usually dependent on the previous step and all aimed at achieving a definite goal. Process description is considered by many to be a special case of function description; however, it is so complex in itself (and is so frequently found in EST discourse) that we choose to treat it as a separate type of the rhetorical function of description.
2. *Definition.* The several types of definition found most commonly in written EST discourse lend themselves well to teaching both reading and writing through the application of the rhetorical approach. The types of definition discussed in this book are a) simple definitions (also called single-sentence definitions), consisting of 1. formal definition, 2. semi-formal definition, and 3. non-formal definition; and b) complex definitions, most of which have special functions such as stipulation, operation, and explication, and which are expansions of simple definitions. This expansion is as a rule in one paragraph, although it can take up an entire text.[4]
3. *Classification.* Classification is also easily divisible into manageable types, thus making the task of analysis easier. We discuss classification from two perspectives: a) the 'direction' in which a classification is made – whether we are finding the members of a given class or are finding a class for one or more given members – and b) whether the classification is explicit or implicit, and if the former whether it is a full or a partial classification. Finally, we discuss the nature of the bases for classification, both those which express similarities and those which express differences.
4. *Instructions.* Instructions are found most often in technical discourse, usually in technical manuals. Instructions can be roughly defined as the rhetoric of telling someone what to do and how to do it to achieve a certain goal. Our detailed investigation of instructions on all levels – from beginners to experts – shows that we can conveniently break this rhetorical function into two major groups: a) 'instructions', the actual telling someone what to do and how to do it, and b) instructional information, that additional information that accompanies most sets of instructions and provides explanations, theory, warnings, etc. We find instructions themselves to be of two types: 1. direct instructions, which are stated in the imperative, and 2. indirect instructions, which often sound more like suggestions than commands but which actually function as imperative statements. This type of instructions usually contains a modal verb such as 'can', 'may', 'should', and less often 'must'.
5. *Visual–verbal relationships.* This final rhetorical function to be discussed is in some respects more complex than the others. It is that part of what Henry Widdowson has called 'information transfer' that deals with illustrative (graphical) material and the written text which accompanies it. In our meaning of the term, 'visual–verbal relationships' also cover the placement of this textual material (the 'verbal') in relation to the visual – whether the two are separated (and if so what is the precise location of the text) or whether the verbal is part of the visual itself. This placement of text in relation to illustration frequently affects both the kinds and amounts of information the text gives in respect to the illustration and the textual reference to the illustration as well.

As we can see from the 'Rhetorical process chart', these five rhetorical functions are the main ones used by EST writers to develop the general rhetorical functions listed under Level B. In chapters 6 and 7, we demonstrate this relationship more precisely.

Chapter 4 offers our solution to one of the most pressing problems in the teaching of specialized language use: how to cope with a class of students who do not form an even approximately homogeneous group. The typical academic EST class (and most EST classes at whatever tertiary level) is characterized by heterogeneity in respect to the students' fields of interest, to their ability levels in English, to their academic standing (whether undergraduate and which year as undergraduate or whether postgraduate and which degree is being sought), to their subject-matter knowledge, and to their varying abilities with their native language.

Our answer to the above is the application of one kind of individualizing of assignments. In discussing this process in detail in chapter 4 we also suggest a way to determine the make-up of any given class, and we look at a teaching procedure that allows us to apply individualizing more satisfactorily than when we first faced the problem. The term we have devised for this procedure is 'parallelism'.

This way of individualizing assignments is illustrated again in chapter 10.