

## CURRENT APPROACHES TO THE DESCRIPTION OF SCIENTIFIC ENGLISH

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### 1. Introduction

In recent years scientific English has received a good deal of attention from researchers working in such diverse fields as Linguistics, ie (Applied) Discourse Analysis and the Sociology of Science. This growing interest in research into scientific English is primarily due to the importance that modern scientific communities have assigned to it. Indeed, over these years English seems to have enjoyed dominance over other languages as the language of international publication, and it is now becoming more and more prominent in the publication of scientific research articles and papers. Mounting evidence for this English domination has been offered by researchers such as Baldauf & Jernudd (1983a; 1983b), Swales (1985), and Maher (1986). In 1983, for example, Baldauf & Jernudd (1983a) conducted a study of the language use patterns in the Fisheries literature for 1978. Their analysis of 884 articles indicated that English is the dominant language (amounting to 75%) in the literature they examined. Having established this English domination, they proceeded to the investigation of the relationship between language use and location of writers. They concluded that "the large proportion of English language articles was due mainly to the large number of authors from English speaking countries and by the use of English as a medium of communication by international organizations" (1983a: 254). In another study, Baldauf & Jernudd (1983b) were able to show that from 1967 to 1981 the number of articles published in English had grown substantially. More interesting perhaps is Baldauf's (1986) finding of his survey of articles published between 1978 and 1982 in four distinguished journals in the field of cross-cultural psychology. He found that 97% of the articles published in the journals under investigation are written in English. Further support is provided by Swales' (1985) survey of 632 articles in Medicine and Economics. He found that only five out of these 632 articles could be attributed to non-native writers of English in Third World countries.

One consequence is obvious of this dominance of English in research publication. This is precisely the importance of teaching scientific English to non-native researchers and writers. One reason for this is that non-native researchers often have to read and write research articles in English using their own resources and without native speaker assistance and guidance at their disposal. Another reason is that in order to survive in their highly competitive scientific communities, they often have to publish their research

papers. This is particularly because research articles are the means by which their research gains acceptance in the academic community; they are "*rites de passage* astride the road to professional advancement and promotion" (Swales 1983: 189).

In view of the prominence of English in academic and research settings, attempts have been made by practitioners and researchers of English for Specific Purposes (ESP) to describe and characterize scientific English. In fact, some approaches have been proposed to better understand the characteristic of scientific English. Even though these approaches were originally developed primarily within one area of activity, that is English for Science and Technology (EST), they have undoubtedly contributed to the development of ESP as a whole. This is understandable since "EST is the senior branch of ESP—senior in age, larger in volume of publications, and greater in number of practitioners employed" (Swales, 1985: x). Furthermore, this is because, as Swales suggests, "with one or two exceptions ... English for Science and Technology has always set and continues to set the trend in theoretical discussion, in ways of analysing language, and in the variety of actual teaching materials" (Ibid.).

This paper is an attempt to review the development of these approaches and their applications in the teaching of ESP. It is worth pointing out at this juncture that these approaches vary in terms of the level and depth of analysis, the scale of research and the theoretical frameworks adopted, and that attempts at characterizing them have also been made (see, for example, Cheong, 1976; Widdowson, 1979; Jarvis, 1983). Our concern here therefore is to complement and develop these characterizations. In addition, this review is deemed necessary, for it will provide us with a map which will guide us in making informed decisions on the teaching of scientific English.

## 2.1. Register Analysis

The first approach to be considered here is commonly known as *register analysis*, or "text-based approach" as Widdowson (1979) calls it. This approach was introduced in 1964 by Halliday, McIntosh and Stevens in their book *The Linguistic Sciences and Language Teaching*. In this particular book, they introduced the concept of "register". They claim that the language we speak or write varies according to the type of situation. They say: "Language varies as its function varies: it differs in different situations. The name given to a variety of a language distinguished according to use is 'register'" (1964: 87).

The assumption underlying this notion of register is that because language varies according to the different people who speak or write it and to the different purposes to which it is put, then there must be different and distinct varieties of particular languages: one is dialect, which is a variety

according to the user, and the other is register, which is a variety according to the use. Both varieties are defined in terms of their linguistic properties. As regards register, Halliday *et al.* say:

registers differ primarily in form ... the crucial criteria of any given register are to be found in its grammar and lexis .... It is by their formal properties that registers are defined. If two samples of language activity from what, on non-linguistic grounds, could be considered different situation types show no differences in grammar and lexis, they are assigned to one and the same register .... (1964: 88—89).

Later Halliday (1978, 1985) developed and refined this concept. He describes three variables in which language varies according to the context of situation: *Field*, *Tenor* and *Mode*. *Field* refers to the purpose and subject matter of communication (ie. what is actually taking place), *Tenor* to the type of role interaction, the set of relevant social relations between participants involved in the communication (ie. who is taking part), and *Mode* to the means by which communication takes place (ie. what part the language is playing, spoken or written). He further maintains that the notion of register is very simple, yet very powerful primarily because of its considerable predictive power. He says that "The notion of register is thus a form of prediction: given that we know the situation, the social context of language use, we can predict a great deal about the language that will occur with reasonable probability of being right" (Halliday, 1978: 32). In other words, register is to him "a variety that is oriented to a particular context: to a certain type of activity, involving certain types of people, with a certain rhetorical force" (Halliday, 1985: 5).

Since its early development in the 1960s and early 1970s, in linguistics this approach has had a tremendous influence on the description of language varieties. Works along this line of investigation include, among others, Crystal and Davy (1969), and Gregory and Carroll (1978). As a research procedure, it has also been very powerful and influential in language teaching and especially in the description of scientific English. It has been adopted as the underlying basis of the production of a good deal of teaching material (see, for example, Ewer & Lattore, 1969; Swales, 1971). The primary reason for this is that quantitative analyses of the formal linguistic features of scientific English can provide a basis for prioritizing teaching items in specialised ESL/EFL materials. Hoffman, for example, argues that:

The peculiarities of LSP (Languages for Special Purposes) are first and foremost of a quantitative nature. It is the significantly frequent occurrence of certain speech elements, forms or structures that characterises scientific writing.... As a consequence statistical methods play an important role in selecting an inventory for teaching purposes.... It is the word and phrase levels that yield the best results, ie. lists of typical lexical and syntactical items which may serve as a highly effective teaching/learning minimum (1981: 114).

Register analysts commonly agree that frequency lists provide useful information for the course writer, and they can provide a framework within which pedagogical selection in reading, teaching and testing can be made (Salager, 1983).

These arguments have motivated researchers to examine the characteristics of academic and research English. Barber (1962) was probably the first to carry out a frequency-count analysis of the nature of scientific English. In particular, he was interested in analysing the occurrence of sentence structure, verb forms and vocabulary. His corpus consisted of a standard university textbook on electronics, an elementary university textbook on biochemistry, and a research paper on astronomy. In this study, Barber was able to show, for example, that the present simple tense was the dominant verb form (amounting to 89%) in the three texts under investigation, and that the progressive tenses were so rare in scientific writing that they could as well be ignored in the preparation of teaching materials.

Since this pioneering work by Barber, a great deal of research has been carried out along this line of analysis. Ewer and Lattore (1967) found that there is wide variety in the language of Science and Technology, and that different subregisters tend to use distinct grammatical structures. Ewer & Hughes-Davies (1971) compared the language of the texts their science students had to read with the language of three general coursebooks. They found that the coursebooks neglected some of the important language forms such as compound nouns, passives, conditionals and modal verbs which are commonly found in scientific literature. They concluded that ESP materials should therefore give special attention to these forms. In his investigation of verb phrases and noun phrases in first year undergraduate laboratory reports and other written texts from history, technology and geography, White (1974) found that in terms of verb forms, laboratory reports were markedly different from science texts and from general English texts, the verbs in the reports occurring predominantly in the passive form. He concluded that the distribution of verb groups in science writing reflects the communicative role or purpose of the user. In a similar study of verb forms and functions in medical writing, Wingard (1981) observed differences in verb use between journal articles which report on medical research and a descriptive manual on cancer diagnosis. He found that active verbs exceeded passives in both types of texts, but the frequency of passives was greater, and that of simple present tense less, in the articles than in the manual.

Those are some of the works carried out within the framework of register analysis. Other studies along these lines include Cheong (1978) and Huddleston (1971) on syntactic structures and verb forms in scientific English, Cowan (1974) on syntactic patterns in various medical texts used at the University of Tehran, West (1980) on that-nominal constructions, Salager (1983) on the vocabulary of medical English, Salager (1984) on

compound nominal phrases in medical English and general English, and Hanania & Akhtar (1984) on verb forms and functions in Master of Science theses in biology, chemistry and physics.

All these studies have provided useful information which is of important pedagogical significance in the teaching of scientific English. They offer relatively comprehensive inventories of the linguistic structures found in scientific writing. These lists can be very useful "as aides-memoire, reminding us of language items or linguistic features which we might otherwise overlook" (Swales, 1976).

However, register analysis as represented by these studies has almost exclusively been concerned with sentence grammar. As a matter of fact, its focus on discrete structural items and not on the interaction between sentences in connected discourse has invited a number of criticisms. Even the concept of register itself has been seriously challenged. Hudson (1980), for example, argues against adopting the notion of variety (be it dialect or register) as an analytical or theoretical concept on account of the difficulty in establishing the boundaries between varieties. For this reason, he proposes an item-based model (for further details on this model, see Hudson, 1980).

This approach has also been criticised for its failure to take into consideration the communicative purpose of a text (Widdowson, 1979, 1983) and the differences between genres (Swales, 1985). Widdowson, for example, argues that register analysis is "an operation on text and does not, as such, reveal how language is used in the discourse process" (1983: 28; for his argument for the difference between text and discourse, see Widdowson, 1979: 112-40). As its focus is on the linguistic characteristics of a text, it fails to take account of how the language system is realized as communicative activity. In this regard, Widdowson says:

The fact that scientific English texts exhibit a relatively high proportion of certain syntactic features and a relatively low proportion of others may be useful for identifying scientific English texts should we ever wish to do such a thing. In fact this approach has proved useful for establishing authorship; it can reveal, with the help of a computer, who wrote what, but it cannot reveal the communicative character of what was written. It cannot of its nature deal with discourse (1979: 55-56).

## 2.2. Discourse and Text Analysis

This brings us now to the second approach which concerns itself with discourse and text analysis. This approach departs from the first in that its focus is no longer on sentence grammar but on the network of linguistic relations at intersentential and paragraph levels. It is concerned with the identification of the organisational patterns in texts and the specification of

the linguistic features by which these patterns are textualized in English. The leading figures in this approach include Widdowson in Britain, and Selinker, Lackstrom and Trimble in America. Below we will discuss the contributions that these figures have made to the description of scientific English.

In Britain, Allen & Widdowson observed in their 1974 paper that:

the difficulties which the students encounter arise not so much from a defective knowledge of the system of English, but from an unfamiliarity with English use, and that consequently their needs cannot be met by a course which simply provides further practice in the composition of sentences, but only by one which develops a knowledge of how sentences are used in the performance of different communicative acts. (1974a).

In response to these difficulties that the students have in learning English, Allen & Widdowson develop a form-function approach which is concerned not only with rhetorical functions such as classification, definition, description, explanation, etc., but also with the grammatical forms which textualise them. They argue that an English course should develop two different kinds of ability: one is the ability to understand the rhetorical coherence of discourse, ie. the rhetorical functioning of language in use, and the other is the ability to recognise and manipulate the grammatical cohesion of text, ie. the formal devices used to combine sentences to create continuous passages of prose. (For the realization of this approach in materials production, see Allen & Widdowson, 1974b).

In an attempt to develop this approach even further, Widdowson (1979) claims that Scientific English can be more appropriately described as realizations of universal sets of concepts and methods or procedures which define disciplines or areas of inquiry independently of any particular language. He says:

We should think of scientific English not as a kind of text, that is to say as a variety of English defined in terms of its formal properties, but as a kind of discourse, that is to say a way of using English to realize universal notions associated with scientific enquiry. These notions have to do with the concepts and procedures of particular branches of science which serve to define these branches as disciplines and which are expressed non-verbally in the same way, whichever language is used in the verbal parts of the discourse.

It is clear then that the assumption underlying this approach is that because science is a universal area of enquiry with identifiable communicative acts which are neutral to any specific language, it is thus possible to devise teaching materials suitable to any groups of EST learners irrespective of their learning contexts and/or cultural backgrounds. But the question remains whether scientific discourse is universal, whether it is the same in every scientific community all over the world. In answer to this universality of scientific discourse, Swales (1985: 71—72) argues that Widdowson is pro-

bably right only in so far as scientific research is concerned, but not in terms of scientific education. His argument is based on his observation of the peculiarities of study modes, teaching styles and of general educational expectations within particular institutions around the world. He says in this regard: "we have to abandon Widdowson's hope of using a methodology based on the teaching of science in their first language because that is now recognized to be a local phenomenon" (1985: 72). In addition, research by Selinker *et al.* (eg. 1976a, 1976b) seems to support Swales' argument. They have shown that foreign learners of EST, coming from certain cultural backgrounds, find it difficult to understand authentic texts because they lack the cognitive skills which are required for negotiating meaning in such texts.

### 2.3. Rhetorical-Grammatical Approach

Another approach which differs slightly from Widdowson's is the one introduced in the late 1960s and developed in the early 1970s by Selinker and his colleagues, notably Louis Trimble and John Lackstrom. Whereas Widdowson's approach is based primarily on his binary distinction of *usage* and *use* (Widdowson, 1971, 1978), the approach that Selinker and his colleagues developed relies on their claim that there are rhetorical principles which determine grammatical choices, and that correct grammatical choice cannot be taught apart from rhetorical and subject matter consideration. Selinker *et al.* (see, eg., Lackstrom *et al.*, 1972, 1973) developed this rhetorical-grammatical approach—so it is commonly known—out of their dissatisfaction with the prevailing American preoccupation in the late 1960s and early 1970s with sentence-oriented grammar, and their observation of the neglect in the teaching of English as a second/foreign language of the important roles of subject matter and rhetoric in the grammatical organization of sentences. This dissatisfaction and observation had then motivated them to investigate the organizational patterning of texts and their textualization in English. They were particularly interested in investigating the relationship between such functions as description, definition and classification, and grammatical choices. In their 1972 paper, for example, they offered a radical interpretation of the meaning and use of tenses. They were able to show that the use of tenses in scientific writing is not directly related to time, but rather to the expressions of degrees of generality. These grammatical items, they argued, are ways employed to signal the rhetorical function of generalization in English scientific discourse (see Lackstrom *et al.*, *ibid.*, for further details).

This approach has been considerably influential in research into the relationship between rhetorical function and grammatical choice. Other works along this line of investigation includes Lackstrom (1978) on the use and function of modals; Oster (1981) on the use of tenses in reporting past

literature; Tarone *et al.* (1981) on the use of the passive; Swales (1981) on the function of *-en* participle; Todd-Trimble & Trimble (1982; 1985) on the use of article; and many others, especially those contained in Todd-Trimble *et al.* (1978) and Selinker *et al.* (1981). It has also been influential in course design and teaching materials production (see, eg., Weissberg & Buker, 1978; Todd-Trimble & Trimble, 1978; Huckin & Olsen, 1983; Trimble, 1985).

In an attempt to develop this approach even further, Selinker *et al.* (1974, 1976a, 1976b, 1978) examined the interaction between presupposition and technical rhetoric. In particular they focused on presuppositional rhetorical information and rhetorical function-shifts. They pointed out that there is implicit as well as explicit defining and classifying information in EST discourse, and that it is the implicit presuppositional rhetorical information which poses problems to the non-native reader. Support for this claim is provided by Flick & Anderson (1980) in their research into rhetorical difficulty in reading comprehension. They found that implicit definitions were more difficult for both native (American) and non-native students to comprehend. They suggested that implicit information seems to be a more general reading problem not only for non-native speakers, but for native speakers as well.

Probably the most important contribution that Selinker *et al.* have made to the description of scientific English is their work on the rhetorical structure of technical writing in English. In their 1973 paper (Lackstrom *et al.*, 1973), they described a hierarchical system of different levels of rhetorical functions. This system, which they call a "Rhetorical Process Chart", is organized in four hierarchical levels as shown in Figure 1 below.

Figure 1. Rhetorical Process Chart: English for Science and Technology

Level	Description of Level
A	<p><i>The Objectives of the total discourse</i></p> <p>EXAMPLES: 1. Detailing an experiment            2. Making a recommendation            3. Presenting new hypothesis or theory            4. Presenting other types of EST information</p>
B	<p><i>The General Rhetorical Functions Employed to Develop the Objectives of Level A</i></p> <p>EXAMPLES: 1. Stating purpose            2. Reporting past research            3. Stating the problem            4. Presenting information on apparatus: description            5. Presenting information on apparatus: operation            6. Presenting information on experimental procedures            7. Referencing an illustration            8. Relating an illustration to the discussion</p>
C	<p><i>The Specific Rhetorical Function Employed to Develop the general Functions of Level B</i></p> <p>EXAMPLES: 1. Definition            2. Classification            3. Description: physical and function            4. Description: process</p>
D	<p><i>The Rhetorical Techniques that Provide Relationship within and between the Units of Level C</i></p> <p>EXAMPLES: 1. Time order            2. Space order            3. Causality            4. Result            5. Comparison            6. Contrast            7. Analogy            8. Exemplification</p>

(Selinker et al., 1976: 283.)

They claim that a choice at the higher level constrains choices at the lower levels. Thus, if a writer chooses to detail an experiment (Level A.1) for example, s/he will be constrained in her/his choice at the next level (Level B.4 and/or B.5), and so on.

Through this chart Selinker *et al.* have been able to show that the relationship between rhetorical functions (Levels B and C) and rhetorical techniques (Level D) is one of different levels. Furthermore, they have been

able to show how there is often a mixture of specific rhetorical functions and rhetorical techniques within what they call a *conceptual paragraph* (see Lackstrom *et al.*, 1972, 1973; also Trimble, 1985, for details on the concept of *conceptual paragraph*).

This particular work on the rhetorical structure of scientific English has contributed a great deal to the investigation of rhetoric in scientific and technical English. More importantly, it has motivated other researchers to further study the discourse structure of scientific texts, especially the research article. Hepworth (1979) is an early example of such studies. Applying the 'discourse bloc' model originally developed by Pitkin (1969), Hepworth examined the introductions to experiment reports from several fields of science. (He did not specify, however, what the corpus he analyzed was and how it was selected.) He claimed that article introductions were typically problem-solution text types. Zappen (1983) made a similar claim when he said that article introductions typically consist of five parts: goal, current capacity, problem, solution and criteria of evaluation. These two studies bear a strong resemblance to the problem-solution model of discourse structure developed by Winter (1977, 1986) and Hoey (1979, 1983). Both Winter and Hoey have suggested that there is a typical discourse structure consisting of four parts: situation, problem, solution and evaluation. They maintain that this problem-solution structure, one among some others, is very common in discourse organization.

Despite its capability of establishing general features of all texts, hence grouping texts together on the basis of similarity (Dudley-Evans, 1986; Hopkins & Dudley-Evans, 1988), this top-down approach cannot distinguish between 'genres' (for the notion of *genre*, see below). Furthermore, such a problem-solution approach fails to take account of the indication that research in particular disciplines is not characterized by problem solving. Adams Smith, for example, observes that according to her informant:

Biomedical research is not a matter of problem-solving. Rather, it is the observation of something interesting that does not seem to fit the pattern, followed by the observation of this phenomenon over a period of time, and the recording and explanation of the findings. It is common for a piece of research to answer the question it has set out to clarify while at the same time it raises other questions to be accounted for in the course of further investigation (1987: 19-20).

#### 2.4. Genre Analysis

Motivated by his dissatisfaction with the top-down, problem-solution approach as well as with the existing materials on the teaching of article introductions, Swales (1981) embarked on a study of the discourse structure of research article introductions. In this particular study, he examined 48

article introductions of journal articles from the 'hard' sciences, the biology/medical field, and the social sciences. He suggested that article introductions typically have four parts which he calls *moves*, and these moves are organized in a consistent order. Swales (1981: 22a) outlines this four-move structure as follows:

Figure 2. Swales' Four-Move Structure

<b>Move One</b>	<b>Establishing the Field</b>
	A) Showing Centrality <ul style="list-style-type: none"> <li>i) by interest</li> <li>ii) by importance</li> <li>iii) by topic prominence</li> <li>iv) by standard procedure</li> </ul>
	B) Stating Current Knowledge
	C) Ascribing Key Characteristics
<b>Move Two</b>	<b>Summarizing Previous Research</b>
	A) Strong Author-Orientations
	B) Weak Author-Orientations
	C) Subject Orientations
<b>Move Three</b>	<b>Preparing for Present Research</b>
	A) Indicating a Gap
	B) Question Raising
	C) Extending a Finding
<b>Move Four</b>	<b>Introducing Present Research</b>
	A) Giving the Purpose
	B) Describing Present Research <ul style="list-style-type: none"> <li>i) by <i>this/the present</i> signals</li> <li>ii) by Move 3 take-up</li> <li>iii) by switching to first person pronoun</li> </ul>

Moreover, Swales has been able to delineate the linguistic exponents that are used to signal each of the four moves. In this respect, and some others, then, his work appears to be more vigorous and comprehensive than earlier work on discourse structure.

Swales claims that his approach to the investigation of article introductions is "genre specific". By *genre* he means "a more or less standardised communicative event with a goal or set of goals mutually understood by the participants in that event and occurring within a functional rather than a social or personal setting" (1981: 10). In a more recent work (Swales, 1990: 45—57), he delimits the notion of *genre* as follows:

- 1) A genre is a class of communicative events.
- 2) The principal criterial feature that turns a collection of communicative events into a genre is some shared set of communicative purpose.
- 3) Exemplars or instances of genre vary in their prototypicality.

- 4) The rationale behind a genre establishes constraints on allowable contributions in terms of their content, positioning, and form.
- 5) A discourse community's nomenclature for genre is an important source of insight.

This genre analysis approach has some important pedagogical value and can illuminate the process of communication in a given genre. In his 1981 and 1990 works, Swales himself has illustrated the pedagogical value of this approach. He claims that the features of particular texts in a given genre, once identified, can provide input for an ESP course. He says in this regard:

it is only within *genres* that viable correlations between *cognitive*, *rhetorical* and *linguistic* features can be established, for it is only within *genres* that language is sufficiently conventionalised and the range of communicative purpose sufficiently narrow for us to hope to establish pedagogically-employable generalisations that will capture certain relationships between function and form (1981: 10; original emphasis).

Other scholars have also noted the usefulness of this genre-analysis approach. Widdowson, for example, points out:

it provides a characterization of the communicative conventions associated with particular areas of language use and takes us beyond the itemization of notions and functions into larger schematic units upon which procedural work can effectively operate (1983: 102).

In addition to pointing out the value of genre analysis, Widdowson also reminds us of the danger of such an analysis. He says that "in revealing typical textualizations, it might lead us to suppose that form-function correlations are fixed and can be learned as formulae, and so to minimize the importance of the procedural aspect of language use and learning" (ibid.). Yet, pedagogically, genre analysis is highly valuable and revealing, and it is now, as Dudley-Evans (1986: 128) puts it, "beginning to provide a bridge between the concerns of Discourse and text analysis, and the need in ESP work for models of communicative activities that will inform materials production."

Furthermore, as a research procedure, Swales' genre-analysis approach has marked off a new field of research in ESP. It has over these years had considerable influence, sometimes more than Swales himself would wish. Numerous attempts have been made to replicate, extend and even validate Swales' 1981 model (see, eg., Cooper, 1985; Crookes, 1986; Swales & Najjar, 1987; Peng, 1987; Hopkins & Dudley-Evans, 1988). This proliferation of research into the discourse structure of the research article, especially the introduction and discussion sections, has brought out into the open some apparent defects in the 1981 model. Bley-Vroman & Selinker (1984) and Crookes (1986), for example, have commented on the difficulties of separating Move 1 and Move 2. Moreover, as Swales' 1981 corpus was over-

ly restrictive in the sense that only short introductions containing at least one reference to previous research were selected, it fails to take account of the possibility of a move cycle that Crookes has found in longer introductions, particularly from the social sciences.

These criticisms, and some others (see, eg., Cooper, 1985; Jacoby 1987), have motivated Swales to revise his 1981 model. He calls the new, revised model *Creating a Research Space* (CARS), as seen in Figure 3 below. The most conspicuous revision that he has made is the conflation of the first **Establishing the Field** move and the second **Summarizing Previous Research** move to form a single, **Establishing a Territory** mover, thus reducing the four moves to three in the new model. In addition, the range of options in Move 2 and Move 3 (of the new model) has also been extended.

Figure 3. A CARS model for Article Introductions

<b>Move 1</b>	<b>Establishing a Territory</b>
Step 1	Claiming Centrality, and/or
Step 2	Making Topic Generalization(s), and/or
Step 3	Reviewing Items of Previous Research
<b>Move 2</b>	<b>Establishing a Niche</b>
Step 1A	Counter-Claiming, or
Step 1B	Indicating a Gap, or
Step 1C	Question-Raising, or
Step 1D	Continuing a Tradition
<b>Move 3</b>	<b>Occupying the Niche</b>
Step 1A	Outlining Purposes, or
Step 1B	Announcing Present Research
Step 2	Announcing Principal Results
Step 3	Indicating RA Structure

It should be clear at this juncture that central to this approach is the notion of *move*. Unfortunately, however, what this term purports to be, Swales himself does not attempt to specify either in his 1981 work or elsewhere even though he implied in his pioneering research (1981) that his use of the term differs from the one adopted by Sinclair & Coulthard (1975). As a matter of fact, very few researchers working along this line of investigation have attempted to offer a definition of it.

An example of attempts at defining *move* is McKinlay (1984). She defines it as a semantic unit which is related to the writer's purpose. She further adds that as a unit of analysis a move can be a sentence, a group of sentences or even a paragraph. A similar view is adopted by Crookes (1986). In an attempt to avoid the embedding of one move inside another, which appeared in one instance in Swales' 1981 corpus, Crookes suggests considering the sentence as the basic unit of analysis. He says in this regard that for his analysis, 'the unit of coding was the sentence. The sentence was selected

as the basic unit of analysis, since it initially appeared that writers reflected the traditional conception of the sentence as constituting a complete unit of meaning (or 'thought')" (1986: 65). However, when an attempt was made to apply this basic unit of analysis to abstracts of journal articles, some difficulty soon emerged (Hardjanto, forthcoming). It was found, for example that in a number of cases a decision had to be forced in order to fit in with the system. (Crookes himself recognized such a difficulty, but he left it unresolved.) An example of such a decision is best illustrated in the following sentence taken from the data:

The asymptomatic subjects were compared with a group of HIV-negative subjects, and no significant differences in neuropsychological functioning were found. (Goethe, et al., 1989).

In this case, the first part of the sentence (the first clause) describes how the authors treated their subjects while the second part presents the result of the treatment (ie. the comparison). This sentence demonstrates very clearly two different purposes of the authors: the first is description of (part of) the procedure of the research and the second is presentation of (part of) the results of the research. Since a move is a semantic unit related to the writer's purpose, the example above should consequently be treated as displaying two different moves. In order to avoid fuzziness of unit boundaries and having to make a force decision in such cases, a decision was then made to take the clause, instead to the sentence, as the basic unit of analysis. Above all, this decision was made in line with the centrality of the clause in discourse as proposed by Winter (1977, 1986) and Hoey (1979, 1983) in their clause-relational approach to English texts. According to Winter (1986), for example, the clause is the significant semantic unit. It is "the central device of relevance; that is its lexical and grammatical choices are guided by their perceived relevance to the message" (1986: 89). He further points out that "the signals of grammar and of the grammatical status of the clause are crucial to the understanding and interpretation of the message" (1986: *ibid.*). It is therefore suggested here that the clause be used as the basic unit of analysis in any genre studies.

### 3. Conclusion

In conclusion, we have thus far seen the major development of approaches in ESP to the description of scientific English. One important development that we can observe is the increasing "thickness" (Swales, 1985c) of analysis, ie. the progression from the straight counting of surface features such as tense, voice and aspect to the deep study of the functions of such surface forms and the consideration of communicative purposes within communicative setting. In other words, there has been a move away from grammatical/structural analysis to rhetorical analysis of textual structure.

This progression, as it were, from strictly linguistic analysis to discursive and rhetorical analysis of texts, both spoken and written, is highly enlightening at least for language teaching practitioners, primarily because explicit teaching of the rhetorical organization of texts can facilitate comprehension; it can help students to better comprehend and recall important information from the texts they read or hear (cf. Carrell, 1985). Support for this claim, for example, is provided by recent research in schema-theoretical approaches to reading (see, eg., Kintsch & van Dijk, 1975, 1978; Carrell, 1983, 1984, 1987). Carrell (1983: 82) in particular suggests that schemata, or background knowledge of both the rhetorical structure and the content of discourse, can "guide the comprehension not only of events and scenes and activities ... but also guide the interpretation of the linguistic representations of these events, scenes, and activities--i.e. of oral and written texts." In other words, knowledge of the rhetorical organization of a piece of discourse is crucial for effective recall and comprehension.

Finally, the range of approaches to the description of scientific English offers language teaching practitioners and researchers valuable information necessary for making informed decisions as regards materials and course design. For example, results obtained from register analysis may complement and enhance results obtained from genre analysis. As a matter of fact, these two approaches may be used in conjunction with each other to offer more valid results and generalizations which can thus provide better input for course and materials design.

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