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Scientific English: Developments and Problems

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❐ ABSTRACT ❐

In this paper, we will review various approaches that have been used in the analysis of scientific writing. The approaches will be discussed from a historical perspective to show the line of development in scientific language and to show how linguists from various periods in this century have handled Scientific language. The discussion will show that linguists started looking at limited characteristics of scientific writing by investigating certain features such as vocabulary and clause-types then stretched it to discourse analysis. Major difficulties that appear to be problematic in scientific discourse will also be discussed.

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الإنكليزية العلمية: تطورات ومشكلات

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❐ ملخص ❐

يقوم هذا البحث بعرض المقاربات المختلفة التي وُظفت في تحليل الكتابة العلمية. وهو يتناول هذه المقاربات من منظور تاريخي يكشف الخط التطوري في اللغة العلمية وكيفية تناول اللسانيين لها في مراحل متفاوتة من هذا القرن. وتكشف المناقشة كيف بدأ اللسانيون بالنظر إلى صفات محددة من اللغة العلمية، بتقصيهم بعض الملامح، كالمفردات، وأشباه الجمل، ومن ثم تحليل الخطاب.

فأما الصعوبات الرئيسية التي تنطوي على إشكاليات في الخطاب العلمي، فسوف تكون بدورها موضع مناقشة.

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1. Discussion.

EST has appeared as a recent trend over the past decade in the linguistic analysis of academic writing. Smith (1982: 84) suggests that much of this analysis has been done "in the course of preparing pedagogical materials for the teaching of English for science and technology (EST) to non-native learners." Porter (1980) mentions that there have been some linguists involved in the study of the language of EST since the late 1930s. For instance, he mentions that Bloomfield wrote a section in the *International Encyclopedia of Unified Science* called "Linguistic Aspects of Science" (1938: 261) which gives explicit examples of scientific English. For example, Bloomfield argues that scientific English processes usually produce the following in the language of science:

1- expressions of exclusion, such as "not," the sentence structure "if"---, "then"---

2- words of existence or prediction such as "there exists" and "is."

3- equational sentences--means; --equals...Porter (1980) argues that for Bloomfield these informal classifications are the nearest that he comes to making actual syntactic description. Porter further elaborates that Bloomfield makes a claim about sentence connection in scientific discourse, but that claim is left as an assertion that lacks clear support and illustration.

Others have made some contribution to the language of science, but they mainly focused on vocabulary as recurring items and not as cohesive elements. For example, Savory (1953) has written *The Language of Science*. His motives were that he found it "... strange that no one seems to have undertaken a board study of the language of science" (1953: 67). His book is mainly concerned with vocabulary and is full of subjective vagueness. For instance, he suggests that "invention of new words should aim at three qualities: brevity, euphony, and purity." He also mentions that it "almost seems as if scientists preferred ugly words" (1953: 67).

One of the most serious attempts to define the characteristics of scientific English is a pioneering article by Barber (1962), in which he provides teachers of English as a foreign or second language with quantitative information on the language used in science. Barber's analysis is concerned with features of his selected texts such as syntax, sentence length, and vocabulary, all of which will now be briefly discussed.

Barber presents detailed analysis of sentence structures as characteristic of scientific writing, using a particular text. He mentions that out of 350 sentences in the

text, 345 are statements, two are commands, and three are statements with commands in parenthesis. there are no questions or requests. Barber found that the average sentence length is 27.6 words.

Barber found that verb forms occurred 2,903 times--61% were finite and 39% were non-finite--in the corpus. he also found that 84% of the finite group verb forms fall into the traditional tenses, while 16% use modal auxiliaries. Out of the 84% of the traditional tenses, 28% are passive verbs. Barber concludes that this is a relatively frequent use of passive verbs in scientific writing.

In reference to the frequency of vocabulary, Barber excerpted from his texts all words which do not occur in the General Service List of English words. He found approximately 23,400 running words in the texts. The number of words he excerpted is 1,089, so the total vocabulary of the texts is 1,089 plus an unknown but large number of the 2,000-odd words of the General Service List. He concludes that what English teachers can do is teach vocabulary which is generally useful to students of science--words that occur often in scientific literature.

The first two features, clause-types and sentence lengths, are considered in only one of his texts which makes them valid only for that text, so that it becomes difficult to draw even tentative conclusions about sentence-length and syntax-type features found or common in scientific discourse.

By the end of the 1960s, scientific discourse was being studied with reference to transformational grammar. One of the most thorough studies mentioned in Huddleston (1971) is *Sentence and Clause in Scientific English* by Huddlestion, Hudson, Winter and Henrici. These linguists compared twenty-seven texts for lexical and syntactic differences. Their texts were selected from three scientific fields, biology, chemistry, and physics, aimed at three levels: highly specialized, introductory level specialization, and a level of generalized understanding. In other words, nine texts come from specialist journals, nine from undergraduate textbooks, and nine from popular works addressed to well-informed laymen. The three levels are shown in sequence in the following examples presented in Huddlestion (1971):

1. All current-time transients were measured ocillogrphica (1971: 110).
2. There has been much criticism of this law and there are exceptions to it, but it still holds good as an approximation (1971: 132).

3. It is a tribute to human nature how often relatives and friends of a dying uraemic patient will offer one of their own healthy kidneys even if there is only an infinitesimal chance of the transplant's success (1971: 91).

On the whole, their study, a statistical appraisal of carefully defined syntactic features in selected texts which focuses on the clause and its constituents, aimed at giving an account of certain areas of grammar in written scientific discourse. Huddlestion (1971) found that features such as the passive voice and relative clauses tend to be characteristic of scientific writing. For instance, he found that of all clauses, the percentage of passive clauses was 26.3% in the corpus; the percentage of the definite relative clauses was 41% while the percentage of the indefinite relative clauses was 59%.

Since the early 1970s, a new orientation has begun to emerge in the study of EST. This time, scientific English has started to be considered and studied as discourse, as longer stretches rather than in one sentence. Terms such as "language in use," "communication functions," and "rhetorical acts" have become commonly used, although the term or notion might not necessarily imply the same thing to different writers.

The sentence-based text analysis discussed above has been challenged by Widdowson (1974, 1979), who has criticized such register-based approaches for ignoring the main rhetorical functions that cut across content differences. Widdowson has reservations about the typical attitudes toward the teaching of specialized English, viewing it as an activity that "involves simply the selection and presentation of the lexical and syntactic features which occur most commonly in passages of English dealing with the specialist topics that ... students are concerned with" (Widdowson 1974: 28).

Widdowson attempts to substantiate his criticism by offering the example of the response of a typical reader of a technical text asked to describe what s/he reads. He explains that the reader will respond that the given text is a description, a set of instructions, or an account of an experiment. Widdowson (1974: 29) points out that "these terms do not refer to the *linguistic properties* of the sample as discourse." A few years later, this view was elaborated by Widdowson and Allen (1978) by suggesting that the teaching of specialized English, including EST, should move from the concern with syntactic forms to at least equal concern with rhetorical functions.

This is a crucial point: EST is perceived in terms of discourse structure and rhetorical function. Of course, that would not imply that research attention to grammatical structure is irrelevant. In fact, the presence, absence, or frequency of certain grammatical structures (such as "tense") could serve as a basis for the reader's perception of rhetorical function. But Widdowson serves an important purpose by emphasizing the need to study English as discourse.

Lackstrom et al. (1970, 1973) also suggest moving from a syntactic approach to the teaching of tense to one that considers the rhetorical functions of tense in the larger text. Lackstrom et al. (1970: 106) suggest the following:

> ... an undue emphasis on tense-time relationships may obscure what are often more crucial factors. It may well be, for example, that paragraph organization will replace time as a governing factor in the choice of tense in a particular paragraph.

Besides showing that tense choice might be determined by the rhetorical functions of the sections of a report in which it takes place, Lackstrom et al. indicate how it might be used evaluatively. They believe that the tense used to provide supporting information in a report is frequently chosen not on the basis of when the supporting events occurred, but on the basis of how common or widespread the author believes the supporting evidence to be. They argue that "if he knows of a larger number of cases, he will use the present tense. If he knows of fewer cases, he will use the present perfect. If he knows of only one case, the past tense will be used" (1970: 109-110).

2- Difficulties in Scientific Discourse

Linguists such as Trimble (1985), Swales (1985), Barnes and Barnes (1981) have focused on issues in scientific English involving science and the language specialist, materials and EST courses, and intelligibility and the linguistic analysis of scientific discourse. For the purposes of this study, we will focus on intelligibility and the analysis of scientific discourse. These issues will be discussed with a major focus on intelligibility and readability.

Intelligibility and readability have been discussed well by Barnes and Barnes (1981), who argue that linguistic features of scientific discourse show a joint problem of both intelligibility and conceptual difficulty when they include technical vocabulary and a correspondingly large number of scientific concepts. It has been mentioned that language showing some of the surface structure of scientific discourse does not necessarily represent authentic scientific writing. There is a weak possibility that this would bring a problem to specialized people in the field as they will take great care in investigating material that is produced and used by practicing scientists. It appears that when authentic material is used, different linguistic features can be identified. For instance Svartvik (1966) has written *On Voice in the English Verb*, which discusses discourse on the sentence level. He found that the frequency of the passive clauses per thousand words in his corpus ranges from 32 in one scientific text to 3 in the sample from television. This is exemplified in the following examples from Cheong (1978: 43):

> A particle is projected from a point A at right angles to SA, and is added on by a force varying inversely as the square of the distance towards S.
>
> Vectors in general are not localized; thus we may have a displacement of an assigned length in an assigned direction and sense but its locality is not specified.

He argues that the first sentence is passive while the second is stative because "are localizing" cannot be substituted for the verb. All of this discussion of such aspects shows the focus on features that represent the surface structure of scientific discourse.

To avoid the analysis of such sentence-based discourse, we should go further and try to analyze the communicative functions of scientific writing in terms of such definitions as defining, evaluating hypothesizing, and so on. Within this context, Barnes and Barnes (1981) argue that linguistic markers provide some indication of the communicative process in a scientific text in the above terms. For instance, "suggest that" indicates a tentative hypothesis from given data. These markers in themselves will not supply communicative comprehension unless the given data (material) is elementary and therefore fully comprehensible by its non-specialist reader. This comprehension might be explained by the assumption that technical/scientific terms in conjunction with other words in an utterance or a sentence will often contain

communicative overtones in addition to their defining purpose in the scientific conceptual sense.

It has further been suggested that in some cases the communicative features provided by these semantic relationships won't have any overt linguistic markers. To clarify this point, consider the example below, presented and explained in Barnes and Barnes (1981: 23).

However, this feature has no evolutionary significance. In reference to what has been discussed above, this clause could be interpreted communicatively in various ways such as explanation, differentiation, and conclusion:

1- Explanation:

Background: aspects of evolution are being considered. A feature which has been considered is expected to have evolutionary significance.

communicative category: we think that surprisingly it has not. This anomaly will prepare you to anticipate a scientific explanation to follow.

2- differentiation:

background: here the main concern is to discriminate between animals which have features of evolutionary significance from those which lack it.

communicative category: I am clear now in differentiating it as one that is not of evolutionary significance.

3- concluding:

background: this feature is not evolutionary.

communicative category: contrary to previous remarks, I conclude that this feature has no evolutionary significance.

It could be argued that such communicative relationships cannot be distinguished without an understanding of a certain given text. The more technical words and expressions used in the texts the more unintelligible they become and the greater the range of the above possibilities. Also, any feature of a sentence which contains a number of scientific statements may subsequently be selected for further

evaluation, explanation, generalization, and so on, relying on the stated academic purposes.

It might be relevant to cite another instance presented by Barnes and Barnes (1981) to explain the issue of communicative comprehension of scientific discourse. Suppose we have in a previous sentence in a text the phrase "low oxygen levels," among other things. This may be followed by a statement such as "anaerobic conditions control zonal relationships." Barnes and Barnes (1981) argue that at the surface level, it is easy to recognize that the term "anaerobic conditions" refers anaphorically to "low oxygen levels" rather than to any other thing. However, this statement could have some other communicative possibilities relying on the context. For example, it could be an explanation of matters raised previously in the given discourse, or a generalization about the previous information.

The significance of such a discussion lies in the fact that scientific situations are usually complicated by the degree of scientific conceptual understanding which the author assumes when introducing her/his data to her/his audience (readers). S/he may suppose an understanding of certain concepts introduced earlier in the given text. As an alternative, s/he might choose to digress into explaining necessary terms and concepts in the current analysis or discussion. The degree of shared scientific knowledge and how the author or writer arranges her/his information will affect the communicative events which take place in a certain situation.

The understanding of a given text is important both in recognizing its communicative events and in arriving at linguistic judgements about its discourse structure. Here, our main concern is with the way discourse is presented rather than with its content. We mentioned earlier that scientific discourse has been analyzed linguistically for its available syntactic structures. We have found analysis of this kind in Cheong (1978), Huddleston (1971), and Svartvik (1966). This may provide the researcher with some stylistic knowledge. However, the student or researcher does not easily know whether what s/he investigated is regarded as a good scientific style by a practicing scientist. By the use of a larger sample, we simply get a range of a given linguistic feature, or a range of usage aspects in relation to one another. Such analysis will not supply us with clues of what good scientific discourse should show in a certain situation. Comprehension of the complexity of the communicative events occurring is also needed. This needs to be linked with a knowledge of how communicative events

could be best figured out within the limits imposed by the scientific method on presentation in a certain situation.

3- Conclusion:

In our discussion, we have shown the development in the way that scientific language (English) has been handled by some linguists in the second half of this century.

It has been mentioned that the main concern of early contributions to the analysis of scientific discourse was a focus on frequency of vocabulary rather than on the text itself. Savory (1953) has written *Language of Science* in which he focused on vocabulary and dealt with issues such as "compound words," "importation of words," and "prefixes."

The "grammatical structure with vocabulary" approach was dominant in the early 1960s. This approach was examplified by a pioneering article by Barber (1962). Barber's study has been praised by Swales (1985) because it gives useful information and ammunition for EST teachers who are struggling to establish the selective nature of EST.

In the late 1960s, scientific discourse began to be a subject of analysis with reference to transformational grammar. The linguists' studies were based on frequency of syntactic forms in texts. The pioneers of this appriach are Svartvik, Huddleston, and Cheong.

It has also been discussed that a new orientation began to emerge in the 1970s. This time, texts have started to be considered in longer strectches that the sentence, and notions such as "communicative functions" and "rhetorical acts" have appeared in the field. Widdowson referred to it as "textualization," by which he means an approach that indicates how functions are realized in texts. A main feature of this approach is that it is qualitative and tells us how forms count for communication and how they express elements of discourse. This approach has been a main concern for some others such as Lackstrom et al. (1973) and Barnes and Barnes (1981). For instance, Lackstrom et al. Emphasized that "syntactic and semantic choices" were determined by "rhetorical considerations" such as making a generalization or describing features.

In the late 1970s, this orientation moved into a broader approach. This time, scientific texts have come to be analyzed at the discourse level. Pioneers of this

approach are Halliday and Hasan (1976), Smith (1982, 1983), Brown and Yule (1983), Beaman (1984), Tannen (1984), Stubbs (1983) and others.

I would like to conclude this study by saying that developments in linguistics are moving towards a broader approach of discourse analysis that focuses on rhetorical functions rather than merely on some grammatical elements.

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