

An Analysis of Stylistic Features of English for Science and Technology Based on Functional Linguistics

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Abstract:

The paper starts from the definition of English for science and technology, and then elaborates the lexical features, syntactic features, and discourse features of English for science and technology based on the stylistic analysis theory of functional linguistics. It finds that in lexicon, English for science and technology has its unique features in etymology, word precision, objectivity and formality. There are three main word sources in English for science and technology. The first one is to borrow the original English words, but with different meanings. The second source is words absorbed from Latin and Greek. The third source is newly-formed words. In syntax, English for science and technology has wide application of passive voice to explain abstract concepts, objective theories, natural phenomena or experimental processes without too much subjectivity. Long and complete sentences are used in English for science and technology to express complex concepts with sufficient details and elaboration. In discourse, English for science and technology shows the characteristics of rigorous organization, strong logic and clear hierarchy. The discourse information flow pattern is that it often starts from generalization, then flows to specification, and ends with a summary. Present tense is used frequently for the discussion of principles, phenomena, objective facts or universal truths that are not limited by time. Modal verbs are also widely used to enhance objectivity and credibility. In English for science and technology, different cohesive devices are also applied to clarify the logical relation of discourse and to enhance the smooth flow of information.

Keywords: *functional linguistics, English for science and technology, stylistic feature.*

I. INTRODUCTION

English for Science and Technology (EST), a branch of English for Special purposes (ESP), was established in the 1970s. Different from general English, EST is an English stylistic form evolved with the development of science and technology. Works on natural and social sciences, academic papers, instructions of experimental steps and experimental reports, patents and product specifications, explanations and descriptions of natural phenomena, and the history of scientific and technological development are all written in this style. Because of the global development of science and technology and the gradual deepening of global economic integration, scientific and technological exchanges between

countries are becoming more and more frequent. New research achievements in the fields of natural science and social science need to be shared, disseminated and exchanged globally. In the current international scientific and technological achievements exchange activities, English is still the most important language. Therefore, the international scientific development and the dissemination of foreign scientific and technological achievements of various countries have promoted the formation of scientific and technological writing style. EST style has its unique language features in lexicon, syntax and text, and has obvious characteristics of practical English. In the late 1950s and early 1960s, a British linguist Halliday constructed the functional linguistics theory, which emphasizes that the characteristics and laws of language should be understood from the actual use of language or the functions that language should complete. Therefore, functional linguistics is also known as applicable linguistics. In addition to the theoretical linguistic features of systematically describing and explaining language phenomena, functional linguistics can also be used to investigate, reveal and explain the common problems and potential rules of language. Functional linguistics can also be used to study language phenomena and solve language related problems. Therefore, the theory of functional linguistics and language analysis methods can be well used to study the discourse characteristics of different writing styles, that is, its practical characteristics in language application, so as to improve the language application ability of language users of different styles and improve their communication effects. This paper will use the stylistic discourse analysis theory of functional linguistics to analyze the stylistic characteristics of scientific and technological papers, with the purpose to improve the communication effects of international communicators of scientific and technological achievements.

II. THEORETICAL BASIS

Systemic functional linguistics was established by British linguist M. A. K. Halliday from the late 1950s to the early 1960s. Halliday's theory and practice of functional linguistics is based on the theory of British linguist J. R. Firth. Functional language school holds that the choice of language form is restricted by its communicative function. Language has three meta-functions: ideational function, interpersonal function and discourse function [1]. Ideational function refers to the function that language can be used to express people's various experiences in the real world; interpersonal function refers to the function that speakers use language to participate in social activities; discourse function refers to the function that language itself should be coherent and connected with the specific register. Therefore, in any communication activity, the speaker always reflects the surrounding objective world and his own inner world (ideational function) while communicating with others (interpersonal function) through coherent discourse (discourse function) [2]. These three functions must be embodied through specific semantic systems, namely transitivity system, mood system and modality system, theme system, information system and cohesion system [3]. Functional language school regards language as a huge and complex symbol system, which is a systematic source of meaning. In the process of using language the system is not chosen by people arbitrarily, but restricted by the conceptual meaning of the speaker, the language system itself and the context. At present, the consensus on functional linguistics is as follows: firstly, the meaning and function of language are very important to language users. Without the specific environment of language use, it is difficult to determine the meaning of language. Secondly, the functional language school attaches

importance to the analysis of discourse, which is a meaningful and coherent text for the functional language school. The study of discourse should be carried out from both micro and macro aspects [4]. Micro research includes transitivity, voice, mood, modality, theme-rheme, cohesive devices and so on; macro research refers to the study of genre structure. In addition, functional linguistics takes social factors into account in stylistic analysis and introduces the concept of register, field of discourse and mode of discourse. Functional linguistics holds that style is the result of selection in the language system driven by a certain situational context. The most direct manifestation of this choice is vocabulary, sentence pattern and text information flow mode. Therefore, the stylistic characteristics of scientific and technological discourse can be analyzed from three aspects: lexicon, syntax and discourse.

III. STYLISTIC FEATURES OF EST

The most basic communicative function of language is to convey information. In linguistics, information refers to the message conveyed by language. Scientific and technological style generally describes the process, characteristics and laws of the development of things scientifically, and states the new discoveries and laws of scientific development. Therefore, as a part of English language and a language style, scientific and technological English has its special stylistic characteristics. Some key characteristics of scientific and technological English are its clear expression, solemn writing, rigorous structure, accurate language, objectivity and less emotional color. The analysis of the stylistic features of EST can be carried out from the perspectives of lexicon, syntax and the overall characteristics of the discourse.

3.1 Lexical Features

Scientific and technological articles require precision in terms of diction, and try to avoid ambiguity or polysemy. Scientific and technological articles have unique characteristics in etymology, precise choice of words, degree of word formality and selection of parts of speech.

3.1.1 Lexical Features in Etymology

There are usually three kinds of lexical sources of EST. One is to borrow the original words in English, but these words have their specific meanings different from general English in the articles of science and technology. Here some specific examples can illustrate this source of EST words. In general English, “work” means the occupation for which one is paid; but in physics, it is used to refer to the manifestation of energy or the transfer of energy from one physical system to another expressed as the product of a force and the distance through which it moves a body in the direction of that force, such as “Work equals force times distance” in EST papers. Another example is the word “force”, which means power, whereas in physics, it refers to the influence that produces a change in a physical quantity. Such sentences as “Force equals mass times acceleration” can be found in EST articles.

The second source of EST vocabulary is words absorbed from Latin and Greek. According to American EST expert Oscar E. Nybaken's statistics, about 46% of the 10000 most common English words are directly derived from Latin, and 7.2% from Greek. This ratio will be higher in scientific and technological words. 2/3 of medical English vocabulary comes from Latin and Greek. The more specialized the technical vocabulary is, the higher the ratio is [5]. More examples of such words in EST are: anachronism, atmosphere, autograph, capsule, dexterity, emanation, parenthesis, pneumonia, etc. EST not only directly absorbs technical vocabulary of Greek and Latin, it also uses Greek and Latin morphemes (prefixes or suffixes) to form new words. The statistical analysis on English vocabulary of modern science and technology discovers that vocabulary composed of the prefix auto- and the sub-technical vocabulary composed of Greek and Latin morphemes account for a very high proportion. In addition to words directly derived from Greek and Latin, many words are composed of the prefix hydro-; still many words are composed of the prefix micro-; and plenty words are composed of the prefix tele- [6]. Words of these sources usually have a narrow scope of meaning and are not easy to produce ambiguity or confusion, so they are more commonly used in EST articles and papers.

The third source of EST vocabulary is the newly-formed words. With the rapid development of science and technology, new materials, new technologies and new processes continue to appear, and countless new words of EST have emerged, such as the word "hormone", which was formed when medical researchers discovered the substance produced by one tissue and conveyed by the bloodstream to another to effect physiological activity, such as growth or metabolism. Another example is the EST word "allergy", which was formed in 1906 when the Austrian pediatrician Pirquet found that many patients had serious pathological reactions when they were injected with smallpox vaccine made of horse serum for the second time. Pirquet first called this phenomenon allergy, which is composed of allos (another) and ergon (activity, activity) in Greek with the original meaning of "another reaction". There will be increasingly more such in EST papers.

3.1.2 Lexical Features in Word Precision and Objectivity

English for science and technology undertakes the important task of transmitting scientific and technological information to people, so it pays more attention to the accuracy of words and the unicity of word meaning in word selection. EST mostly uses words with precise and single meaning. Words with Latin and Greek morphemes occupy an important proportion in scientific and technological vocabulary. The fundamental reason is that these two languages are relatively ancient languages, which will not cause changes in word form and meaning due to people's frequent use or cultural development, and are not easy to cause ambiguity. In addition, Latin and Greek have rich affixes, which are combined with different stems to derive countless new words with specific meaning. These words have a narrower scope of use than ordinary words derived from Anglo-Saxon English, and are more easily to meet the requirement of accuracy in diction in scientific and technological English. Scientific and technological articles reflect objective matters and existence. Therefore subjectivity is always avoided and words and statements in EST articles are usually objective and accurate recording of scientific and technological topics, research and discoveries. Next is an example.

On the initial stage of its journey the rocket rises vertically from the pad; then its direction gradually changes in accordance with a pre-set programme. After a flight that lasts from eight to fifteen minutes the rocket attains a velocity of about eight kilometers a second; by this time its flight position is practically horizontal and thus parallel to the earth's surface.

This example objectively explains the journey of rocket flight with some precise and objective words, such as: vertically, programme, attain, velocity, horizontal, etc. these technical and objective terms make the writing style scientific and serious.

3.1.3 Lexical Features in Word Formality Degree

Another remarkable feature of EST in terms of words is the use of formal words and the extensive use of nouns or noun phrases. Therefore, nominalization is also a significant feature of EST. Nominalization words are generally derived from verbs, mainly referring to abstract nouns indicating action or state, as well as nouns with action meaning and nouns composed of adjectives and suffixes [7]. Verbs and adjectives which are used in general style are often replaced by abstract nouns in English for science and technology. Nominalized nouns have a high degree of abstraction. They are an indispensable language means to express the logical thinking or abstract thinking of science and technology, so they have become an important feature of EST. In addition, the degree of formality of EST vocabulary is also reflected in the choice of single verbs with a higher degree of formality to replace the synonymous verb phrases. This is because verb phrases are mostly used in daily English or literary works, which are more colloquial and slangy and easy to produce ambiguity. However, the word meaning range of a single verb with a high degree of formality is narrow and relatively more stable. Therefore they are more commonly used in EST papers.

3.2 Syntactic Features

Scientific and technological English style also has syntactic characteristics different from general English style. Functional linguistics holds that a sentence can be divided into theme and rheme. Theme is the information starting point in the sentence. What it expresses is known information or at least clear information in the given context, from which the speaker begins to talk; the rest of the sentence is rheme, which expresses new information that is related to the theme stated by the speaker. The theory of sentence structure analysis from the perspective of the function of information transmission can better guide the analysis of the syntactic features of scientific and technological language style.

3.2.1 The Use of Passive Voice

One of the remarkable syntactic features of EST is the wide application of passive voice, which is closely related to the stylistic features of scientific texts. The subjects of EST papers are mostly objective things, phenomena or processes without any subjective color. Therefore, passive voice has become an important language means to pursue the objectivity and standardization of narration. This also means that

EST often starts from the known information-theme, and the information in the sentence flows gradually to the rheme-the new information. The passive voice used in EST usually omits the doer. Even if the passive sentence of EST has the doer, it, different from the doer's behavior expressed in general English, often expresses ways, methods, means or reasons of the action. The following description about phosphorus combustion can well illustrate this feature.

A small piece of phosphorus is carefully dried and placed on a crucible lid inside a bell-jar. It is then ignited with a warm glass rod and a stopper is inserted. The phosphorus burns producing dense white fumes of phosphorous pentoxide which react with the water. The water level is first depressed as the air becomes warm but eventually it rises as the oxygen is used up. In order to restore the pressure of the remaining gas to normal water is now poured into the trough until the water levels are made equal. Approximately one-fifth of the bell-jar is now occupied with water showing that one-fifth of the air is consumed when phosphorous burns.

In the above description, there are ten passive structures in only six sentences. Of the fifteen predicate verbs, two-thirds are passive structures without the clearly stated doer. Therefore the description objectively shows the phenomenon in the process of phosphorus combustion, without any personal subjective judgment, only focuses on the objective phenomenon of the thing itself, and ignores the unimportant action doer.

According to the statistics of foreign linguists, in physics, chemistry and engineering textbooks, at least one third of all finite verbs use the passive voice. Some people have also made statistical analysis and found that scientific and technological style uses five to six times of passive voice more than in literary style [8]. Therefore, the objective narration expressed by passive voice has become a major syntactic feature of EST.

3.2.2 The Use of Long, Complete Sentences

Long and complete sentences are used much more in EST to express some complex concepts than in ordinary English. English for science and technology is often used to express complex scientific ideas such as scientific theories, principles, laws, concepts and the complex relationship between things, while cannot be expressed in simple short sentences. Consequently long sentences with complex grammatical structure are more often used in English for science and technology. Long sentences are usually divided into two categories. One is long sentences containing many parallel components as modifiers, prepositional phrases, adjective phrases and non-finite verb phrases. The other category of long sentence is complex sentences or parallel complex sentences containing clauses. At the same time, long sentences also have complex structures such as juxtaposition, inversion or ellipsis, but the scientific and technological content expressed by long sentences is strict, accurate and logical. Therefore, long sentences with complex structure, strict logic, clear hierarchy and prominent focus have become another important feature of scientific and Technological English style. The following instructions on the use of fire extinguishers can well illustrate this feature.

A hand fire extinguisher is a device which is used to extinguish a fire before it becomes too big to be controlled. There are two main types: those which are used to fight a Type A fire, and those which are used to fight a Type B fire. Type A fires are those which involve solid substances such as wood, paper and cloth. Type B fires are those which involve liquids such as petrol and oil.

In this illustration, all the sentences are complete sentences with an average of 19 words in each sentence. All the four sentences are complex sentences with an attribute clause which defines or provides more details concerning the topic discussed in the sentence. Long and structurally complete sentences can clearly explain certain scientific or technological terms or concepts.

3.3 Discourse Features

The functional linguistics attaches importance to the analysis of discourse. For the functional language school, discourse is a meaningful and coherent text. The analysis of discourse features can be carried out from the aspects of overall structure, information flow mode, tense, mood and modality, cohesion and coherence.

3.3.1 The Overall Structure

The basic functions of EST discourse can be roughly divided into three types: definition, classification and explanation. In the discourse structure, it shows the characteristics of rigorous organization, strong logic and clear hierarchy. Discourse refers to the language unit actually used. It is composed of a series of continuous paragraphs or sentences in communication process. Macro structure is a high-level semantic structure of a text, which is demonstrated as a tree structure of theme, sub- theme and sub-sub-theme in a specific text. The tree structure of the text can help readers analyze the macro structure of the text by using their already-known language knowledge and skills of text genre analysis, so as to better understand the new information in the text.

When defining, scientific and technological articles usually reveal the essential attributes of the object reflected by the concept and tries to differentiate things. In scientific English articles, the definition is often presented at the beginning of the article or paragraph, that is, in the position of the sentence theme in terms of thematic structure, and the definition usually points out the name, category and main characteristics of things in accurate and concise terms. There are usually fixed sentence patterns and expressions to give definition in EST. At the same time, some formulas and symbols are often used in definition. In addition, according to the essential attributes or distinctive features, objects can be divided into different categories in scientific definition.

The most commonly used expressing means in scientific and technological articles is explanation, which can be either a physical explanation with a set of fixed sentence patterns and complex sentence structure, such as a static description of the physical properties of the whole object or its components, or a functional explanation of the purpose and utility of objects. In addition, it can also be a dynamic

description of the changes of various phenomena and the efficiency, function, mutual connection and cooperation of various actions, as well as the development process of the occurrence, evolution, formation and extinction of things, as well as the production process, technological process, experimental process, etc. Regardless of the way of explanation, the main feature of EST text is to organize detailed information in a clear and logical discourse structure.

3.3.2 The Information Flow Mode

Halliday believes that sentences are the basic writing units of discourse, whereas clauses are the grammatical unit. Through several limited logical and semantic relations, clauses are connected into a whole grammatical unit which is higher than clauses and is called clause complex. According to the characteristics of continuous transmission of discourse information, functional linguistics divides sentences into two parts: theme and rheme. Theme is the starting point of discourse, and rheme is the core content of discourse. In the process of language communication, theme is mostly the known information for both sides in the specific communication activity, while rheme is the new information which is to be transmitted in the discourse, the unknown information to the receiver, and the information that both sides intend to transmit. The thematic progression constitutes the information flow mode of specific discourse. An accurate grasp of the discourse information flow pattern can help to have a faster and more accurate grasp of the core information of scientific and technological articles.

Scientific and technological style is actually a kind of expository text. Some researchers believe that the information flow in EST articles usually follows the pattern like: generalization – specification – summary. The more specific patterns of information flow can be of time, space or logic. Kinneary once proposed a model for EST expository text: current approach – demonstration of inadequacies – statement of problem – statement of hypothesis – testing of hypothesis – proof of hypothesis [9]. The frequent use of passive voice also forms a new mode of text information flow in scientific and technological style, that is, the main information in each sentence is placed at the beginning of the sentence, and the combination of the main information at the beginning of the sentence forms the information flow mode of the whole article. At the same time, the grasp of the main information at the beginning of the sentence can basically grasp the most important information in the article.

3.3.3 The Tense and Modality

English for science and technology often uses the present tense to discuss principles or phenomena and express objective facts or universal truths that are not limited by time. The next sentence from a science book can illustrate this point.

Basically, the theory proposed among other things, that the maximum speed possible in the universe is that of light; that mass appears to increase with speed.

Present tense is also applied in the explanation of experimental process. At the same time, the object clauses expressing laws, formulas, etc. in EST are not limited by the tense of the main sentence, and still use present tense. According to the statistics of some experts, in scientific and technological articles, the active form of the general present tense accounts for about 60%, the passive form of the general present tense accounts for 17%, and the combination of two forms account for more than 77% [10]. The application of the general present tense can give people an accurate “timeless notion”, and also eliminate any misunderstanding involved with time, so as to make the writing more vivid and the expression more rigorous and scientific.

Modal verbs are also widely used in scientific and technological style. According to statistics, among the 1322 sentences in the book of *Understanding Science*, modal verbs such as can, could, should, would, may, might, must and have to appear 350 times, of which the modal verb “can” appears the most, 156 times in total. This proves that the use of a large number of modal verbs is also a prominent feature of scientific and technological style. The most common modal verbs in EST are “can” and “may”, and their main function is to express the author’s comment on the ability of something and the judgment of the possibility of something happening or existing. The use of could, should, had to is also to express the author’s viewpoint on something entirely based on facts, which enhances the objectivity and credibility of the article.

3.3.4 Discourse Cohesion and Coherence

Cohesion, a semantic concept, refers to the semantic connection between language components in a text. Cohesion occurs when the meaning of one component in a text depends on the interpretation of another component. Halliday divides cohesion into grammatical cohesion and lexical cohesion. There are four types of grammatical cohesion: reference, ellipsis, substitution and conjunction [11]. Reference refers to the phenomenon that one component is used as the reference point of another component in a text, including anaphora. Ellipsis refers to the omission of one or some components in a text. Substitution refers to the substitution of a component with substitute words, including noun substitution, verb substitution and clause substitution. Conjunction refers to the means of reflecting various logical relations in a text through connecting components. There are also four types of lexical cohesion: repetition, synonymy/antonymy, hyponymy and collocation.

The coherence of information transmission is very important in EST, because only semantic coherence can advance the flow of information [12]. If not, it is bound to make readers confused and will affect readers’ understanding of the article. Pronoun reference is frequently used in EST articles. In EST articles, personal pronoun is used much less than demonstrative pronouns for the purpose of objectivity, while demonstrative pronouns can help to achieve coherence. Nominal substitution is also a very common phenomenon in EST articles. For the purpose of logical clarity, EST papers also contain large number of conjunctions, such as and, or, also, in addition to, firstly, secondly, etc to clarify the logical relation of the discourse.

III. CONCLUSION

English for Science and Technology (EST) is a kind of English variant gradually formed to meet the development and communication demand in the field of science and technology. EST, evolved from general English, is a branch of general English. It follows the lexical, syntactic and textual rules of general English, so it has something in common with general English. However, due to its specific communication purposes and communication objects, EST is different from ordinary English in lexicon, syntax and discourse, forming its unique stylistic characteristics. Generally speaking, EST has the characteristics of accurate concept, appropriate judgment and careful reasoning. It uses more words and terms with single meaning, high degree of abstraction and nominalized structure. In the choice of sentence patterns, it is more inclined to long sentences and complex sentences with complete structure and more objective and standardized passive voice. In terms of discourse, it is characterized by extensive use of the general present tense to state objective phenomena and universal truth, clear information flow mode, and logical semantic coherence. In short, the analysis of scientific and technological stylistic language style under the guidance of functional linguistics is more helpful for readers to understand scientific and technological stylistics and for scientific and technological workers to transmit their own scientific and technological achievements.

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