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A Study on the Translation of English for Science and Technology from the Perspective of Cognitive Schema Theory

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Abstract: *With the rapid development of modern technology, more and more technical terms are created and extended. Therefore, the requirements and difficulties for translation of English for science and technology increase with each passing day. The translation of EST is a process of closely combining translation theory on the one hand and professional knowledge and practices on the other hand. As a result of the differences between the source language authors and the target language readers in the aspects of languages, cultures and ways of thinking, their cognitive schemata show certain differences. Cognitive schema theory is one of the important theories for translation of EST, but there are few studies on the translation of EST based on cognitive schema theory. Therefore, from the perspective of cognitive schema theory, the author analyzed the differences between the source language and the target language by some translation examples of EST, so as to analyze the application of translation of EST and put forward some strategies for the translation of EST.*

Keywords: *cognitive schema theory; translation of EST; application study*

1. Introduction

Scientific and technical literature is the basis for the public and professionals to acquire scientific knowledge as well as a carrier of knowledge dissemination and advanced science and technology. Without excellent translation of English for science and technology (EST), it is impossible to have good scientific and technical communication. Therefore, the importance of EST translation is obvious, and the question of how to improve the quality and speed of translation has become a common concern of translators and researchers today. So it is necessary to master some translation theories or principles. Cognitive schema theory is exactly one of the outstanding translation theories, which has a great influence on translation and plays a directive role in translation practice. In this paper, the author tends to explain the psychological process of the translator, and to offer a theoretical guidance for translators and translation of EST from the perspective of cognitive schema theory[1].

2. Overview of Cognitive Schema Theory

2.1. Cognitive Schema Theory

Schema theory is a theory to translate the psychological process by psychologists. The theory refers to the storage mode in people's brain of their knowledge and experiences. It is the accumulation of encyclopedia knowledge and life experience of human beings and the foundation of cognition. As a result of different language cultures, thinking ways and life experiences among different nations, there are certain differences at their cognitive schemata, which causes some difficulties in people's understanding and translation[2].

Study on schema theory was first seen in the philosophical theory by classical German philosopher Immanuel Kant (1781) in the 18th century. In his book *Critique of Pure Reason*, Kant put forward the concept of "schema", he believes schema is a means to connect perception and concept. He regards the schema as a stimulant, and uses the schema concept to characterize the innate structure which helps us perceive the world. Gestalt psychology in the 20th century actively promote the formation and development of schema theory, and firstly pays high attention to schema from a theoretical perspective. In the book *Remembering*, British psychologist Sir Frederic Bartlett (1932) also used the schema

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concept. He thinks that people's understanding and memorization for things are affected by their expectations, and these expectations are exactly characterized by schema. Psychologist Jean Piaget (1952) holds the view that schema is the structure or organization of action. In his opinion, cognition comes from the interaction between the subject and the object, it gets the object assimilated into the body schema by self-regulation, and accommodate the new object by adjusting and creating schema. Later on, Rumelhart (1980) developed and improved Bartlett's theory. In his opinion, schema theory is a theory mode which refers to the function when the system deeply discusses the long term memory in the process of understanding[3].

The long history process witnesses the development and improvement of schema theory, from schema to schema theory, all these achievements focus the overwhelming efforts of philosophers, psychologists and other scholars.

The studies on schema theory at home can be approximately divided into three phases. The first phase (1980-1990) is the introduction phase of theory, there are few published works in this phase, studies mainly focus on introducing and interpreting schema, and mainly refer to the philosophy field. Scholars like Wen Chunru (1997) introduced Kant's schema theory, made comments on his theory and pointed out the value and significance of his theory. Shi Xiangshi (1994) interpreted the schema concept, introduced Piaget's schema theory and pointed out the deficiency of his theory. The second phase (1991-2000) is the coexisting phase of theoretical introduction and application. People had realized the application matter of schema theory, except for continuously introducing theories, they began applying the theory to the fields like reading and translation. The research fields had expanded from philosophy to psychology, cognitive science and foreign language teaching. Tang Xuefeng (2004) put forward that mental representation based on conceptual schema is the best presentation form to solve problems[4]. Li Ping (1997) discussed the establishment and improvement of schema in readers' cognitive structure. The third phase (2001-now) is the application phase of theory. The published works about schema studies increased rapidly, the studies on schema theory gradually focused on theoretical application from theoretical introduction, especially focused on foreign language teaching, and the research methods became more rigorous. Lu Zhongyi (2003) and Wang Zhe (2003) stated that the training for the schema of English argumentation can improve students' reading ability by experimental approach. Ma Junbo (2005) discussed the feasibility of combing schema theory and ESP network courseware[5].

From a general view, the studies on schema theory at home have two trends. First, the applied range in foreign language teaching presents a continuously expanding tendency. Second, the research fields become reduced. There is almost no one shows any interest in philosophy, the earliest research field by people, and the studies on psychology become much less.

2.2. Cognitive Schema Theory and Translation

Cognitive Schema theory provides important messages for translation practice. So the translator in the interpretation should be equipped with not only the schema of the source language authors, including the authors' writing intention, words, sentence-making patterns, layout, cultural background knowledge, but also the schema of the target language readers, in other words, code of the target language and grammar rules[6].

Translation has two processes which include the understanding of the source language and the presentation of the target language. Understanding the source language is the prerequisite and foundation of translation, that can be said, it is the key of translation. Firstly, a translator must be a reader, so it will be more strict for the reader simultaneously serving as the translator when doing reading and the translator must understand the source language deeply and correctly. When reading the source language, the translator will transfer the information of the source language into the schemata. In the presentation of the target language, the translator should fully activate the schemata of the source language stored in brain, and code these schemata in an appropriate way using the target language, so as to make the readers understand the source language correctly through the target language. The information of the source language acquired by the target language readers comes from the understanding and expression of the translators. That is to say, whether the target language reader can acquire the effective information or not depends on whether the translator has abundant knowledge schemata. Therefore, the schemata of the source language and the target language are closely linked with each other in the process of translation[7].

In a word, conclusions can be drawn from CNKI: the studies on cognitive schema theory mainly

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focus on the application of foreign language teaching, and there are few studies on translation. Thus, it is necessary to make more studies on translation under cognitive schema theory so as to guide more translation practices.

3. The Significance of Cognitive Schema Theory on Translation of EST

3.1. The Understanding Stage of the Source Language

When people deal with text or other information, one or some existing cognitive schemata in their brain are activated in the stimulation of linguistic or contextual factors and used to predict and explain the event happened before, both of which are understanding process. We can say that the source language understanding relies on the existing cognitive schemata of the translator. However, cognitive schemata not always play a positive role in understanding, sometimes the role is negative. Moreover, there is interaction between cognitive schema and the source language, that is to say, the source language has side effects on the existing cognitive schema of the translator like reservation, strengthening, modification, reconstruction and new[8].

Cognitive schemata play an active role in the understanding process of the source language, when the existing cognitive schemata of the translator are consistent with the source language information, these cognitive schemata will promote the understanding of the source language, specifically in the aspects of eliminating ambiguity and filling default information.

Meanwhile, cognitive schemata also play a negative role in the process of understanding the source language. Because the cognitive schema of the translator is not always consistent with the source language information, when they both don't meet with each other, the cognitive schemata of the translator will have negative effects on understanding, even make the translator distort the text information in the purpose of adapting to their own cognitive schemata, which results in understanding deviation[9].

3.2. The Presentation Stage of the Target Language

Even if the translator has correctly interpreted the source language, in the expression, it will unavoidably appear disconnection between the source language and the target language. This is mainly because the source language author, the translator and the target language reader have their own different cognitive schemata and cognitive differences resulting from that cause the deviations coming from the target language presentation by the translator or the understanding of the target language reader. So in the presentation of the target language, the translator should consider the cognitive schemata of the target language reader, do some compensation jobs for possible cultural defaults which are disordered in the aspect of coherence, correct the cultural dislocations, or take appropriate translation strategies to avoid communication barriers caused by cognitive differences[10].

4. Schematic Differences in Translation of EST

Cognitive schemata involved in the translation process includes not only the translator’s cognitive schemata but also the reader’s. People coming from different nations or countries show differences in language cultures, ways of thinking and life experiences, therefore, their cognitive schemata also present some certain differences, which will bring some difficulties for cross-cultural communication. As informational texts, the texts of science and technology are equipped with these unique stylistic and linguistic characteristics like official tone, objective and accurate statement, strong logicality, strongly professional term. This part analyzes the differences of content schema, linguistic schema, formal schema in the source language and the target language so as to analyze the related matters of translation of EST[11].

4.1. Content Schema

Content Schemata differences refer to the schematic differences having different linguistic and cultural backgrounds. The common issue in translation of EST is that the translator has few schemata about background knowledge, professional knowledge, cultural knowledge, or even has no idea about these schemata at all. Content schema is also regarded as contextual schema, that is to say, the translator should employ corresponding words by different contexts in translation.

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Example 1: Bad welding will bring deformation and internal stress, and even cause the death of the parts[12].

The English source language of example 1 employ the word “death”, we all know that in Chinese “death” literally means “the permanent end of the life of a person or animal”, however, when the translator translates the whole sentence into Chinese and just keeps the literal meaning of “death”, the expression will end up with a much less vivid effect. Generally, we do not say such expressions like “the death of the part” from the Chinese pragmatic perspective, the more frequent we use is the expression “useless”. Once we realize the differences of this schema, the translator should employ the schema same with or similar to the source language in the target language, accurately select the exact word to code according to the context, and do not make the target language readers surprised after reading the target language.

Example 2**:** The third power of 2 is 8.

By power we mean the rate of doing work.

Zinc has a combining power of two.

From the three English sentences in Example 1 we can find that they have used the word “power”, we know, in Chinese “power” means “energy, strength and authority” and so on. The sentences of example 2 involve different areas like mathematics, physics, chemistry. Therefore, when the translator translates the word “power” in these three sentences, he should master the relevant background schema, and be good at inspiring existing schema. In order to improve the quality of translation and do not make stupid mistakes in the target language, the translator should broaden their knowledge through network, books, magazines and other resources to form the corresponding schemata in his brain, and take full advantage of the cognitive schemata of the target language.

4.2. Linguistic Schema

In the translation of science and technology, there are mainly three types of words: pure scientific vocabularies, scientific vocabularies and derivations. Pure scientific vocabularies refer to the professional words in some certain specialties, fields or disciplines, therefore, the significance of pure scientific vocabulary, generally, is clear and fixed, their semantic range is narrow, and the words also have the targeted characteristic, for example, cytoplasm. Scientific vocabularies refer to the vocabularies widely used in different kinds of disciplines. These words have high frequencies and relatively stable meanings. For instance, we always find the word “transmission” in many different fields, in the field of radio and engineering, it can be translated into “launch”; in the mechanical field, it can be translated into “sending or passing something or speed change”; in the field of physics, it can be translated into “the emission of incident light through an object after refraction”; in the medical field, it should be translated into “heredity”.

Scientific vocabularies can use literal translation to translate, but there are also a part of the vocabularies of science and technology which cannot find schemata completely matching with the source language in the schemata of the target language, so free translation is an effective translation method when meeting those cases. Skylab, for example, is a compound word, which is translated into “space station”. With the progress and communication of science and technology, the schema of space lab has widely formed in readers' brain, so the translation is considered to be desirable. These words such as T-track, Y-pipe respectively can be translated into “hammer-type trail” and “fork-shaped tube” by graphological translation. There are few cases to describe an object by letters in Chinese, and the target language readers have been equipped with the schemata of hammer and fork, so the use of graphological translation is able to resonate with the readers. Transliteration is also a common translation method of scientific vocabularies, for example, clone. The reason why we adopt transliteration is that cloning technology has been familiar to the vast majority of the target language readers, and they have had the schema of cloning in their brain. Note translation is one of the common translation methods, such as “compactor”, can be translated into “garbage mashers (processing equipment that compresses waste into relatively small pieces)”. Although the readers can probably understand the meaning of “compactor”, they cannot form the clear schema in their mind. The word “compactor” is derived by another word “compact”, and “compact” has the meaning of compression, which is beneficial for readers to form the accurate schema of “compactor”. Therefore, only to make notes for the target language can it better serve reader’s understanding. When translating the texts of science and technology, the translator should master the linguistic schemata as much as possible, including the differences of different linguistic schemata, enhancing the reading ability, and improving

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the quality of translation[13].

4.3. Formal Schema

It is relatively typical for formal schema differences or structural differences of language. By comparing the two languages, English and Chinese, we can find that the sentences of EST are generally longer and more complex in structure, and the components in a sentence connect together by prepositions, non-finite verbs and relatives. Therefore, English is also said to be “hypotaxis” language, and the various components in the sentences of this language are reflected from the aspect of morphology. Chinese is “parataxis” language, therefore, Chinese attaches great importance on semantic expression and emphasizes on parataxis. Chinese sentences expand linearly in bamboo-stype structure. The translator should pay more attention to the adjustment of sentence structure in translation of EST.

Example 3: It is due to the development of integrated circuits that there is the possibility to make electronic devices smaller and smaller.

The source language of example 3 is a long English sentence. The phrase “It is due to...that...” in this sentence is a common expression of English, which is in line with the typical characteristic of English, hypotaxis. When translating English to Chinese, the translator should take the expression characteristics of Chinese into consideration, analyze the semantic and logical relations of the sentence, and finally find the expression conforming to the sentence patterns of Chinese from the related schemata[14].

5. Strategies for Translation of EST Based on Cognitive Schema Theory

In this chapter, the author will make a discussion from the two aspects of schematic application in translation of EST on the one hand and strategies for translation of EST on the other hand.

5.1. Schematic Application in Translation of EST

This part will analyze schematic application in translation of EST from the perspective of linguistic schema, contextual and cultural schema in the source language and the target language.

5.1.1. Application of Linguistic Schema

Linguistic schema refers to the language knowledge in the aspects of vocabulary, syntax, idiom and grammar. Mastering certain language schemata is the foundation of doing good translation. The texts of science and technology mainly discuss the arguments of science and technology or describe the laws of nature, scientific principles, phenomena and so on, each discipline or specialty has a set of specific nouns and terms both of which are precise but narrow in meaning. If you don't know the linguistic schema in a certain field of science and technology, you will not understand the scientific literature in this field. Scientific vocabularies mostly consist of the roots, prefixes and suffixes deriving from Latin or Greek. The common prefixes and suffixes are more than 100, and have their own unique meanings, such as auto- ,counter-, hyper-, poly-, -able, -ship, -ize, -wise. The words made up of the prefix auto- are auto-detecting, auto-alarm, etc; the words made up of the suffix -ize are civilize, legalize, etc. According to the meaning of the prefixes and suffixes, it is easy for the translator to interpret the meaning of scientific vocabularies by using the relevant linguistic schemata. Therefore, in the learning process of the translation of EST, the translator should master the linguistic schemata as much as possible like prefixes, suffixes and their derived words to improve the speed and quality of translation.

5.1.2. Application of Contextual Schema

Contextual schema refers to the logical sequences of language components making influence on the meaning of words and various subjective and objective environmental factors, which indicate the using environments of language. Context is the only factor determining the meaning of words, so it is very important to translate the contextual schemata in translation of EST. Polysemy is one of the most obvious characteristics in scientific English vocabularies, and the meaning of the terms shall be determined by the contexts and logical relations in articles. Please see a group of examples containing “transmission” below, and judge the translation by different contextual schemata:

1) The influenza virus has shown person-to-person transmission in a given locate.

2) Tests demonstrated that the crystallinity of grown Pbl2 crystal is excellent and the infrared

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transmission is about 45%.

3) It is a kind of new mechanical transmission-the planetary ringy gear transmission.

4) The toxins lock the transmission of the nerving pulse.

The word "transmission" has different meanings in different contextual schemata, in example 1, it is easy to judge that "transmission" in this sentence belonging to the field of biology means "spread of disease", according to the contextual schemata of "influenza virus" and "person-to-person". In example 2, we can judge that the schema of "transmission" in this sentence means "penetration rate" of physics, according to the previous attribute "infrared". And so on, it is easy to determine that the meaning of "transmission" in example 3 and 4 respectively are "the system in a machine by which power is passed from the engine to the parts" and "sending".

5.1.3. Application of Cultural Schema

Language is the carrier of culture, and culture is deeply rooted in the language. When translating, the translator should understand not only linguistic schema and contextual schema, but also cultural schema. Cultural schema refers to cultural knowledge structures, including local conditions and customs, conventions, ways of life, ways of thinking, social institutions, religious beliefs, etc, and it is a cultural knowledge organization pattern accumulated by the previous experience of human beings. Due to the two different cultural deposits of English and Chinese, different thinking patterns and cultural environments will result in different understanding and expression habits for the same thing. For translation, the translator firstly should activate the cultural schema of the source language to understand the source language, then recode the information of the source language to activate the cultural schema of the target language readers, and finally achieve the purpose of cross-cultural communication of translation. For example:

America has set up a loneliness industry.

The phrase "loneliness industry" in some translations were misinterpreted into "a lonely industry", because the translator was lack of the cultural schemata in this aspect. "Loneliness industry" refers to a part of the American welfare, as more and more children do not live with their parents together, so there appears a lot of lonely old men who are uncared-for and live the difficult times in American society, which becomes a social problem. Later, the American government decides to set up a social project "loneliness industry" specially serving for the lonely old men. As a result, "loneliness industry" should be translated into "social projects for orphans and widows".

5.2. Strategies for Translation of EST

5.2.1. Translation Methods of Sci-tech Neologisms

With the great boom of science and technology, a large quantity of sci-tech neologisms pour in China continuously. Some can adopt literal translation, but there are also a part of sci-tech neologisms—it is difficult for them to express the connotative meaning of the source language accurately and fully just by direct literal translation, or to say it is inconsistent with the language habits of the target language by literal translation. This suggests that the translator in translating is unable to find the schema completely matching with the target language from the content and grammar schema of the source language, so free translation is exactly an efficient flexible translation method. That is to say, the translator should do free-and-easy translation on the basis of being faithful to the content of the source language, for example, holography and skylab.

For the translation of sci-tech neologisms, there are also a few flexible translation methods in the following except for the free translation:

Transliteration: translates the pronunciation of English words into the Chinese characters which are approximately same with the source language, for example: clone, radar, sonar, Etc.

Graphological translation: uses the images of the letters to name the objects whose shapes are similar to those words, such as T-track, X-ray and Y-pipe.

Mixed translation: adopts the method combining pronunciation and meaning together, for example: genebank, kilowatt and hacker.

Note translation: translates with notation or just explains directly by noting, for example, compactor—garbage mashers (processing equipment that compresses waste into relatively small

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pieces).

5.2.2. Class Shift and Extension

In the translation of EST, the faithfulness and flexibility of wording also reflect on the part of class shift. EST uses abstract nouns and prepositions a lot, especially nominal structures, which can make the language take on a static tendency. Nominalization is a typical characteristic of EST in the aspect of wording, while Chinese for science and technology uses verbs more to express, which can make the language take on a dynamic tendency. So in the translation of EST, the translator should adjust the cognitive schema timely according to the characteristics of different languages, and shift the classes, to make the expression of the target language more authentic. Especially, when translating EST into Chinese, the nominalized action nouns should be translated into verbs.

Example 1: The new UAV (unmanned aerial vehicles) have found application for the exploration of the seabed.

The nouns “application” and “exploration” of the source language are respectively translated into the verbs with the meaning of “be used to” and “search and discover”, which is more in line with the language habits of Chinese and makes the target language more smooth and fluent. In addition, on the word selections about EST translation of EST, there is another flexible translation method which is called extension: due to the spatial differences of cognitive schema, a word in different contexts has different connotations and translation methods, so the translator should adopt the corresponding flexible translation methods according to different contexts.

Example 2: Bad welding will bring deformation and internal stress, and even cause the death of the parts.

The meaning of “death” in the source language gets extended because of the context, so the translator should deduce the meaning of words from the contexts. Therefore, this word in the sentence should be translated into “useless”, which is more faithful to the meaning of the source language.

5.2.3. Flexible Adaptation of Sentences

In the translation of EST, the faithfulness and flexibility in the aspect of sentences organization indicate that on the basis of correctly understanding the ideas and contents of the source language beyond the language forms of the source language, the translator should adopt the sentence patterns and word orders to express, both of which conform to the language habits of the target language and grammar rules. Therefore, the translator should adjust their cognitive schema according to the formal differences of language, and translate with flexible methods. For example, when translating the complex sentences of EST, generally, the translator should divide the long sentence into the small ones as much as possible, then analyze the sense relations among various components seeing if they are logical relations, time relations, primary and secondary relations, parallel relations, subjective and objective relations or other relations, and finally arrange the orders according to theses relations. However, when translating EST into Chinese, the translator should break the framework of Chinese, firstly determine a verb as the main verb of the English sentence, and then build a spatial structure to illustrate this action using different pronouns, prepositions, non-finite verbs and other connection forms. Such loop-de-looping grape-type structure is exactly the typical characteristic of EST.

Example 3: Each cylinder is encased in a water jacket, which forms part of a circuit through which water is pumped continually, and cooled by means air drawn in from the outside atmosphere by large rotary fans worked by auxiliary motors.

The source language is a complex sentence with two attributive clauses led by “which” and “through which” respectively explaining “a water jacket” and “a circuit”. In addition, there are also two postpositional participial phrases “drawn in” and “worked by” served as attributes respectively modifying “air” and “fans”. This loop-de-looping grape-type structure is the typical characteristic of English serving as a “hypotaxis” language. When it is unable to translate in a normal word order, the translator must divide the whole sentence into the small ones, then analyze the logical relations, and finally find the appropriate target language forms to express from the related schemata. Sometimes the translator can adopt the method called “inverse translation”.

6. Conclusion

Translation is a process of closely combing translation theories on the one hand and practices and

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professional knowledge on the other hand. The cognitive schemata of the source language authors and the target language readers show certain differences because of the differences of their languages, cultures and ways of thinking. Texts of science and technology enjoy their unique linguistic and stylistic characteristics, therefore, in the process of translation, the equivalent of the source language and the target language may be broken up to varying degrees in the aspects of word meanings, semantics and styles. The translator should try their best to save the basic information of the source language and meanwhile deal with the expression forms in a free and flexible way through certain creative means, in order to make up for the differences of cognitive schemata. At the same time, the schematic phenomena fully embody the active role people using the existing cognitive schemata to handle the external information. When understanding the translation texts, the translator should analyze, judge, and revise the relevant schemata according to the clues provided by the contexts. The more the existing knowledge (that is background knowledge) people accumulate, the more the schemata they build in their brain. If the translator masters more schemata, the translation will become easier, more accurate and more fast in interpreting new knowledge.

In translation of EST, it is unrealistic to emphasize the objective criteria of translation only while ignoring the subjective role played by the translator. People should attach importance to the logical and psychological factors of the translator in the process of translation. It is important for the translator to fully activate the linguistic schemata, contextual schemata and cultural schemata in their brain and analyze them so as to play the subjective initiative role of a translator. They can use these flexible methods such as domestication, transformation and inverse translation to make the target language more authentic and more acceptable from the perspective of the target language readers, and ultimately achieve the purpose of translation of EST.

Because of the limited knowledge mastered by the author, and other reasons, the paper still exists some limitations. The author just did study on E-C translation of EST without touching C-E translation of EST, and the analyses were mostly extended from words, sentences while no examples in one whole paragraph or text were used in the paper. Therefore, the author hope scholars, experts and readers offer more advice. Finally, sincerely wish there are more language scholars, translators doing further attempts and efforts in the studies for the translation of EST from the perspective of cognitive schema theory or other translation theories and in the exploration of more translation strategies.

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