Metaphorical Use of Words in English for Science and Technology

Zhang Na
School of Foreign Languages and Cultures, Beijing wuzi University, Beijing, China
zhangna@bwu.edu.cn

Abstract - The development of metaphor theories provides foundations for the existence of metaphorical words in English for Science and Technology(EST). Metaphor and science are not in conflict. Conversely, metaphor is a way of thinking or reshaping human experience. The metaphorical use of words in EST can be divided into two categories: similarity-based metaphor and similarity-creative metaphor, which play important roles in explicating or constructing scientific theories.

Index Terms - metaphor, cognition, EST

I. Introduction

English for Science and Technology, which is shortened as EST for convenience, belongs to a branch of ESP (English for Special Purposes). It refers to the English in the fields of agriculture, medicine, mathematics, biology, chemistry, physics, astronautics, computer science, etc. It can be divided into two kinds generally: the English for specialized science and technology (ESST) and the English for common science and technology (ECST). Since science is generally regarded as the epitomes of rational theorizing, careful observation, and efficient application, while metaphorical language lacks scientific precision, metaphor, as a kind of figure of speech, is historically avoided in scientific discourse. And "we need the metaphors in just those cases where there can be no question as yet of the precision of scientific statements" (Boyd, 1993: 482). Here, metaphor refers to the lexical metaphor or metaphorical use of words of course, which is compared with grammatical metaphors even with discourse metaphors. If not specifically mentioned, metaphors normally refer to lexical metaphors or metaphorical use of words traditionally.

However, metaphor, as a ubiquitous feature of natural language, exists not only in literature, in daily discourse, in professional discourses (e.g., theology, philosophy, and law), but in scientific languages. With the appearance of the contemporary theories of metaphor, the attitude towards metaphor in scientific discourse has changed.

Today, metaphor is no longer deemed illicit and a violation of the scientific discourse principles of clarity, precision and verifiability. Rather, it is recognized as one of the deepest and most persisting phenomenon of thinking and theory building. Metaphors are deliberately used by scientists, who are usually aware (sometimes painfully) that their hypotheses are metaphorical and speculative. Advocacy of the existence of literal scientific statements does not eliminate the need for metaphors. Boyd (1993) also argues that there is an important class of metaphors which plays a role in the development and articulation of theories in relatively mature sciences.

II. Metaphor theories

Metaphor originates from the Greek word "metapherein", which means "to carry over, transfer".

Aristotle is found to make the first systematic treatment on metaphor. In the Rhetoric, Aristotle articulates the Elliptical Simile Theory of metaphor, in which a metaphor is taken as being a comparison abbreviated by dropping the word "like".

Quintillian regards metaphor as a kind of rhetorical phenomenon which uses one word to substitute for another. In the sentence "John is a lion", for example, the metaphorical use of the word "lion" is the substitution for "a courageous man".

In contrast to both Comparison theory (which are associated with the elliptical simile theory attributed to Aristotle) and Substitution theory (wherein metaphors are decorative substitutes for mundane terms), Black(1962) proposes an Interaction theory, stressing the conceptual role of metaphor. He insists that a metaphor is not an isolated word. He takes metaphor as a predication whose expression is a sentence: metaphors do not just rename an entity, they make a statement. This shift brings metaphor into the purview of cognitively significant discourse.

Lakoff and Johnson (1980) initiate their arguments with a harsh criticism of the traditional view of metaphor as "a device of poetic imagination" and "the rhetorical flourish". They offer their cognitive view of metaphor: "The essence of metaphor is understanding and experiencing one kind of thing in terms of another". In other words, metaphor has come to mean "a cross domain mapping in the conceptual system" and should be understood as "metaphorical concepts" (Lakoff, 1993). The locus of it is not in language at all, but "in the way we conceptualize one mental domain in terms of another" (Lakoff, 1993).

III. Metaphorical Use of Words in EST

Different researchers adopt different ways in classifying the metaphorical use of words for their research purposes. For example, Lakoff and Johnson (1980) distinguish three kinds of metaphors: structural metaphor, orientational metaphor and ontological metaphor. Indurkhya (1992) classifies similarity-based metaphor and similarity-creative metaphor.

On the basis of the similarities between new things and old ones, the metaphorical process helps man understand the new ones. So similarity can be one basic element of metaphor. Metaphors in Lakoff and Johnson's classification are similarity-based ones. However, there is also the kind of metaphor "having no similarities between the source and the target concept networks prior to the metaphor (Indarkhya, 1992). This kind of metaphor is called "similarity-creating metaphor" by Indarkhya. He also points out that "such metaphors can be found in the history of science and creative problem solving" (Indarkhya, 1992). In view of the scientific feature of EST, the classification of Indurkhya here is adopted to analyze the metaphorical use of words in EST.

A. Similarity-based Metaphor

Similarity is the similar feature or aspect between two things. It is a mapping of knowledge from one domain (the source) into another (the target) such that a system of relations that holds among the source objects also holds among the target objects. There can be physical similarities and psychological similarities. Physical similarities here refer to the similarities with physical features such as appearance, position, function, etc. Psychological similarities refer to the similarities realized by speakers or listeners under their cultural or psychological background. With the different kinds of similarities, metaphors can be seen in EST to help people recognize and understand those technical phenomena.

1) Metaphor Based on Physical Similarities

In EST, there are a great many of lexical words which are actually used metaphorically. According to the kinds of physical similarities, we mainly classify nominal metaphor into five kinds.

a. Similarity in shape

There is metaphorical usage of technical words on the basis of similarity in shape. If a thing in technical field has the similar shape with that of one thing which we are familiar with in our daily life, it may be expressed with the name of our familiar thing through a metaphorical process.

Take "branch" for an example, the original meaning of "branch" is "arm-like division of a tree", however, it has been used for a variety of things in technical field on the basis of the similar shape with the branch of a tree. It can refer to the similar division of a river, road, mountain range, and so on. There is no need to create certain terms to indicate these things. With the same word "branch", one can easily understand and recognize other things with the similar division.

"Belly plug" is another example to explain the cognitive process of recognizing things. "Plug" is known as a piece of metal, rubber or plastic that fits tightly into a hole. Thus "belly plug" refers to a kind of plug whose surface is bulged out just like the belly of a human body.

On the experience of familiar things, people can recognize technical things like horseshoe magnet, T-beam, I-steel, U-bolt, V-belt, zigzag wave, etc.

With the similarity in shape, people can recognize not only the visible things but also those invisible ones. For example, "water wave" can be easily understood for we can see the vibration of water. Furthermore, from the phenomenon of water, we can understand the wave of heat, of light, of sound, of magnetism and even of electricity. In a word, the direct perception towards shape makes people easily understand technical things and name those things in a metaphorical way.

b. Similarity in position

The primary and basic experience of human being is the experience about the concrete and commonplace things in our daily life. And the recognition and understanding of new things are based on those primary and basic experiences. By referring to the position of human's or animal' body parts, a great deal of technical words are used metaphorically, such as bottleneck, the face of clock, head of an arrow, etc.

Head, as the front or top part of human body, can be used to refer to the front or top part of technical things. "Screw head" refers to the front surface of a screw, and "hammer head" refers to the heavy front part of a hammer.

Not only the part of head, but also other parts of body can be metaphorically used in technical words. In aeronautical field, it is not difficult for a common person to recognize the body of a plane, the wing of a plane and the tail of a plane.

Since people always recognize unknown things through the known ones, sometimes the organ of human body which is not very familiar for people is termed in medicine by a common word. "Appendix", which means the section that *gives* extra information at the end of a book or document, refers to the small tube-shaped bag of tissue attached to the intestine in the field of medicine.

Take the adjective word "high" for another example. "High" originally refers to the special position. However, it is often metaphorically used in other aspects. In the sentence "the temperature of the work must be high enough to melt the spelter", "high" no longer refers to special position of something, but the state of temperature. According to Lakoff's concept metaphor theory, there is one root metaphor that MORE IS UP and LESS IS DOWN. Lakoff gives its physical basis that if you add more of a substance or of physical objects to a container or pile, the level goes up. Therefore, when more heat is added, the temperature will be up and gets higher.

c. Similarity in image

Some technical things or phenomena are named with the names of our familiar things for they have similar images. For example, "shower" is the brief fall of rain. In field of astronomy, when pieces of a meteor are falling down to the earth, it is called "meteor shower". Thus the falling of a meteor is described clearly and easily through the mapping from the image of the falling rain to the image of the falling pieces of a meteor. And "the milky way" is also the case with the image of the large systems of stars which looks like a milky path in outer space.

Another example is "firestorm". The image of storm is the violent weather condition with heavy rain or snow and high

wind. Similar with the image of storm, "firestorm" refers to the image of violent fire when an atomic bomb is exploded. And with the similarity of image that birds can fly off and land on a farm, aircraft carrier, which is built to carry aircraft, with a long, wide deck for their taking off and landing, can be metaphorically named "birdfarm".

Moreover, there are some technical terms which are formed to express the image by complex nouns of the relevant verbal phrases, such as flyover (grade separation), blastoff (the launch of a rocket or missile), splashdown (the landing of a spacecraft in the sea), and pile-up (the crash of a number of vehicles into each other).

d) Similarity in function

Another kind of similarity is the similarity in function. Take "dog" for example, "dog" is known by everyone as a kind of common domestic animal. Its smell sense is so keen that it can follow others even by slight smell. For its function of following others, "dog" can be used in airport to refer to the signal for following the course.

The computer system has many examples with this kind of similarity. The computer is viewed as "electrical brain", for it has the similar function of human's brain, such as calculating, remembering, etc. And there is a kind of software which can infect or destroy programs in operation system just like the virus in human's body. Therefore this kind of software is called "computer virus". And another kind of software which can eliminate the computer virus is called "kill virus". It is on the similarities of function between computer system and familiar things that people have a better way to access computer science.

2) Metaphor Based on Psychological Similarities

There is also a kind of metaphor which associates with allusion, mythology, some historical person's name or something else on the basis of some kind of similarity or association. Because these metaphors are related to the cultural elements, they are departed away into a category and can be named "cultural metaphor".

Some scientific or technical terms borrow their names from allusion or mythology. "Adam's apple", for example, is a well-known and typical example. "Caesarian operation" is another example which refers to the operation of bearing a baby by cutting abdomen. (It is said that Caesar was born this way.) And "Achilles tendon/heel", which is the weakest and vital part of Achilles' body according to the Greek mythology, refers to the vital part of body which is easy to be hurt in medicine. With the help of allusion or mythology, some specific terms can be named and understood metaphorically.

Some specific terms can be named with the name of a real person or a person in literature or historical events. In medicine, some diseases are named by human names, such as "Lincoln's syndrome" and "Parcjinson's syndrome" which borrow the names of true people. And "Pickwickian syndrome" borrows its name from Dickens' novel "Pickwick Papers" to refer to the extreme fatness like the fat boy Joe in this novel. In astronomy, there are also some stars borrowing their names from their finders or being used to memorize those extraordinary people.

It should be mentioned here that some metaphorical use of words are not on the basis of only one kind of similarity, but on the basis of two or more kinds of similarities. "Eye hole" is the case. It is not only similar with an eye in shape, but also has the similar function of observing things. Thus, the eye-like hole is expressed metaphorically on the basis of the similarities not only in shape but also in function. In addition, sometimes the same word can produce different metaphorical meanings on the basis of different similarities, such as "bug". Bug can refer to a kind of car on the similarity of shape and also refer to a kind of small hidden microphone for listening secretly to conversations on the similarity of function. In a word, with one or more kinds of similarities, common words can be metaphorically used in EST.

B. Similarity-creative Metaphor

Although lexical metaphor in EST is generally based on similarities between the source domain and the target domain to concretize the abstract or familiarize the strange, there are instances of similarity-creative metaphor in the history of science and scientific problem solving. In other words, to uncover some unknown characteristics of things in scientific fields, scientists sometimes depart from the normal discipline and use their poetic imagination to metaphorize these things with no similarities between the source domain and the target domain. Only after the metaphor is understood, if it is understood at all, were there similarities between the two domains.

In comparison with similarity-based metaphor, similarity-creative metaphor plays more important role in creative problem solving or building scientific theories. An example is that about Kekule (Indurkhya, 1992:62) who comes up with the idea that carbon atoms in the benzene molecule may be arranged in the form of a ring when he dreams of a serpent swallowing its own tail. Here there is an image that leads to the solution of a problem. After the solution, one could see the similarities between the molecular structure of benzene and a snake swallowing its tail. But before that, there are no similarities. The image of the snake suggests an idea that turns out to be fruitful.

In building scientific theories such as naming new scientific things, similarity-creative metaphor exerts its cognitive function as well. One typical example is the naming process of elementary particle in Quantum Mechanics. When American theoretical physicist Murray Gellmann points out that elementary particle can be divided into smaller components, he names this kind of component "quark". The word "quark" is originally created as onomatopoeia by the novelist James Joyce. Gellmann borrows this interesting word to name the elementary particle which he has found. Then the first three kinds of "quark" is called by him "up", "down" and "sideways", and the next three kinds he has found later is named "charm", "truth" and "beauty". The most interesting thing is that different kinds of "quark" has different "flavor"

and the quark with the same “flavor’ is divided into three kinds of “color”: “red”, “green” and “blue”. Of course, “flavor” and “color” used here have no relationship with those of our daily life. Thus, the naming process by Gellmann is seen to be the results of metaphorical thinking. Through the metaphorical process of naming the elementary particle, these particles are endowed with impression which is familiar for us. Thus they are recognized more easily. As a result, the findings of these components improve the study in the field of quantum mechanics.

In a word, the kind of similarity-creative metaphor manifests metaphorical process at deeper level. And the use of this kind of metaphor in EST shows more cognitive power in recognizing new things.

IV. Conclusion

Metaphor is not a patent of literary language; it also appears in scientific discourse. It is more than a figure of speech, but a way of thinking or reshaping human experience. Metaphorical use of words enriches the expressions for new things in the field of science and technology. It not only creates many technical terms for those things, but also plays an important role in explicating or constructing scientific theories. Explanation without metaphor would be difficult if not completely impossible, for in order to describe the unknown, we must resort to concepts that we know and understand. Thus the similarities between the source domain and the target domain set the basis for a metaphorical transference. Moreover, similarities can also be created to make the association between the source domain and target domain, and a metaphor in such a case reflects more cognitive power.

In conclusion, metaphor is an inevitable and necessary phenomenon in EST, and it plays an important role in it. Metaphor does not spoil scientific precision, just as what Boyd (1993) indicates, “there are no distinct principles of linguistic precision in science, but rather that linguistic precision is one of the consequences of methodological precision of a quite general sort”.

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