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The Cognitive Function of Analogical Inference and Its Effect on Innovation

LIN Yi, JIANG Lili
Tiangong University, Tianjin, China

As a method of logical thinking, analogical inference has a long history both in ancient Greece and in the ancient East, and has been widely used in the daily life. Even today it still plays an important role in understanding and improving the world. Particularly, its cognitive function is not only reflected in the interpretation and further understanding of the existing knowledge, but more importantly, it can still improve our scientific level, expand our cognitive field, and help us open up the unknown field. That, of course, is where its innovation lies. From the perspective of analogical inference, its innovative function should be based on the identical or at least the similar relationship between the things. In addition, it should also be based on the ability of imagination played by the cognition subject.

Keywords: image analogy, analog inference, imagination

In Chinese traditional medicine, the shape and color of medicine are often related both with the efficacy of the medicine and the characteristics of the corresponded Zang and Fu.[1] For example, in the Chinese traditional medicine, it is believed that the nature of the Lung is related to the Color White, or the Color White is one of the characters of the Lung. Thus, in Chinese traditional medicine, some drug which color is white could be considered as the medicine treated the illness in the Lung or the Lung Channel, such as the Bai Bu[2], Bai Qian[3], and Bai He[4]. Similarly, the Color Black is the character of the Kidney, so something black to eat could be considered into the Kidney Channel. For example the Zhi Ma ("sesame") is healthy to the Kidney as well as the Kidney Channel. This method is called "to analogize" in the *The Huang Di's Canon of Internal Medicine* as the earliest Chinese medical classics in China. That is the main thinking pattern in the Chinese traditional medicine,

LIN Yi, associate professor and master's supervisor, School of Marxism, Tiangong University, Tianjin; research staff of the Collaborative Innovation Center for Theoretical Research of Socialism with Chinese Characteristics in Beijing Universities, Beijing; associate professor of Tiangong University base of the Research Center of Theoretical System of Socialism with Chinese Characteristics, Tianjin, China.

JIANG Lili, postgraduate, School of Marxism, Tiangong University, Tianjin, China.

[1] The Zang and Fu is the saying in the traditional Chinese medicine; it refers to the Viscera, including the Liver, the Heart, the Spleen, the Lung, and the Kidney.

[2] Baibu, the name of traditional Chinese medicine. The dried tuberous roots of Stemona sessilifolia (Miq.) Miq., Stemona japonica (Bl.) Miq. Or Stemona tuberosa Lour. It has the effect of moistening the lung, relieving cough, and killing insects and lice. Commonly used for new cough, tuberculosis cough, cough; external use for head lice, body lice, pinworm disease, itching.

[3] Bai Qian, Chinese traditional medicine name. They are stems erect, young branches covered with brown hairs. Follicles 1-2, narrowly ovate. It grows on the bank of the river and between sand and stone. Mainly produced in Jiangsu, Zhejiang, Anhui, and other places. Efficacy and function of Rhizoma Bletillae: reducing Qi, eliminating phlegm, and relieving cough.

[4] Bai He, Chinese medicine name. They are dry fleshy scales of Lilium lancifolium Thunb., Lilium brownii f.e. brown var, viridulum baker or Lilium pumilum DC. It has the effect of Nourishing Yin, moistening lung, clearing heart, and calming mind. It is commonly used in Yin deficiency dry cough, labor cough, hemoptysis, deficiency and palpitation, insomnia and dreaminess.

called as “image analogy”, namely, the thinking of classification according to manifestation. It is a kind of thinking method that reflects the universal connection and regularity of things on the basis of observing things and getting direct experience, expressing the concrete images of the objective world and their symbolic signs, thinking by means of metaphor, symbol, association generalization, and so on. In fact, from the perspective of logical thinking, it is to some extent the use of “analogical inference” method.

Analogical Inference

As one of the important methods of human thinking, analogical inference has a very long history of development.

In ancient Greece, it was first used by Democritus, Plato, and others, but it was not until Aristotle that he finally began to really study it. Aristotle calls this “analogy”.

> It is analogy if the end word (big word) belongs to the middle word is proved by a word similar to a small word. At the same time, it should be noted that middle words belong to small words, while big words belong to a word similar to small words. (Huang, 2006, p. 247, as cited in Akhmanov, 1980, p. 287)

Therefore, the analogy is reflected by the use of four words: big word, middle word, small word, and one word similar to small word, as in the classic example, “The war between the Athenians and Thebes was evil”. In the ancient East, the method of “analogical inference” has already been for a long time, especially, applied in the ancient Indian’s philosophy “Inmingology”. In the period of Pre-Qin Dynasty in ancient China, Mozi (a great philosopher) firstly put forward the idea of “Cha Lei Ming Gu (察类明故)”, namely observing the kind then understanding the reason, which is similarly with the “analog inference”. The “kind” here refers to the common belonging and generality of Beings. By observing the “kind”, people can find the generality of the different Beings and find out its general principles. Then, it’s logical for people to make analogies. For example, Mozi advocated “non-attack (非攻)”, while the other side countered with “King Wu defeating Zhou (武王伐纣)”. Mozi retorted that he was not discussing about the word “to attack (攻)”, but the word “to accuser (诛)”, and “to attack” and “to accuser” were not the same, so no analogy could be made. In the famous debate between Mozi and Gong Shuban, Gong said, “My righteousness (义) will not allow me to kill others”. But Mozi retorted by analogy: “If you build a ladder for the king of Chu, you will attack the State of Song. This is killing the many instead of the few! (义不杀少而杀众)” “Righteousness without killing few and killing many which cannot be called kind” (Liu, 2002). In addition, analogical inference has been widely used in people’s daily life. As the author mentioned in the beginning of the article, “image analogy” in Chinese traditional medicine is a summary of people’s daily life experience.

So, what does analogical inference really mean?

Analogical reasoning, also known as “analogy”, is based on the identical or similarity of some attributes between two or two kinds of objects, thus, from which deduces that their other attributes are the same or similar. From the process of thinking, we can see that analogical inference is different from deductive inference—from general to individual, it is also different from inductive reasoning—from individual to general. Instead, it is either from general to general inference, or from individual to individual inference. And, of course, it is similar to inductive inference in that both are probabilistic. Perhaps because of these characteristics, it has become an important tool for human beings to understand and reform the world, and has played an important role in various human activities.

The Important Role of Analogical Inference

Analogical inference, as an important reasoning and logical method, is applied in many fields and categories, especially in its cognitive function.

First of all, analogical inference plays an important role in the understanding of people, things, and others that we have acquired. In fact, it is manifested in the aspect of increasing knowledge or understanding through indirect experience. On the one hand, the method represented as "demonstrative by example", as Aristotle called it "exemplification" in his Rhetoric. For instance, in a debate, we will often use this method to illustrate and support our own arguments, which cannot only fully demonstrate our language skills, but also improve the credibility of our views or positions. On the other hand, the method represented as "metaphors". Here is a very graphic example: In Chinese traditional medicine, a kind of very important treatment method is called the "needling (针刺)", namely we speak everyday "acupuncture (针灸)" method. For some people, it is very difficult to learn acupuncture, or even just to understand it. For example, "pulling out the needle" means taking out the needle. In narrative language, it can be described as "holding the needle in the right hand and slowly turning it into the skin, and then pulling it out quickly"[5]. It is hard to understand very well, but if you use exemplification, which is analogical inference, the situation might be quite different—like "pulling out the tail of a tiger" (语出《针灸大成》); in this way, we can understand how to combine speed with weight. Therefore, when explaining relevant theories, analogical inference can clearly explain esoteric and difficult theories by virtue of its simple and vivid truth, which is more acceptable to people than the tediously long plain narration. In addition, analogical inference is also important for expanding the scope of human knowledge; certainly, this is also its innovation. With the help of analogy, people's knowledge can be transferred from one field to another, enlightening and broadening their thinking, and playing a role in drawing inferences about other cases from one instance. This is especially true in the development of people's scientific understanding.

For one thing, it is an important way for us to obtain new scientific discoveries. More than 200 years ago, the American scientist Benjamin Franklin conducted an experiment to catch lightning, which made people finally realize that thunder and lightning are only a natural phenomenon. What inspired Franklin's experiment was an analogy: Before the experiment, he had noticed that when two objects with different electric charges came into contact, there would be sparks, sounds, and electric currents. When thunder and lightning struck, there would also be huge sounds and sparks, so he drew the analogy that lightning was also a natural discharge. This theory was later verified. British doctor Jenner found that "vaccination" can prevent smallpox, because he was inspired with Milkmaid who infected with smallpox bov is and do not suffer from smallpox (Department of Philosophy, Nankai University, Teaching and Research Department of Logic, 2004). There are many other facts which may enlighten us in this way, so that "we may assert that the proportion of the total knowledge acquired by modern scientific knowledge by means of analogy is increasing day by day" (Department of Philosophy, Nankai University, Teaching and Research Department of Logic, 2004, as cited in World Science, 1982). For another thing, we can also use analogies and associations to creatively put forward some scientific hypotheses. Kant once said, "The method of analogy tends to guide us whenever the reason lacks the thought of sound arguments". For example, from 1906 to 1909, physicist Rutherford and his students made a hypothesis through the α particle scattering experiment: In an atom there is a nucleus that makes up only a tiny part of the atomic volume but has most of the atomic mass, while the extranuclear electrons have only a tiny mass. He was

[5] Tianjin College of Traditional Chinese Medicine. *Acupuncture.* Tianjin: Tianjin University of Traditional Chinese Medicine.

also inspired by the Copernican theory that, just as most of the mass of the solar system is concentrated on the central sun, so most of the mass of atoms is concentrated on the positively charged particles at the center of the atom. Thus, in 1911, Rutherford hypothesized a planetary model of an atomic structure consisting of electrons orbiting the nucleus of a positively charged nucleus (Li, 2004). In a word, from the above discussion, we can realize the important role of analogical reasoning in people's understanding of the world, especially in expanding people's cognitive field, improving people's ability of knowledge and scientific and technological level.

What is the basis for the innovation of analogical inference? The author thinks that we should return to analogical reasoning itself. Analogical inference is based on the identical or similarity of two or two kinds of things in some properties, thus deducing the reasoning that they are the same in other properties. So, first of all, this requires that the object of cognition, the object of different things or domains, must have some degree of identity or similarity. Then, it requires that the object of cognition, that is, the object of different things or domains, must have identity or similarity to some extent, which is also the key point, which constitutes the basis of "ratio". Secondly, it requires the cognitive subject to give full play to the ability of "association" which can often bring us strange information. Legend has it that Lu Ban invented the saw, just because he discovered the characteristics of thatch and exerted the power of association; this feature applied to the iron sheet; the manufacture of aircraft and ships is also created by people after using association; China's famous Olympic stadium "Bird's Nest" is also in the understanding of the bird's Nest model, shape, and plays the association of its use in the stadium construction. Therefore, the "identity" and "similarity" of cognitive objects and the "associative ability" of cognitive subjects provide a basis for the creative function of analogical inference.

Conclusion

In a word, although analogical inference is probabilistic and can lead to some fallacies, we cannot deny the role of analogical inference in the process of understanding and reforming the world, and we cannot ignore its cognitive function and its role in innovation. Analogical inference, which is closely related to human life, is very helpful to our study and work in reality, and it will also promote our understanding of the unknown world.

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