

Reflections about Evolutionary Epistemology: EEM Program and EET Program

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Abstract—Evolutionary epistemology has been classified into two programs by Bradie Michael : Evolutionary Epistemology Mechanism (EEM) and Evolutionary Epistemology Theory program (EET). This paper investigates the differences between EEM and EET. It is shown that EEM focused on the biological mechanism of cognitive occurrence whereas EET focused on the result of cognitive activity. It is found that there are flaws in this classification that EEM and EET should be given consideration for the logical unification with methodological innovation by focusing on cognitive processes as well as social and cultural mechanism.

Keywords—evolutionary epistemology; EEM program; EET program; limitations

I. INTRODUCTION

Bradie Michael(1986), as a scientific philosopher, argues that evolutionary epistemology involves two related but not identical programs: Evolutionary Epistemology Mechanism program (EEM) and Evolutionary Epistemology Theory program (EET). EEM program attempts to account for the characteristics of biological cognitive mechanisms and extends evolutionary biology theory directly into the traits or physiological characteristics of animal cognitive activities such as brain, sensory systems, and motor systems. EET program generally evaluates and interprets ideas, scientific theories and cultures through evolutionary biological models and metaphors. [1]

EEM and EET are related mutually. In other words, cognitive and intellectual phenomena, including rational and scientific reasoning, are different themes of evolutionary epistemology. Evolutionary epistemology of these two programs can be traced back to Darwin, Spencer and others in the field of biology and philosophy at the 19th century. Most of the contemporary studies have been derived from the ideas of Lorenz, Campbell, Popper and the like. The evolution of organism can be understood by ontogenetic and phylogenetic approaches. The evolution of knowledge and the evolution of cognitive mechanisms demonstrate parallelism. However, EEM is focused on the biologically cognitive mechanism whereas EET is focused on the outcome of cognitive activities. EEM must clarify what cognitive ability is, merely based on the cognitive

mechanism? How does cognitive development research combine with the evolution of cognitive mechanisms to promote in-depth interpretation of questions, such as reasoning? Is this classification of EEM and EET reasonable if they represent the whole program of evolutionary epistemology? Those questions will be discussed in this paper, based on the insight into the two programs.

II. UNDERSTANDING OF EEM AND EET PROGRAM

EEM program gives an account of biological substrate of cognition. This program can be understood at both phylogenetic or ontogenetic levels.

A. EEM Program

In understanding of the EEM, we mainly addressed the biological basis of cognitive evolution. It emphasizes that human cognitive ability can be interpreted from the evolutionary point of view. EEM can be understood in terms of the following points:

1) *Response to traditional epistemology*: Lorenz K. Z. , as a famous biological behaviorist, a typical representative of EEM, is one of important pioneers of evolutionary epistemology, who gives an account of EEM. This interpretation is related to his comments on Kant's synthetic a priori claims. That is, the so-called a priori knowledge or a priori cognitive structure lies not so much in one's experiences. With the innate cognitive structure, individuals are likely to gain knowledge. Hereby, cognitive evolution, to any given individual, is seen as ontogenetically a priori. In addition, genetic information is obtained in the evolutionary process, and cognitive structure schema is selected by many generations, so that cognitive evolution is regarded as phylogenetically a posteriori.[2]

2) *Response to evolutionary biology*: Bradie (1979) insists that our cognitive mechanism is the result of evolution in this sense that natural selection can be interpreted as a basis for maintaining and producing sensory and cognitive mechanisms and that keeps fitness between sensory and cognitive mechanisms [3]. That is, natural selection will be keen on reliable knowledge acquisition methods, favoring the way to generate real knowledge, whereas animal's senses, the nervous system and other organs can provide animals with the world's pictures. The

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subjective cognitive structure can adapt to the external world, because the cognitive mechanism has evolved to adapt to the outside world.

In this regard, cognitive development is essential for biological survival and evolution. The biological system is the knowledge system, and the biological evolution is the process of knowledge acquisition. The mechanism of cognitive mechanism helps explain the basic adaptive process of biological cognitive structure. The biological structure of cognitive activities can be explained by Modern Synthesis.

B. EET Program

EET elucidates the knowledge growth by use of selectionism model to build a new model, like branch tree for evolutionary biology, blind-selection-retention, etc.

The core of the EET is that the improvement of scientific theory and the growth of knowledge are also similar with the natural selection process. The EET analyzes the growth of knowledge through the evolutionary model. Knowledge acquisition similar to the process of biological evolution attempts to construct a universal theory to account for the biological evolution, individual learning, cultural changes and scientific progress. EET relates to the history of scientific evolution.

Popperly, a famous philosopher of science, a typical representative of EET, argues that scientific development is the result of theoretical competitions, so that competitions are not confined to inside or outside scientific communities. It would appear that changes of science are a process of selection, and selectionism applies not only to natural selection, but also to the evolution theory and ideas.[4]

However, are theoretical innovation and knowledge growth explosive or progressive? Theoretical development and knowledge growth are sometimes explosive, but more progressive. Ackermann R states briefly that it is a gradual process from traditional to non-traditional theories, such as from Newtonian mechanics to Einstein's theory of relativity.[5]

C. Theoretical Model of EET Program

1) *Branch tree for evolutionary biology model:* Popper makes use of the "branch tree for evolutionary biology" model to elaborate that knowledge growth is similar to evolutionary processes. This model suggests that the phylogenetic tree of biological evolution begins with a single "tree branch" and then becomes a "screen" that allows many initial nodes to be linked to other nodes through crisscrossed network lines rather than forming a single "tree" or "shrub". In Popper's view, the "tool tree" evolved is in line with the "biological tree" development logic. On this basis, Popper allows for the third tree similar with the above "tool tree" and "biological tree", that is, "tree of applied knowledge", but Popper maintains that the evolution of three trees (tools, application knowledge or pure knowledge, biology) makes clear. [4]

This model of EET is very instructive, and the evolution from organism, tools and knowledge shows parallelism between biological evolution and knowledge growth. The branch tree for evolutionary biology model reveals the evolutionary significance phylogenically. On this basis, Popper recommends using the analogy ontogenetically to promote the analogy phylogenically.

2) *Blind-selection-retention model:* Campbell D.L. utilizes "blind-selection-retention model" to explicate the relation between the growth of scientific knowledge and evolution of biological structures. He argues that there is not only a competitive relationship between organism, but also between knowledge and theory. In this model, the development of human cognition is promoted through eliminating adverse theories and knowledge and retaining favorable ones.[6] Popper believes that perception and thinking have the origins of biological evolution. He shows clearly that evolution is understood as a process of knowledge in a biological sense. From a view of natural selection, knowledge growth is similar to biological evolution. Trial and error learning can increase knowledge and enhance individual's cognitive capability. The growth of knowledge depends on the improvement of cognitive ability. [7]

Popper's interpretation is in line with Campbell's theoretical model, pointing to the evolution of knowledge and scientific theory inseparable from the evolution of cognitive ability. Both can not be divorced from the interpretation of biological evolution principles.

To sum up, EEM is in attempts to construct a universal biological theory that explains the evolution of biological cognitive abilities. EET regards knowledge as an adaptation, which is conducive to increasing the adaptability of reproduction, trying to clarify why human beings become cognitive subjects from the perspective of naturalism. In fact, the difference between EEM and EET is seen as a difference between knowledge of adaption and adaptation of knowledge.

III. CRITICAL REVIEW ON EEM AND EET PROGRAM

A. Comparison of classifications between Bradie and others

Is it rational for us to accept Bradie's classification of EEM and EET ?

1) *Comparison of classification between Bradie and Lorentz:* Lorenz K. classifies evolutionary epistemology by use of phylogenetic and ontogenetic approaches. Inspired by him, Bradie has made his evolutionary epistemological research closely related to the phylogenetic approach. As early as the first half of the twentieth century, Lorenz reflects upon the relation between phylogenetic and ontogenetic approach, in attempts to seek a physiological basis for cognition. The phylogenetic approach to evolutionary epistemology mainly focuses on the study of the brain and sensory mechanisms, the Kantian transcendental category. [8]

Bradie's EEM program has the similar implication with that of Lorentz's phylogenetic ones. However, he is more concerned with physiological substrate, such as evolution of the brain and sensory mechanisms, whereas he is ignorant of ontogenetic approaches, especially the individual cognitive ability, including trial and error learning, nerve Darwinism and so on.

2) *Comparison of classification between Bradie and Gontier*: Gontier N. divides evolutionary epistemology into two categories: traditional evolutionary epistemology and new evolutionary epistemology. This classification is different from that of Bradie. The differences between traditional and new one are reflected in the time differences and the perspectives' differences. The former accepts an environmental perspective based on the adaptationism approach, emphasizing the absolute superiority of natural selection to biological evolution. The latter accepts the internal perspective of the organism based on the non-adaptationism approach, emphasizing constructivism.[9]

Gontier's traditional and new approaches reflect the implications of evolutionary theoretical results to evolutionary epistemology at different stages, which makes traditional evolutionary epistemology centered on the role of environmental selection whereas the new evolutionary epistemology focuses on the role of mental construction. In his view, evolutionary epistemology requires three major pursuits: the first is to distinguish different cognitive processes of organism; the second is to examine how biologically cognitive ability is evolved from single-celled organisms; the third is to understand the product of cognition, such as light or color perception, from an evolutionary perspective. In this way, in addition to EEM and EET, the cognitive process should be investigated, that is, the process of mental evolution.

On account of the above, there is a problem deserving concern based on the classification of EEM and EET by Bradie. As Henke W. et al. indicate, EEM emphasizing the development of the cognitive structure through selection theory cannot guarantee these models that can be used to understand the development of human knowledge system. Similarly, the interpretation of EET about human knowledge growth by selection theory cannot ensure that the special or general brain structure of cognition is based on the role of natural selection to improve cognitive ability. Although these two programs are introduced from the same model or metaphor, they are complementary but lack of unification logically. [10]

Why can EEM and EET not be logically unified? It may be that evolutionary epistemological approaches not only involve the biological substrate of the cognitive activity (EEM) and the results of cognitive activities (EET), but also involve the intermediate process, namely, mental construction. This has brought a hidden crisis to the development of EEM.

Bradie unfortunately did not pay attention to the importance of mental evolution, but the key is that is it feasible to the proposed solution ?

B. Early Attempts for Unified Logic between EEM and EET

EEM seeks evolutionary explanations for cognitive abilities, focusing on cognitive activity traits or physiological characteristics around the brain, sensory systems, motor systems. Inspired by traditional epistemological questions, the early research from evolutionary biology has been focused on the question of where a priori structure is derived.

Bradie's definition of EEM focuses on the level of biological theory related to cognitive activity traits. The EET mainly uses evolutionary biological metaphors to account for scientific and intellectual growth. The intermediate link from the beginning of evolution of biological traits (EEM) to the result of knowledge growth (EET) is often ignored. In order to elucidate the evolution from the cognitive mechanism to evolution of knowledge, Bradie constructs a "slippery slope chain model".

This model suggests that from evolution of biological substrate to evolution of human knowledge, it is more like an induced interpretation. This model stands, at a phylogenesis perspective, to try to interpret the evolution of biological cognitive mechanism, revealing the evolution process involving "material" and "cognitive content". This indicates that from a phylogenesis perspective, all of the organism retain special cognition mechanism traits, so each organism has a priori "Kantian category" and finally reach to EET. The content of knowledge, to some extent, is determined by the transcendental category and experienced by development and evolution. [1]

The biology-based EEM needs to allow for psychological phenomena that are common to all organism, showing a similar structure of nervous system or performing a similar function at a lower level. Mental phenomena depend on the particular combination of nerve cells (neurons) and come from the special brain activity in the human system. It requires the absorption from the psychological research. Especially, psychological and spiritual phenomena from an evolutionary point of view are special. Knowledge and science is the product of mental evolution, which relies on the human mental ability (i.e. knowledge processing), and these issues are also worth attention by EEM. Wuketits F.M., as a well-known scholar of evolutionary epistemology, argues that the evolution of cognitive mechanisms, including evolution of human cognition, will be addressed by integrating evolutionary biology, psychology with animal behavior research. The evolution itself is described as learning and cognitive process, which is the process of information processing. [11]

EEM investigates thoroughly the brain mechanism, but it is not enough to focus on biological traits merely, since what organism perceive is relied upon the mental process by obtaining a model of life-sustaining responses. Especially, in order to produce internal and external reality model, the brain helps form rational knowledge and irrational beliefs. Therefore, the human brain mechanism helps generate high mental ability, such as creative imagination. Knowledge is limited by the brain and comes from the interaction between subject and object in a process of mental construction.

It seems that Bradie's "slippery slope effect" is seen as a good attempt to connect EEM with EET. However, Bradie's model focuses only on biological mechanisms but does not incorporate psychological mechanisms, even if the psychological mechanism is on the basis of biological mechanism. However, the psychological mechanism can not be fully interpreted with biological mechanisms. In particular, human cognition also involves the problems of social and cultural mechanisms, which poses challenges that EEM and EET have to face in a unified process.

C. Reflections of EEM and EET: Reductive Problem

The premise of knowledge growth lies in the evolution of organism, so the evolution of human knowledge can be explained from a perspective of organism's evolution. However, organism's evolution explanations can not be translated into cultural and societal explanations, for example, we can not make use of biological terms to interpret the rise and fall of ancient Rome and the first world war. The evolution of scientific theory and principle of knowledge growth are different from evolutionary principles of organism. Although the organism's evolution can be compared with knowledge growth, we can not really explain the relationship along the two evolutionary lines: Firstly, evolution of organisms, especially human brain evolution is the basis for knowledge growth. Secondly, cultural evolution can not be reduced to organism evolution. The study of biological evolution provides a prerequisite for the exploration of knowledge growth, but in the strict sense, the evolution of knowledge and the evolution of thought need to go beyond the evolutionary biology theory. The evolution from single-celled organisms to humans is inseparable from the evolution of the organism's environment, but this particularity of cultural evolution can not be simply articulated from the relationship between EEM and EET, so that it should be incorporated.

IV. CONCLUSION

Evolutionary epistemology originates from Darwinian theory. To overcome the limitations of traditional epistemology, evolutionary epistemology attempts to solve the problems of Kant's synthetic a priori judgment, providing a powerful solution, whereas philosophical epistemology leads to scientific epistemology. Bradie's classifications of EEM and EET has inherited epistemological naturalism. In a traditional sense, EEM is normative because natural selection can produce cognitive mechanisms; EET is understood as descriptive because EET argues that life evolution is similar to the evolution of science in a sense of natural selection. EEM tries to provide an evolutionary explanation for the development of cognitive structures, synthesizes the theoretical knowledge of multiple disciplines, and solves different research questions. Trial and error learning and scientific theory evolution are interpreted as a selection process by EET and are in attempts to analyze the development of human knowledge and epistemology norms.

In general, EEM explores how the general evolutionary principles are used to elucidate the carrier mechanisms and acting mechanisms of cognitive activities and cognitive abilities of organism, which focuses on the physiological

basis or carrier of cognitive activities. However, Bradie's classification also has significant flaws. The evolution of human cognitive ability can not be interpreted only by biological mechanisms, but by psychological mechanisms as well as social and cultural mechanisms so as to achieve the logic unification. EEM in the development process complies with natural selection theory but is still challenged by this.

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