Cognitive science research and the development of related discipline

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Cognitive science is a new and interdisciplinary field that the world's scientific and academic circles pay attention to. The development of cognitive science will change people's living conditions, improve people's quality of life, and will also promote the development of many related disciplines. This article focuses on the dual goals of cognitive science construction: exploring the mysteries of the human mind and promoting the development of related disciplines. It also brief the status of cognitive science research carried out by world-class universities, as well as the basic strategies and some results of Tsinghua University's development of cognitive science.

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In 2001, the Humanities and Social Sciences of Tsinghua University had formed a group known as the Cognitive Science Innovation team which joint by the Humanities and Social Sciences, Computer and Information Science, Medicine and Neurosciences of Tsinghua University and other off campus organizations such as Institute of Psychology, Chinese Academy of Sciences and Institute of Languages, Chinese Academy of Social Sciences, etc. In October 2004, the cognitive science team of Tsinghua University won the "985" project bidding competition organized by the Ministry of Education and the Ministry of Finance, and received funding from the Ministry of Education's Philosophy and Social Science Major Innovation Base Project to establish a cognitive science innovation base, thereby, the cognitive science research of Tsinghua University

has begun to enter the normal track of development.

Many friends asked me why does Tsinghua University do cognitive science research? What can cognitive science bring to you? Thus, this article intends to briefly discuss the relevant knowledge and experience of cognitive science research, and also to seek advice from colleagues in the academic circle and all scholars who are concerned about the development of cognitive science.

1. Goal 1: to explore the mystery of the human mind

As mankind enters the 21st century, two major secrets will be revealed, one is the mystery of life, and the other is the secret of the mind. The United States has launched two major scientific projects for this purpose-the "Human Genome Project" and the "Human Cognitive Group Project." For the former, China's scientific, educational, press and publishing, academic journals, and academia have all paid enough attention, while for the latter, it is far from enough. The mind is the function of the brain and nerves, and the bridge between the brain and the mind is cognition. Cognitive science is the theory and philosophy of the study of the mind.

Chinese scholars have integrated the six disciplines including philosophy, psychology, linguistics, anthropology, computer science and neuroscience, in order to study "how information is transmitted in the process of cognition". The result of this research project has produced an emerging discipline---Cognitive Science.

The development of cognitive science first produced 6 new development directions within the original 6 supporting disciplines, which are philosophy of mind, cognitive psychology, cognitive linguistics (or language and cognition), and cognitive anthropology. (Or culture, evolution and cognition), artificial intelligence and cognitive neuroscience. These 6 emerging disciplines are the 6 university branches of cognitive science. These 6 supporting disciplines intersect with each other, and 11 new interdisciplinary disciplines emerge: (1) Cybernetics; (2) Neurolinguistics; (3) Neuropsychology; (4) Cognitive process simulation; (5) Computational Linguistics; (6) Psycholinguistics; (7) Philosophy of Mind; (8) Philosophy of Language; (9) Linguistics of Anthropology; (10) Cognitive Anthropology; (11) Brain Evolution.

What does cognitive science do? What will it bring us? The answer to these questions first involves the value and significance of cognitive science itself.

Cognition is the process and activity by which the brain and nervous system producing the mind. Generally speaking, any animal with a brain and nervous system has a certain degree of mind.Cognitive science is a science that takes the cognitive process and its laws as the research object. Cognition involves learning, memory, thinking, understanding, and other behaviors that occur in the cognitive process. [1](P5)Therefore, language and psychology, brain and nerves are important research contents of cognitive science. As far as the human mind is concerned, because humans are social animals, language and philosophy, culture and evolution, as well as human-specific tools-computers and their scientific theories, have also become the object of cognitive science research.

Fundamentally, the goal of cognitive science is to uncover the mysteries of the human mind. How to accomplish this mission? At present, it is exploring and researching from such aspects. In basic theory, cognitive science studies computing and cognition, symbolic structure and cognition, mental structure and connectionism, grammatical theory, model theory semantics and other semantics, experimental methods of cognitive science, brain and cognition, etc. Some research areas of cognitive science include: language acquisition, reading, discourse, mental models, concepts and induction, problem solving and cognitive skills acquisition, visual computing, visual attention, memory, behavior, geometry and machinery in motor planning Issues, culture and cognition, philosophical issues in cognitive science, physical and mental issues, intentionality, qualia, subjective and objective, etc. Through these studies, as well as the development and deepening of some newer areas, scientists believe that we will finally uncover the mysteries of the human mind.

Since modern times, even dating back to ancient times, the problem of body and mind has always been a fundamental problem that plagued philosophers. René Descartes's famous proposition "I think, therefore I am" reflects the essential characteristics of human beings able to recognize themselves. His "Body and Mind Dualism" is an important version of the "Body and Mind" problem.。 Since the middle of the 20th century, due to the development of psychology, brain and neuroscience, especially after the establishment of cognitive science, this problem has become the famous problem of "Brain and Mind". Obviously, the study of "mind" and "brain" in cognitive science is very

different from the study of physical and mental issues in the history of philosophy and science. The main difference is that cognitive science is no longer the study of mind. Philosophical speculation is not just empirical research in a single subject such as psychology and physiology, but a comprehensive multi-disciplinary research based on the development of brain science.

In the past 20 years, the important progress of cognitive science has benefited from the development of brain science, and the development of brain science has benefited from the great progress of brain imaging technology. Computerized Tomography (CT), Magnetic Resonance Imaging (MRI), Functional Magnetic Resonance Imaging (FMRI), Positron Emission Tomography, PET) and other technologies are widely used in the research of brain and neuroscience, which promotes the development of brain and neuroscience. These developments in brain science have prepared the conditions for us to reveal the secrets of human wisdom.

The goal and significance of cognitive science is that it will combine with nanotechnology, biotechnology and information technology to change the way of human existence in the 21st century.

In 2000, when mankind had just entered the threshold of the new century, the National Science Foundation (NSF) and the US Department of Commerce (DOC) jointly funded more than 50 scientists to carry out a research project with the purpose of figuring out which ones are in the new century. The subject is the leading subject. The result of the research is a 680-page research report, but the conclusion is only 4 letters --NBIC. They stand for Nanotechnology, Biotechnology, Information technology, and Cognitive science.

This research report describes NBIC's research goals as follows: "In the next century, or within about 5 generations, some breakthroughs will appear in nanotechnology (eliminating the boundary between natural and man-made molecular systems), information science (toward more autonomous and intelligent machines), biological sciences and life sciences (to extend human life through genetics and proteology), cognition and neuroscience (creating artificial neural networks and deciphering human cognition) and social sciences (understanding cultural information, controlling collective intelligence). These breakthroughs are used to accelerate the pace of technological advancement and may once again change our species, and their far-reaching significance can be comparable to that of humans who learned oral language knowledge for the first

time hundreds of thousands of generations agoNBIC nano-biology-information-cognition A society) technology integration may become the propellant for the great change of mankind. " [3](P102)There is a classic sentence in the report of this important research: "Convergence technology (NBIC) is guided by cognitive science. For once we can understand thinking in the four levels of how, why, where, and when, we can use nanotechnology to make it, use biotechnology and biomedicine to realize it, and finally use information technology to manipulate and control it to make it work."

What a picture this is! First of all, cognitive science research will crack the mystery of the human mind, and its ultimate goal is to create an artificial neural network system. According to John R. Searle's artificial intelligence model, current computer systems are not intelligent, while artificial neural network systems are intelligent systems with human brain functions.。 Just imagine the possible applications of artificial neural network systems in modern science and technology and human real life. The importance of cognitive science is self-evident. Secondly, among the four leading disciplines NBIC in the 21st century, cognitive science is the most important, and it is the leading discipline among the four leading disciplines. The combination of cognitive science and nanotechnology, biotechnology and information technology, together with the development of social sciences, will fundamentally change the way human beings live, and even our species. What an exciting picture this is!

The mystery of the human mind is called the last secret of God, because once the mystery of the human mind is revealed, God has no secrets to speak of. Therefore, some people (including some scientists) assert that this goal of cognitive science is simply impossible to achieve. It's not that God doesn't let us achieve it, but we can't do it ourselves. It is impossible for a system to recognize its own movement. This is a basic law of system science.

That being the case, why should human beings try to know themselves? This is because most scientists believe that humans' attempts to understand themselves have not violated any scientific laws. Human beings have the ability to recognize themselves, because their thinking can point to themselves-this is self-awareness. Among all animals, only humans and advanced primates such as gorillas have self-awareness. Moreover, people also have self-referential language that can reflect this self-consciousness. Self-awareness and self-referential language are one of the fundamental signs that distinguish humans

from other animals. Therefore, human beings can recognize themselves.

Self-awareness and self-referential language are one of the fundamental signs that distinguish humans from other animals. Therefore, human beings can recognize themselves. Before the emergence of cognitive science, scientific theories solved the universal problem of cognition: scientific principles apply to all people. The development of cognitive science has to solve the problem of individual differences in cognition: cognitive science will prescribe different prescriptions for each person. Cognitive science is "embodied", which studies cognitive problems related to the individual's body and mind. It is foreseeable that with the development of cognitive science, in the 21st century we will have food, medicine, clothing, houses and transportation for different people, as well as education, entertainment and art for different people.

Because of these characteristics of cognitive science itself, scientists generally believe that it is the commanding height of science in the new century, and countries all over the world have to seize this commanding height. This shows how important the strategic position of cognitive science is in the scientific development strategy of the 21st century.

2. Goal 2: Promote the development of related disciplines

Another significance of the development of cognitive science is that it will drive the development of other related disciplines. It can be said that in the 21st century, the development of philosophy, psychology, linguistics, anthropology, computer science, brain and neuroscience, and also the other traditional disciplines such as mathematics, physics, astronomy, geography, biology, literature, history, economics, political science, law, management science, and pedagogy, cannot be further developed if the study is not done with cognitive science or integrate with cognitive science. This is because that the further development of these discipline depends on the exploit of brain and mind, therefore it is related to cognitive science.

For example, the development of philosophy. In the early stage of human cognition, people cast their consciousness towards the world, thinking about what the origin of the world is. This is the ancient ontological philosophy. After modern times, the object of philosophical research has turned to the subject

itself, in order to study the question of how cognition is possible. And this is called modern epistemological philosophy.,After the middle of the 20th century, philosophical eyes began to turn to the language of the intermediate link between the subject and the object. This is the contemporary Western philosophy of language. In the process of research on linguistics and philosophy of language, linguists and philosophers of language discovered that language is the reflection of mind and the mind is the function of the brain. Many of them have moved from the study of language to the study of mind and cognition. Chomsky said: "Language is the mirror of the soul." [4] (P4), while Searle said: "Language is the basic function of the human mind. "[5] \After the mid-1970s, the object of philosophy has naturally turned to the human mind. Searle believes that "the most important development in cognitive science is the transfer of cognitive scientists from the computational model of cognitive science to the cognitive neuroscience model. This shows that the brain as the basis of cognition has replaced digital computers as the basis of cognition. We regard the neurobiological brain as the basis of human cognition. This is a very important change. " He also said: "The most promising research field is cognitive neuroscience, not just brain micro-nanotechnology. The hope lies in cognitive neuroscience, and I think this is the field where the most exciting research results will appear." As mentioned earlier, in the development of Western philosophy, with Europe and the United States as the mainstream, there is an obvious main line, which is: the philosophy of the object → the philosophy of the subject → the philosophy of language → the philosophy of mind. So, what is the essential difference between the philosophy of mind and the philosophy of the past? The most fundamental point is that the philosophy of mind is the philosophy of cognitive science. It is a philosophical study of the human mind based on the development of cognitive science, especially cognitive neuroscience. The research questions of philosophy of mind include: physical and mental problems, consciousness problems, psychological causality theory, mind and brain (the theory of identity of mind), mind and behaviorism, mind and calculationism, mind and causal structure, etc. The well-known mental philosopher Searle, in his new book "Mind: A Concise Introduction", summarizes the problems in the study of philosophy of mind as following: (1) the problem of mind and body; (2) the mind of others; (3) skepticism; (4)) Perception analysis; (5) Free will problem; (6) Self and personal identity; (7) Animal mind; (8) Sleep problem; (9)

Intentional problem; (10) Psychological causality and paraphenomenology; (11) Unconscious; (12) Psychological and sociological explanations.。 Among these 12 questions, the first 8 are so-called "Cartesian questions." Although the famous French rationalist philosopher Descartes raised questions about this as early as 300 years ago. However, today's philosophy of mind research on these issues is very different from traditional philosophy. The main difference is that the philosophy of mind has absorbed the achievements of cognitive science including cognitive psychology, cognitive linguistics, cognitive neuroscience, computer science and artificial intelligence, cultural evolution and the development of social sciences. Therefore, the study of these issues in the philosophy of mind is not just a philosophical speculation, but a philosophical analysis and explanation of the issues of mind and cognition based on the development of cognitive science, especially brain and neuroscience. It can be seen that without the development of brain and neuroscience and cognitive science, the cognitive turn of philosophy would not have occurred, the philosophy of mind would have been impossible, and the study of "Descartes' problems" by philosophers would have been impossible. Therefore, it is impossible for today's Western philosophy to develop to the current level. In contrast to current Chinese philosophy, in the development model of "objective philosophy→subject philosophy→philosophy of language→philosophy of mind", the development of Chinese philosophy today lacks many links. We seem to be still at the stage of development of subject philosophy, and still remain In the discourse system of German classical philosophy. We have not experienced the development stage of language analysis, let alone absorbed the results of the development of cognitive science, we still use concepts and speculative methods to construct a philosophical system. From subject philosophy to language philosophy to philosophy of mind, the development of Chinese philosophy still has a long way to go. the development of natural science as an example. Ancient science also took the objective world as its object to answer the question of what the world is. Modern science takes subjective cognitive ability as its object to answer the question of how the world is known. Contemporary science proposes that the so-called scientific theory is nothing but a subjective creation of man and a product of man's mind. The development of science in the 20th century not only solved the problem of "food, clothing, shelter, and transportation", but also solved the problem of "going into the earth". The footprint and influence of

mankind have spread far to the moon and Mars. The scientific development of the 21st century will penetrate deeply into people's own brains and minds.

The development of cognitive science has an impact on these important disciplines of NBI in NBIC, and jointly affects human life in the last century. "Whatever cognitive scientists think and do, materials scientists can use nanotechnology to make it, biologists and life scientists can use biotechnology and biomedicine to achieve it, and information scientists and computer experts use information technology to manipulate it, to control it and to make it work. "Described here is a robot, which is a robot equipped with an artificial neural network system. Searle asserted that current binary digital computers are not intelligent, but he believes that in the future, biological computers that we will build based on the principles of cognitive neuroscience may have human intelligence.Imagine that if such a computer system is applied to our study, work and life, and if such a computer system is equipped in our schools, factories, farms, ports, airports, and transportation systems, how humans will live in the 21st century ? How will humanity exist from now on? In particular, we must imagine that when the two major scientific projects, the Human Genome Project and the Human Cognitive Group Project, are combined and breakthroughs have been made, we may even have intelligent life with the characteristics of individual human cognition.

What is the commanding height of science and technology in the 21st century? It is cognitive science, artificial neural network, intelligent robot, and intelligent life with the characteristics of individual human cognition.

So, who can occupy the commanding heights of science and technology in the 21st century? It seems too early to answer this question, it depends on our efforts, but we should at least consider this question.

3. The status of cognitive science research carried out by world-class universities and Tsinghua University

(1) The Enlightenment of the Development of Cognitive Science by World-Class Universities All the world-class universities have carried out cognitive science research and have achieved fruitful results in their respective research fields. Harvard University ranks mind and body, society, earth, space, and technology

as six major research categories; MIT regards "neural and cognitive science" as an important research field, and emphasizes that "neural science and cognitive science have been widely used Recognizing that this is the most exciting research field in the next few decades,it is also the most important growth area for MIT in the next 10-20 years." MIT has established the "Department of Brain and Cognitive Sciences", "Massachusetts Institute of Brain Science" and other institutions, and published the magazine "Cognitive Neuroscience" science".The Department of Cognitive Science at the University of California, San Diego is mainly engaged in research in three areas: brain, behavior, and computing.The Cognitive Research Institute of the University of California, Berkeley studies cognitive activities in real life and tries to give theoretical explanations to these phenomena. The "Department of Cognitive and Linguistic Sciences" at Brown University is one of the earliest cognitive science departments established in the United States. Vision and speech are the main research areas of the department. Others like Stanford University, Cambridge University, and University of Tokyo are also actively carrying out research in this field. At the present, more than 60 world-renowned universities in North America and Europe have established cognitive science departments or research centers.

In October 2006, the author and his party spoke to Washington University in St. Louis, University of Illinois at Urbana-Champaign and University of California at Berkeley, etc. Field investigations were conducted on the status of cognitive science research carried out by three well-known universities. Their approach is thought-provoking and gives us profound enlightenment.

The PNP (Philosophy, Neuroscience, Psychology) research program of Washington University was founded in 1993. It was originally an innovative project. In 2003, the PNP Research Center was established. The PNP project combines philosophy, neuroscience and psychology. The project now includes not only the training program for graduate students, but also the training program for undergraduate students. It has achieved a number of important achievements in cognitive science and related disciplines Academic value and impact of research results.

The University of Illinois is well-known as the Beckman Institute for conducting interdisciplinary cognitive science research. Beckman College currently has three research sections: 1) Biological Intelligence; 2) Human-Computer Intelligence Interaction; 3) Molecular and Electronic Nanostructures.

Beckman College is an interdisciplinary research entity integrating physical science, computer science, engineering, biology, behavioral research, cognition, and neuroscience. Beckman College has achieved many impressive research results in the cross-field of cognitive science, including books, papers, patents and various awards. Beckman College has successfully turned the ideal of interdisciplinary research into a complete reality. This is what many universities want to do but fail to achieve and it is a very worthy reference for us.

(2) Tsinghua University's cognitive science research has achieved initial results. In April 2006, the School of Humanities of Tsinghua University established the Psychology and Cognitive Science Research Center, which aims to develop the psychology of Tsinghua University and rebuild the Department of Psychology of Tsinghua University through cognitive scientific research. This is the application of the second meaning of cognitive science research we discussed earlier in discipline construction. The guiding ideology and development strategy of the discipline construction of Tsinghua University's Cognitive Science Innovation Base can be simply expressed as "two cross-integration, two supporting platforms". In the construction of psychology and cognitive sciences, Tsinghua University must reflect the complete range of disciplines of humanities and sciences, and show the advantages of integration and intersection of the disciplines, highlight the intersection and integration of psychology and cognitive science, highlight the intersection and fusion of psychology and neuroscience. The development strategy of psychology is a secondary discipline that focuses on cognitive psychology and neuropsychology. Cognitive psychology is supported by the research power of the center and reflects the combination of psychology and cognitive science; neuropsychology is supported by the cooperative research between the center and the brain intelligence center, which reflects the combination of psychology and neuroscience. On the one hand, we are striving to build our school's cognitive psychology and neuropsychology into world-class disciplines, so that the construction of our school's psychology will come from behind and be at the domestic and international advanced level. On the other hand, through the construction of cognitive psychology and neuropsychology, and through cooperative research with the Brain Science Center, we will promote the construction and development of our school's cognitive science, making it a unique feature of our school and at home and abroad. Influential cognitive science system. Since the

establishment of the Cognitive Science Innovation Base of Tsinghua University, a number of important results have been achieved in discipline construction, scientific research, teaching activities, international academic exchanges, talent training, and team building.

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