

On the Five Levels of Human Cognition

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Abstract: This paper puts forward the idea of five levels of human cognition: neural cognition, psychological cognition, linguistic cognition, thinking cognition and cultural cognition. It distinguishes the differences between low-order cognition and high-order cognition. Human cognition, that is, high-order cognition, is based on language and characterized by thinking and culture. The five levels of human cognition are divided according to the scientific standard, which means divided according to the level of cognitive process in human mind. This kind of division is the basis of scientific research, too. The cognition of five levels determines the development of cognitive science, and their cross connection determines the development of more interdisciplinary subjects. This paper discusses in detail the present situation and achievements of research on the cognition of five levels, which helps us see not only the relationship between all levels, but also the relations between scientific research on cognitive science and its discipline development. The classification of five levels has important theoretical significance and practical value.

Key words: neural cognitive; psychological cognition; linguistic cognition; thinking cognition; cultural cognition

1. The five levels of human cognition

Human cognition can be divided into five levels from the low level to the high level: the cognition of the neural level; the cognition of the psychological level; the cognition of the linguistic level; the cognition of the thinking level; the cognition of the cultural level. In some situation they can be easily referred to as neural cognition, psychological cognition, linguistic cognition, thinking cognition and cul-

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tural cognition respectively. So far, human cognition can only and must be included in these five levels. The first two levels of cognition, psychological cognition and neural cognition, are known as the “lower-order cognition” which human and animals both have. The latter three levels of cognition are unique to human beings, known as the “high-order cognition”. Five levels of cognition form a sequence: neural cognition→psychological cognition→linguistic cognition→thinking cognition→cultural cognition, The arrow“→”shows the direction of human mind, so the direction of human mind. The relationship of human cognition can be arranged vertically as below. In this sequence, low level cognition is the basis of high level cognition, and high-level cognition has a downward impact on cognition.¹

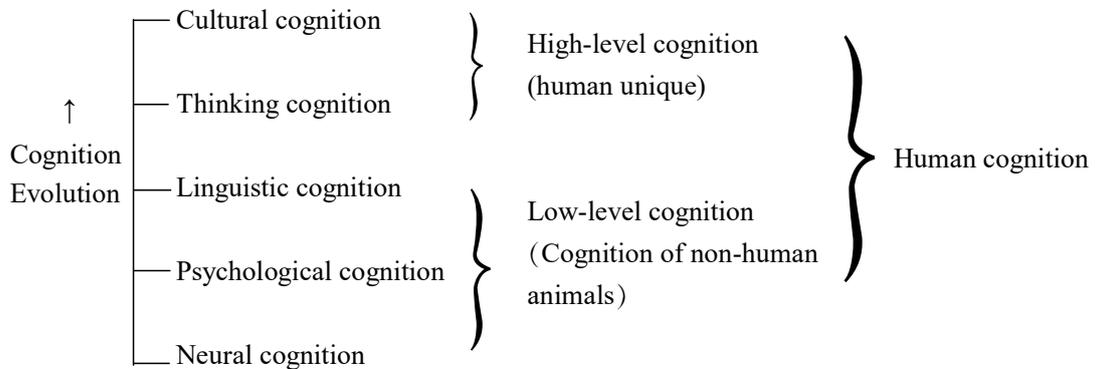


Figure1. The five levels of human cognition (Shushan Cai , 2015)

The following conclusions can be made from the above figure.

(1) Human cognition covers all five levels, including higher-order and lower-order. Development from neural cognition, psychological cognition, linguistic cognition, thinking cognition to cultural cognition is the reflection of evolution of human mind and cognition; the existence of five levels of human cognition is the legacy of the various stages of mental and cognitive evolution.

(2) Each low-level cognition is the basis of high-level cognition. For example, neural cognition is the basis of psychological cognition; psychological cognition is the foundation of linguistic cognition; linguistic cognition is the foundation of thinking cognition; thinking cognition is the basis of cultural cognition. Of course, we can also say that neural cognition and psychological cognition are the foundation of linguistic cognition; neural cognition, psychological cognition and linguistic cognition are the foundation of thinking cognition; neural cognition, psychological cognition, linguistic cognition and thinking cognition are the basis of cultural cognition and so forth.

(3) Because high-level cognitions involve low-level cognitions, the higher have

an impact on the lower. For example, cultural cognition has impact on thinking cognition, linguistic cognition, psychological cognition and neural cognition; thinking cognition has an effect on linguistic cognition, psychological cognition and neural cognition; linguistic cognition affects psychological cognition and neural cognition, etc...

(4) High-order cognition, which is composed of linguistic cognition, thinking cognition and cultural cognition, is a special form of human cognition. High-order cognition is the focus of this paper. In high-order cognition, linguistic cognition is the foundation. In the five levels of human cognition, linguistic cognition is the core.

(5) Low-order cognition is the cognition of non-human animals. Of course, humans also have this cognition. This paper is not particularly concerned with it, but some studies must be made concerning its influence on high-order cognition. For example, because of the central role of linguistic cognition in the whole human cognition, this paper will also discuss the relation on neural cognition, psychological cognition and linguistic cognition.

Five levels of cognition are classified according to scientific standards. The so-called scientific standard, are to use the object of scientific research as the basis of this division. Up to now, the objects of cognitive science have been divided into five levels, and there is no cognitive object beyond these five levels. Of course, some of the objects are cross-level, which forms an interdisciplinary study of cognitive science.

2. Subject Standard and Scientific Standard of Cognitive Science

Cognitive science has a well known framework, as shown in figure 2.²

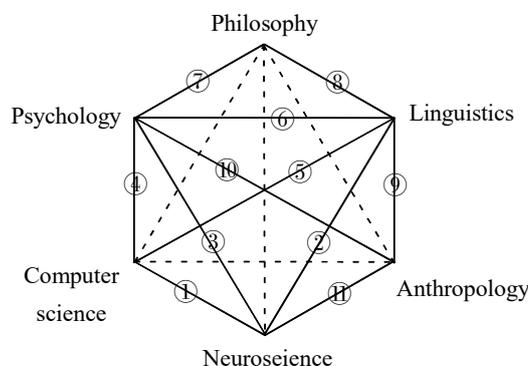


Figure2. Cognitive science subject structure (Pylyshyn, 1983:76)

In the figure, neuroscience, psychology, linguistics, philosophy, computer science and anthropology are called the six major sources of cognitive science. In the framework of cognitive science, the six sources of disciplines cross each other, and produce 11 emerging disciplines, which are control theory; neural linguistics; neural psychology; computer simulation; computer linguistics; linguistic psychology or psychological linguistic; psychological philosophy; the philosophy of language or linguistics theory; the evolution of linguistics, or the birth and evolution of language, or anthropological linguistics; the cognitive anthropology; brain evolution.

In this way, we have two relationships in cognitive science. The first is the above figure 1, which is divided from the five levels of human cognition. It is based on the cognitive process of human minds, that is, according to the relationship between each cognitive science research objects.

Because Figure1 is based on the scientific standard, it is called “the figure of scientific relations”. Figure2, divided from the source of cognitive science, as it is based on the academic standards, should be called “the figure of discipline relations.”

The scientific relations of the five levels of cognitive science are fundamental, and the relationship between the 6 branches and cognitive science is subordinate. The reasons are: one the one hand, the relationship between science and discipline, the scientific research which is problem-oriented should be put on the first place, it is the dominant; and the subject setting aimed at standard is secondary and subordinate. On the other hand, the scientific relationship of cognitive science determines its relationship. Second, the scientific relationship of cognitive science determines its disciplinary relationship. It is easy to see the relationship between the five levels of cognitive science and the six subjects, respectively. From the low level to the high level are 6 corresponding relationships: neural cognition → neuroscience; psychological cognition → psychology; linguistic cognition → linguistics; thinking cognition → computer science, logic, philosophy; cultural cognition → anthropology. Here, the arrows represent the mapping. It is clear that the mapping relationship is not established in turn. This shows that the scientific relationship of cognitive science is the basis of the relationship between disciplines, because the five levels in the cognitive process of human beings cross each other, so do disciplines of cognitive science. Third, the five levels of cognitive science intersect each other, resulting in a number of interdisciplinary subjects. Here are the interdisciplinary subjects resulting from the cross of the five level.

(1) On the neural cognitive level, we have the cross discipline mapping as follows: nerve-psychology cross → neuropsychology; nerve-language cross → neural

Linguistics; nerve-thinking cross → computer science (cybernetics, computational neuroscience, philosophy of neuroscience (philosophy of mind), neural thinking science(the logic of the nervous system and epistemic logic); nerve-culture cross → cultural neuroscience.

(2) On the level of psychological cognition, we have the following mappings: psychology - language cross → psycholinguistics, linguistic psychology; psychology - thinking cross → thinking psychology, mental logic; psychology - culture cross → cultural psychology, social psychology , cognitive anthropology.

(3) On the level of language cognition, we have the following mappings: language-thinking cross → language logic, computational linguistics, philosophy of language, theoretical linguistics (logic linguistics); language-culture cross → evolutionary linguistics, the emergence and evolution of language, anthropological linguistics.

(4) On the level of cognitive thinking, we have the following mappings: nerve-culture cross → cultural logic, cultural philosophy (such as Liang Shuming), thinking culture, ethnic culture.

In addition, we may also have the discipline based on the cross of multiple disciplines, such as the intersection of language-thinking- culture, which produces the famous Sapir hypothesis (The Sapir-Whorf hypothesis), as well as the language of chemistry and thinking culture.

We can see that there is a perfect corresponding relationship here: the five levels of human cognition and the relationship between the five levels, and the structure of cognitive science and interdisciplinary subjects. We also see that cognitive science and interdisciplinary subject structure is decided by the structure of the five levels of cognitive science and the cross between them, including the famous hexagonal structure (Figure 2), but there are much more interdisciplinary subjects, and this is what we failed to realize in the past.

3.Research Status and Achievements of Five Levels of Cognition

Here we look at the present research situation of five levels of cognition and some important landmarks.

3.1The cognition on the neural level

This is the common cognition that human and animals both have. The study on the neural level of cognition has produced phrenology and neuroscience in history,

which are represented by Willis (Thomas Willis, 1621 - 1675), the brain mapping theory, Gall (Franz Joseph Gall, 1758- 1828), phrenology and anatomical study, Jackson (John Hughlings Jackson, 1835-1911), positioning principle and so on. And one of the most meaningful research and discovery comes from the work of French neuroscientist Broca (Paul, Broca, 1824-1880) and the German neurologist, Carl Wernicke. In 1861, Broca reported the first neurological case of brain damage. The symptom is that the patient can understand the language, but cannot speak, the exact location of the patient's brain injury is the lower part of the left frontal lobe, which was later named the Broca district. In 1876, Vinick reported a stroke case, whose symptom is that the patient can speak freely, but does not make sense, and cannot understand both written and spoken language. The location of the patient's brain injury is in the left hemisphere backward area, that is, near the junction of the temporal lobe and the parietal lobe, which is now known as the Vinik area.

Since then, more physiologists, anatomists, neuroscientists, neural-anatomists have been involved in the study of brain and nerves. Representatives and doctrines are Italian Golgi (1843-1926) —neuronal staining theory and the ganglion cell maps of the different animals; Santiago Ramony Cajal (1852-1934)—Neuronal has homogeneity, and neuronal electrical conduction is unidirectional, only from the dendrites to axons. They won Nobel Prize in Physiology or Medicine in 1906.

At the same time, psychology has undergone the change from behavioral psychology, connectionism psychology to cognitive psychology, and representatives are: behaviorism by Burrhus Frederic Skinner (1904-1990), connectionism by Hermann (Hermann Ebbinghaus, 1850-1909), Edward Lee Thorndike (1874-1949), Wahson (John B. Waston, 1878-1958), and so on. In 1956, the genius psycho-linguist, Noam Chomsky (1928-), in the “Three Models of Language Description”, profoundly reveals that behaviorism and connectionism doctrine simply cannot explain how we learn language. He points out that the complex form of language is embedded in the brain, and the reason why it works is beyond all human and all languages, and the language is universal—it is Chomsky's liberalism and psycholinguistics. Almost overnight, psychologists think in a cognitive way, and completely abandon the behaviorism. George A. Miller (1920-2012) The once determined behaviorist, influenced by Chomsky, turned to the study of cognitive psychology in the human mind and established Harvard's cognition Science laboratory, which is the world's first cognitive psychology laboratory. Since then, cognitive neuroscience has been born.

There were a number of major discoveries in the brain and neuroscience in the twentieth century, such as RW Sperry, in the 1960s, through a series of experiments that confirmed the “left and right brain division of labor theory” of brain asymme-

try, won the 1981 Nobel Prize in Physiology or Medicine. The left brain is responsible for logical understanding, memory, time, language, judgment, arrangement, classification, logic, analysis, writing, reasoning, inhibition, five senses (vision, listen, smell, tactile, taste), etc., thinking with continuity, duration and analysis. So the left brain can be called “consciousness brain”, “academic brain”, “language brain”. The right hemisphere is mainly responsible for the spatial image of memory, intuition, emotion, physical coordination, visual perception, art, music rhythm, imagination, inspiration, and epiphany. Its thinking mode is disorderly, jumping, intuitive and so on. So the right brain can be called “instinctive brain”, “subconscious mind”, “creative brain”, “music brain”, and “artistic brain”. The development of neuroscience makes us fully aware of the structure and function of the brain and the nervous system. On this basis, we can define mind, cognition and cognitive science. Mind is the intelligent way of the brain and the nervous system. The process of creating mind from the brain and the nervous system is called cognition. Cognitive science is a science that studies cognitive phenomena and laws.³ From this we know that humans and animals have mind and cognition. What are their differences? Obviously, mind and cognition on the nerve level are not enough to distinguish the two.

To reveal the working principle of the human brain and the nervous system, it is necessary to understand the working methods and processing mechanisms of the nervous system from the five levels of interrelationships, since the five levels of cognition are interrelated in the human brain. Therefore, at the level of neurological cognition, we should at least have the following scientific crossings to the interdisciplinary mapping:

- (1)Nerve-psychological cross → neuropsychology;
- (2)Nerve-linguistic cross → neural Linguistics;
- (3)Nerve-thinking cross → neural computer science (cybernetics), computational neuroscience, neuroscience philosophy (mental philosophy), neuroticism (logic and cognitive or logic of nervous system);
- (4)Nerve -cultural cross → cultural neuroscience.

The third edition of M.S.Gazzaniga and G.R.Mangun’s “Cognitive Neuroscience: Mind Biology” basically talks about cognitive neuroscience in terms of the five levels of crossover. The first part of this book is “background and method” that introduces a brief history of cognitive neuroscience, the structure and function of the nervous system, and the method of cognitive neuroscience. The second part of the book “core process” have 11 chapters in total, which are: Chapter 4 The specificity of the cerebral hemisphere; Chapter 5 The senses and perception; Chapter 6

Object identification; Chapter 7 Attention; Chapter 8 Behavior; Chapter 9 Memory; Chapter 10 Emotion; Chapter 11 Language; Chapter 12 Cognitive Control; Chapter 13 Social Cognition; Chapter 14 Consciousness, Free Will and Law.⁴ It is easy to see that Chapter 4 is about neural cognition; Chapter 5-10 is psychological cognition; Chapter 11 is linguistic cognition; Chapter 12 involves thinking cognition, but not entirely; Chapter 13 is cultural and social cognition. The change in this book from the third edition (2009) to the fourth edition (2014) is very interesting. In the third edition, the specificity of the cerebral hemisphere is in Chapter 11, after linguistic cognition, and in the fourth edition, this part has moved to Chapter 4, the first chapter of the “core process”, so that the order of the entire chapter is in accordance with the five levels of cognition from low to high. But this book does not have a special chapter to analysis thinking, logic and reasoning of neuroscience, which is a deficiency in terms of system; and since the birth of cognitive science, there have been a lot of important research and results in neuroscience. It is also a pity that they are not included in this book.

3.2 The Cognition on the Psychological Level

This is also the cognition that human and animals both have. The study of psychological cognition also originated from Chomsky. As mentioned earlier, Chomsky Miller had opened up research on mind and cognition on the psychological level, and since then, psychology has said goodbye to the era of behaviorism, and walked into the era of cognition.

In 20th century, psychologists were studying on the basic psychological phenomena systematically, like sense, perception, attention, presentation and memory. Sense is a direct understanding of a single sensory, including vision, hearing, taste,

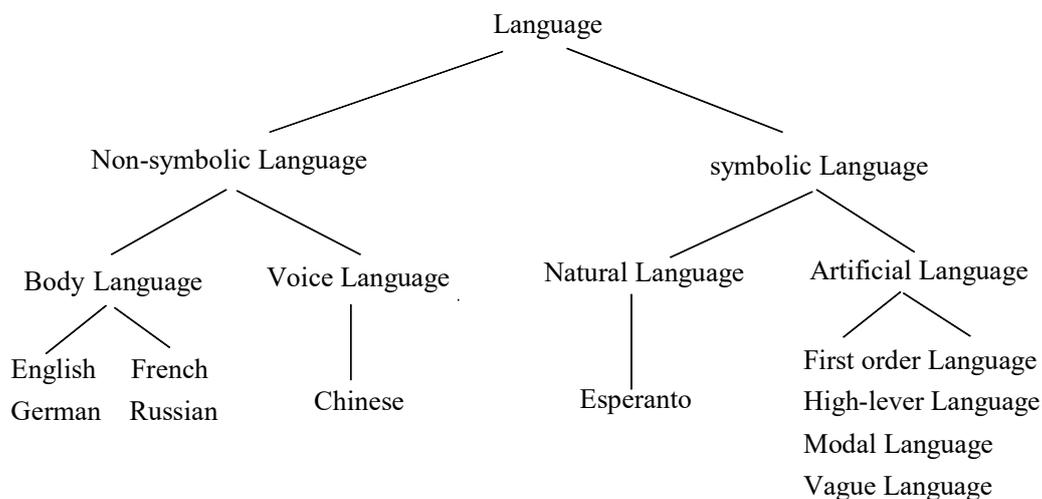


Figure 3 Language classification system and branch map

smell, tactile, and sensory or cross-channel recognition, which is synesthesia. For example, in visual level, we also feel temperature about the color, such as red and orange. Yellow will make people feel warm, so these colors are called warm color; blue, green will make people feel cold, so these colors are called cool color and so on. Consciousness or perception is the psychological process of brain and nerve, which re-process the sensory information in order to obtain a holistic understanding of things. Perception has the characteristics of integrity, constantness, meaning, selectivity and so on. Both sensation and perception gain knowledge through the senses, and they are closely intertwined, often referred to as sensations and perceptions. Attention is an important way of cognitive processing at the level of perception and consciousness, which is a form of perceived selective concentration that leads to the level of awareness of local stimulation. Attention is one of the most popular areas of research in cognitive psychology.

Image or presentation is a form of cognition about experience on the basis of sense and perception, with further processing of the brain. Sense and perception cannot exist without the senses, but the image can. The presentation is visual, intuitive and general. Presentation often occurs on a variety of sensory channels; for example, we have visual presentations, auditory presentations, and smell, taste and tactile, dynamic presentations, and so on. In psychology, the presentation is the process of the image of the things that have been perceived in the past. In philosophy it is to represent the world as the object, with the corresponding spiritual category called concept. Memory is a special form of presentations. Presentation is usually reflected in the memory effect. When people are thinking, often accompanied by presentation about things, and sometimes the solution to certain things also depends on the help of presentation. In 20th century, psychologists studied the representation and memory profoundly. For example, according to Miller (G. Miller) research, human working memory capacity is limited, usually 7 ± 2 , which is 5 to 9 units. If you exceed the capacity of short-term memory, short-term memory is easily disturbed and forgotten. The famous elbow curve shows that the memory is a function of time. Forgetting begins immediately after learning. At first, the forgetting is fast, and then slowly, but after review, the number of things forgotten will be reduced, and the amount of memory will be significantly improved. This has provided a scientific basis for the Chinese educator Confucius' s famous thesis which has a history over 2,500 years, “ is it not pleasant to learn with a constant perseverance and application? ”

Presentation and memory are the intermediate transition from perception to thinking, and presentation has some sort of elementary form of thinking and plays

an important role in thinking. The effect of presentation on thinking is expressed as: First, the presentation of thinking (image thinking), that is does thinking operation by presentation. The “psychological rotation” of R. Shepard shows that the greater the angle of the letter rotation, the longer it takes to judge the pros and cons. The time difference between the psychological rotation angles proves the existence of the image thinking-presentation operation. The Shepard experiment also proves that the psychological rotation, in nature, resembles the physical rotation of the actual object, thus providing further evidence for the representation of the symbol in the form of storage. Second, the presentation and the word do double coding in the psychological operations, but between the image and the words, there can be corresponding relationship. The cognition of the relationship between presentation and words is of great significance in artistic creation. For example, Wang Wei’s poem is created through the conversion of “presentation-word”, and is appreciated by the conversion of “word-presentation”. The creation and appreciation of novels and scripts are also like this. Third, the presentation is the basis of conceptual thinking. And the operation of conceptual thinking needs the support and participation of presentation. The different tasks of thinking determine whether the presentation operation appears in the process. For example, geometry relies heavily on the support of image operations, which are the necessary pillars of geometric operations. But algebra and equation operation only need to use the concept of symbols, completely ruling out the image operation. Some of the major theoretical issues of image thinking need to be pursued; for example, are there presentations of thinking? Is the animal thinking? These questions remain a major theoretical problem that has not been resolved in the psychology and cognitive sciences.

Cognition on the psychological level also crosses with other levels of cognition. Therefore, on the level of psychological cognition, in addition to the mainstream cognitive psychology, there are the following scientific crossings to the interdisciplinary mapping: psychology-linguistic cross → psychology linguistics, language psychology; psychology-thinking cross → thinking psychology, psychological logic; psychology-cultural cross → cultural psychology, social psychology, cognitive anthropology. In these areas, we have achieved a lot of important successes in the last half a century.

3.3 The Cognition on the Linguistic Level

This is the unique mind and cognitive form which only mankind possess. In the five levels of human cognition, language has a special status and meaning. First, it is in the middle of the five levels; second, it is the conjunction of low-level cognition

and high-level cognition; third, it is the basis of high-level cognition. Human mind and cognition are language-based, so cognitive science has a special meaning for language research. The language of the animal world is both unified and differentiated. Unity is that all languages are the result of natural evolution. The difference lies in the fact that the natural language has a unique position in the evolutionary tree of the language, and even the different languages under the same system have the characteristics that can be distinguished from each other. For example, the sound language of the animal, the cricket's tweets and the nightingale's singing are completely different. And both belong to the human ideographic symbol language, as phonetic language and graphics language are completely different. Even for the same national language, regional differences will be very great. This distinction in language provides a basic for cognitive science to explain individual differences. The evolutionary forms of animals from low to high are: body language, voice language, ideographic symbolic language (Figure 3).⁵ The symbolic language that human possesses is abstract, generative, arbitrary and ambiguous. The unique symbolic language and text make mankind finally evolve into human beings.

Since the second half of the 20th century, linguistic research has made significant progress and became one of the original disciplines of cognitive science. The third language framework of contemporary linguistics comes from the study of semiotics, which forms the three major areas of contemporary linguistics: syntax, semantics and pragmatics. Representatives and important theories are Chomsky's formal syntax, R. Montague's formal semantics, Austrian (J. L. Austin) and Seler (J. R. Searle)' speech act theory, Kaide Meng' (N. Kadmon) formal pragmatics. Syntax is the subject that studies the spatial arrangement of linguistic signs. Semantics is to study the sign and meaning of linguistic signs. Pragmatics studies the relationship between linguistic symbols and users. From syntax to semantics and then to pragmatics is a process of gradual expansion, and the order of processing is "bottom-up". From pragmatics to semantics and then to syntax is to be included, the order of processing is "top-down". In modern linguistics, the discipline of linguistic theory, which is based on syntactic, semantic and pragmatic frameworks and methods, is called theoretical linguistics. Another discipline devoted to language theory is called logical linguistics, which is divided into three parts: structural theory (morphology), meaning theory and validity theory. Linguistic semantics, treated as a branch of semiotics to study, is a kind of linguistics of metaphorical nature.

The study of language and linguistics is of particular importance to the establishment and development of cognitive science. In the field of syntax, we take Chomsky as an example. In 1957, Chomsky's theory of syntactic structure sound-

ed the first horn of the linguistic revolution and cognitive science revolution. Over the next 40 years, he has made a number of significant theoretical contributions to the fields of linguistics, linguistic philosophy and cognitive science. In the field of linguistics, Chomsky has established syntactic structure theory (SS), standard theory (ST), extended standard theory (EST) and Revised Extended Standard Theory (REST), Jurisdiction and Government and Binding Theory (GB), Minimalist Program (MP) and so on. In the field of linguistic philosophy, his contribution is multifaceted: he put forward the scientific hypothesis of Innate Language Faculty (ILF), which distinguishes linguistic competence and linguistic knowledge. This hypothesis was later confirmed by scientific experiments which enabled us to have an unprecedented deep understanding about language skills. He established the universal grammar (UG), indicating the identity of the whole human language: only one language, only one grammar. He also established the psychological and rationalist linguistics, so that our understanding of the language has been essentially changed. In the field of psychology, his contribution is also multifaceted. He criticized Skinner (BF Skinner), the representative of the behavioral psychology; his thought influenced another behaviorist psychologist Miller (G. Miller), who later turned to cognitive psychology research, and also led Psychology change from the era of behaviorism to the era of cognitive psychology; his language theories created theoretical linguistics, psycholinguistics, experimental psycholinguistics and many other linguistic emerging areas; his universal grammar theory enriched the language psychology learning theory and research on language acquisition. In the field of computer and artificial intelligence, Chomsky established formal grammar, so that the natural language of the machine analysis became possible. He is also one of the earliest founders of artificial intelligence theory and technology. It can be said that if there were no Chomsky, half a century of human civilization would be different, and the world would be different too In short, Chomsky has changed our way of thinking, and won the same status of Descartes and Darwin. Chomsky is the first-generation leader of cognitive science.⁶

In the field of pragmatics, Austin (JL Austin) proposed speech act theory. He distinguished three Speech acts: locutionary act, illocutionary act and perlocutionary act, and also classified speech acts. On this basis, J. R. Searle further promoted the study on speech act theory. He generalized speech act theory, treating all the speech acts as pragmatic behavior, "talking things is doing things." He reclassified speech acts and used symbols to express them. On this basis, he and his partner van der Vaife (Daniel Vanderveken) established together the illocutionary logic. Searle further extended the speech act theory and established indirect speech acts theory.

On the basis of speech act theory, Searle further studied intentionality and human mind, so that his philosophy extended from language philosophy into the field of cognitive philosophy and social philosophy. On the language - mind - cognitive relationship, Searle had dialogue with the author and made a profound exposition.⁷

The cognition on the linguistic level also intersects with other levels of cognition. On the level of linguistic cognition, we not only have cognitive linguistics, but also language and cognition, as well as the following mappings from the field of scientific research to subjects: linguistic-thinking cross → language logic, computational linguistics, linguistic philosophy, theoretical linguistics (logical linguistics); linguistics - cultural cross → evolutionary linguistics, the emergence and evolution of language, anthropological linguistics and so on.

3.4 The Cognition on the Thinking Level

This is a unique form of human mind and cognition, which are characterized by thinking. Thinking is the highest level of human activity made by mankind. All human performances and progresses are the product of human thinking. Culture, art, literature, science and technology are all the results of thinking.⁸ The French philosopher Descartes' famous assertion "I think so I am" (French: Je pense, donc je suis.) (English: I think, therefore I am.) defines the relationship between thought and existence as a causal relationship. I am thinking, so I exist. The definition of the life existence in philosophy is three hundred years earlier than modern medical brain death. In fact, Descartes' scientific thought is as famous as his philosophical thought. Descartes' Mind-Body problem is the eternal problem of philosophy and cognitive science.

Ancient Chinese thinkers have also had a very brilliant exposition of thinking. Confucius and Xunzi have discussed the relationship between learning and thinking. Confucius said, "Learning needs to be combined with thinking."⁹ Xunzi said, "Moments of learning is far beyond days of thinking."¹⁰ Mencius not only distinguishes sensibility and rational knowledge (thinking), but also profoundly discusses the relationship between the two. He said, "Ears, eyes, these organs will not think, easy to be blinded by foreign objects. So once contact with foreign object could be tempted. Heart as an organ could think, thinking can get goodness. This is the most important talent that Creator gives us. First grasp this important organ, the eyes of the secondary organs will not be taken away by the temptation of foreign objects. This is the truth of becoming a gentleman."¹¹

The form and the law of thought have always been the field of logic research. The form of thinking in the study of logic includes concepts, judgments, reasoning

and argument, and the law of thought includes the law of identity, the law of contradiction and law of excluded middle.¹² Concept, judgment, reasoning are the high-level form and advanced stage of cognition.

The scope of psychology research is feeling, perception and presentation, the main areas are feeling, perception, consciousness and attention, presentation and memory, motivation and emotions, which belong to the low-level or primary stage of knowledge. In addition, psychology also studies the psychological characteristics of people, such as ability and personality, as well as human learning activities. After the establishment of cognitive science, due to the interaction between psychology and logic, psychology has also entered the field of thinking research.¹³

After the establishment of cognitive science, there appeared the trend of cross-integration between psychology and logic, which are re-unified in the background of cognitive science framework. From 2004 to 2009, the author published articles at domestic and foreign academic journals and academic conferences, established the disciplinary framework of cognitive logic, and mapped the disciplines of cognitive science (Figure.1) into the background of modern logic. The logic framework of cognitive, which includes philosophical logic, linguistic logic, mental logic, logic of artificial intelligence, logic of culture and evolution, and logic of nervous system. The disciplinary framework of cognitive logic is shown in Fig.4.¹⁴ In the framework of cognitive logic, we could see that the reunification of psychology and Logic. The process from split to re-unit of psychology and logic shown in Figure 5¹⁵ :

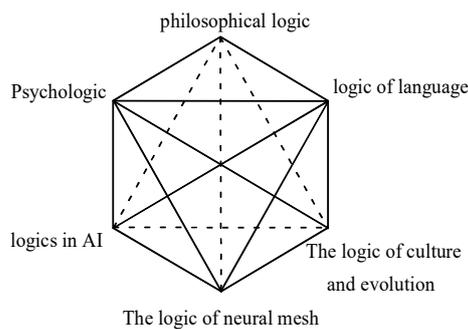


Figure 4: Cognitive logic subject frame

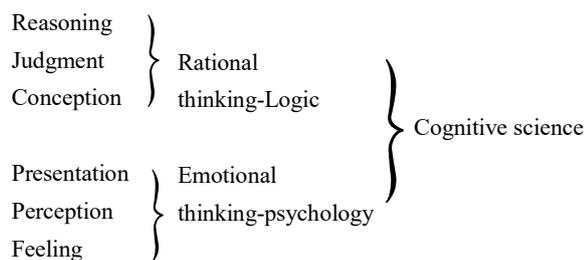


Figure 5: Psychology and logic re-unified diagram

The result of the fusion of psychology and logic has produced a number of e-emerging disciplines such as psychological logic / mental logic and psychology of thinking, and has made a series of important research results. For example, the famous Watson selection task (1966)¹⁶ profoundly reveals the relationship between logical processing and psychological processing in human cognitive processes. First

of all, people's minds do not mean "logic". The logic of the mind, or the logic used in thinking and cognitive activity, is related to experience. The logic that is universal, unrelated to experience and absence of individual difference does not exist, or that it exists only in the ideal model of the logician. Second, the ideal logical model in the practical application, often have a certain degree of psychological biases, which shows that people in the actual thinking and cognitive process, the logical process and psychological processes are intertwined with each other, logic reasoning is subject to psychological factors. Thirdly, although the psychological factors affect the logical reasoning, the correct logical reasoning model (including the innate MP and the acquired MT) will constrain and revise the thinking and cognitive process, so that it runs in a scientific and reasonable range.¹⁷

After Watson's experiment, Watson, G. A. Miller, Miller (PN Johnson-Laird) had made a lot of remarkable results in the field of psychology and logic. The main achievements are reasoning psychology, language and perception, thinking, mental models, human and machine thinking and so on, while Rips (L. J. Rips) focused on the concept, reasoning and the proof of psychology. In the book "Proof Psychology", Rips studied the psychological logic of the theory of syllogism, hypothetical reasoning and first-order logic by means of psychological experiments. The most eye-catching work of psychological logic, I think it is psychologists Daniel Kahneman (D. Kahneman) and Amos Tversky (A. Tversky)'s venture capital theory. The study found that people's risk-taking decisions are asymmetric: when in the face of profitability, people shows a tendency to "risk aversion", when in the face of a loss, people's decision-making showed a "risk-seeking" tendency.¹⁸ They have spent more than 30 years developing this important economic theory called the "prospect theory" and have received the 2002 Nobel Prize in Economics. In 2011, Kahneman published his book "Thinking: Fast and Slow", he used two agent metaphors, namely System 1 and System 2, to describe people's thinking activities. System 1 is psychological, intuitive, automatic and unconscious, it is fast thinking system; system 2 is logical, analytical, controlled and conscious, and it is slow thinking system. Kahneman argues that System 1 has a greater role in judging and making decisions than we know, and it is the secret author of judgment and decision making.¹⁹

On the cognitive level of knowledge, we have the following mappings from scientific research to disciplinary development: thinking-cultural cross → cultural logic, cultural philosophy (such as Liang Shuming), thinking culture, national culture and so on.

On the thinking level of cognition, we obtain the research results can be said to be fruitful in the last half century. Our research team has also made considerable

achievements in this fields, the reader can refer to the author and the research team members of other works and paper.

3.5 The Cognition on the Cultural Level

Cultural cognition is the highest level of cognitive form in five levels, and it is also a cognitive form that only human possesses. To sum up, human cognition is a language-based, high-level cognition characterized by thinking and culture. Culture is a category of opposition to nature. Culture is the sum of all the objects that people create, and also are human creations, including material existence, social existence and spiritual existence. So, culture is humanized.

Everything created by man is culture, civilization is the culture developed to a certain stage. Culture and civilization are closely related, and they are the product of human activities. The two are closely linked but differentiated from each other. Culture and civilization are human creatures, and this is their common ground. But culture emphasizes the spiritual wealth created by mankind, such as religion, philosophy, literature, art, music, dance and so on. Civilization is more focused on the material wealth and social systems created by mankind, such as electric lights, telephone, computer, network, law, country and so on.

The development of civilization has a tendency to deviate from culture and nature. Ancient civilization is directly related to culture, but also close to nature. Modern civilization began to deviate from culture, and treat nature as a dissident object to be modified and used. Science and technology-oriented contemporary civilization is completely deviated from culture, and began to carry out large-scale destruction of nature, and even trying to transform and change it. The development of mankind today is the time to profoundly understand and correctly grasp the relationship between nature, mankind, culture and civilization!

Culture influences cognition. This is one of the most profound topics in current cognitive science research. According to the type of human culture, we can divide human cognition into three levels and discuss the relationship between culture and cognition.

At the cultural level, the three levels of human cognition are science, philosophy and religion. They are closely linked with the human culture, and the process is from the primary to the senior.

Scientific cognition is at the bottom of cultural cognition, which is the most basic form of human cultural cognition. Scientists at this level reveal the truth of nature. They use mathematical methods based on scientific method. Pythagorean theorem with “hook three quadruple five” can get a right triangle, so as to solve a lot

of ancient building problems. This theorem is later expressed by the mathematical variables as “ $a^2 + b^2 = c^2$ ” by Pythagoras, making it more universal and applied to a larger range. Following this theory, the students of Pythagoras get a unit length of the diagonal length of the square is $\sqrt{2}$, which is an irrational number. This discovery led to the first mathematical crisis, leading to the expansion of the number of systems and the development of mathematics.

Newton’s second law of motion, i.e., the law of momentum, $F = ma$, depicts the relationship between force, mass and acceleration in the movement of macroscopic objects. Surprisingly, Newton’s original formula, $F = d(mv) / dt$ is still valid in relativity. Einstein’s theory of relativity, starting from the basic formula “ $dE = Fds$ ” about the relationship between object kinetic and displacement, using the momentum law, derived the famous quality formula “ $E = mc^2$ ”, which not only explains the relationship between the object’s energy, quality and speed, but also technically releases atomic energy, so that humans can master new energy. Scientists use mathematical and logical derivation to induct these formula, which are all confirmed by scientific experiments and scientific practice. This is the power of the human mind’s advanced form of rationality!

Science is not omnipotent. Since the method of scientific cognition is empirical and falsifiable, it limits its scope of application. When this range is beyond the empirical and falsifiable, scientific cognition is powerless, and human cognition must resort to the more advanced form of philosophy.

Philosophy is the higher form of human cognition, this truth of the universal has been proven by many modern and contemporary outstanding philosophers. Lao Tzu’s “Tao Te Ching” has no more than five thousand words, but the world view as demonstrated by this book has been guiding people to explore the value of nature and the meaning of life. The truth contained in the Book of Taoism has kept people pursuing for more than two thousand years, but we are not closer to it, but farther. Lao Tzu will always be a world-class philosopher. For more than two thousand years, there is in China another world-class philosopher, who is the founder of the heart, the Ming Dynasty Confucianism, the only man who has been extolled by people from generation to generation for three things: establishing a noble morality, building achievements for the people and making a speech of insight. He is Wang Yangming. From the ontological theory of “the mind is the reason”, the epistemology of “knowing conscience” and the practice of “combining knowledge and practice”, Yangming’s mind and contemporary cognitive science coincide with each other, and it is only 500 years earlier than the west! Wang Yangming’s thoughts and actions influenced Zeng Guofan, Liang Qichao, Sun Yat-sen and Chiang

Kai-shek, and he is their spiritual mentor. Zhang Taiyan said, “Japan’s Meiji Restoration, is also guided by his thought.” Japan’s backstage leader Saigō Takamori said, “Practice chill, and all learn from Yangming.” Togo Heihachiro said, “Pursue yangming in my whole life”. Mr. Du Weiming said: “For five hundred years, the source of Confucianism has been in Wang Yangming, and the 21st century will be the century of Wang Yangming.”

For more than two thousand years, Western philosophers have also been contemplating the same question, the world’s origin, the mystery of knowledge, and the philosophy of life. Ancient Western philosophy to explore the origin of the world is the ontological philosophy. Thales thinks the origin of the world is water, Heraclitus’ Fire, Pythagoras’ number and the Democritus’ atom. They also explore metaphysical problems, Plato’s theory of ideas and Aristotle’s empiricism. They also founded scientific and philosophical research methods, such as Euclidean geometry and Aristotle syllogism. Modern European philosophy explores human cognitive ability, which is epistemological philosophy. Bacon’s inductive law, Descartes’ deductive law, Locke’s whiteboard sayings and Berkeley’s presence are perceived, so are Hume’s induction problem and agnosticism, Kant’s purely rational criticism and innate comprehensive judgment. Modern European philosophy continues the debate between theory and empiricism. Western philosophy in the 20th century is divided into three stages, positivism and analytical philosophy in the 1920s-1950s, represented by Russell, early Wittgenstein and the Vienna school of the logic; linguistic school in the 1940s-1970s, represented by Wittgenstein and the philosophy of language co-founded by Chomsky, Austin, Montague, Searle; the philosophy of mind developed by John R. Searle in the mid-1970s when cognitive science was founded. Analytic philosophy, linguistic philosophy and cognitive philosophy, the three mainstreams of western philosophy in the 20th century are all related to language. Analytic philosophy uses symbolic language and its mathematical logic as an analytical tool to study the nature of thinking objects which the symbolic language reflects; linguistic philosophy returns to natural language to study the syntactic features of natural language, semantic features, pragmatic features and the substitutive features of language objects (language as the object and language’s object). The philosophy of mind studies the nature of human mind with language as the carrier and thinking as the feature. As mentioned earlier, the human mind can be understood and studied from the five levels of nerve, psychology, language, thinking and culture. To sum up, we can say that the ancient ontological philosophy treats object as the object, modern epistemological philosophy treats subject as the object, and contemporary language philosophy and philosophy of mind treat lan-

guage as the object. The subject cannot reach the object unless it passes through the language. In addition to language, we know nothing about it.

Broadly speaking, religion is also a part of culture, because religion is also the creation of mankind. As early as the beginning of cognitive science, Harvard Medical School began to study the relationship between religion and cognition. In 1979, Dr. Herbert Benson, an associate professor at Harvard Medical School and dean of the Institute of Physical and Mental Medicine, met with the Buda Lama at Harvard University, and Dr. Benson made a presentation to the Buda Lama Test to understand how the mind affects the body. Since then there have been several expeditions to India. The first time was in the mountains of Dharamsala, when the temperature was 16 °C. The subjects were three practitioners of humble yoga, whose skin, fingers, toes are significantly warming. The results were published in the *Journal of Nature* in 1982, No. 295. The second test took place in the coldest day in Manali, when room temperature was 4.5 °C. Monks with bed sheets were immersed in ice water, and then the sheets were used to cover almost completely naked bodies. Three or five minutes later, the sheets began to take heat, and within forty-five minutes, the sheets were completely dried. The third test was in Longde Temple, a place in Sikkim with 7, 000 feet above sea level. The subjects were three monks, one of whose metabolism significantly slowed down instead of acceleration. But when he was asked to sit and rest, his oxygen consumption surprisingly reduced by 64%. The results of these studies have been used to treat diseases. For example, in the treatment of cancer, the patient can sit and imagine the white blood cells to attack cancer cells to obtain treatment. At the seminar, the Buda Lama said, "Some modern scholars believe that Buddhism is not a religion, but a mental science! This claim does not seem to be unfounded."²⁰

On March 8, 2009, an academic speech made by Academician Zhu Qingshi "Physics into the Zen Environment: the Origin of Empty" shocked many people. As an internationally renowned physicist and educator, basing on the latest achievements of modern physics and combining with the philosophy of Buddhism, he explored the material and consciousness of the essential significance. He argues that science and religion are interrelated by comparing Einstein's theory of unity, Hawking's string theory, and the Buddhist scriptures of the Buddhist classics. He said humorously, "Long before scientists take great difficulty in climbing to the top of the mountains, the master of Buddhism has been waiting for them there!"²¹

Science, philosophy and religion reflect human mind and human understanding of the material world and the spiritual world from different perspectives and different levels. Science, philosophy and religion reflect the wisdom of the creator, the

highest wisdom embodied in the ancient and modern human mind, like the sun's glory in every tree, every grass, every drop of water, and every drop of dew. "Who is now seeing the old month? But today's moon shines on the ancients. Our ancients and we are like water, passing through like waves after waves. But the moon never changes."²²

4. Some Conclusions and Simple Discussions

4.1 Having a Clear Understanding of the Relationship Between the Five Levels of Human Cognition

The well-known subject structure of cognitive science is the discipline structure and relationship of cognitive science, not the relationship between cognitive science research objects, which cannot explain the cognitive process and structure of people's minds well. Therefore, it is necessary to rethink the process and structure of human cognition, so as to more rationally explain the cognitive process of people's minds, the relationship between various objects of cognitive science, and the comprehensive development of cognitive science Explanation.

Five levels of cognition are divided according to scientific standards. The so-called scientific standards is using the object of scientific research as the basis for the division. The five levels of human cognition are based on the cognitive process that occurs in people's minds, that is, based on the relationship between cognitive scientific research objects, the scientific standards, so it is the "scientific relationship diagram" among the subjects of cognitive science. The promotion from neural cognition to psychological cognition, linguistic cognition, thinking cognition and cultural cognition is consistent with the evolution of mind and cognition, which is the remnant of the evolution of mind and cognitive ability.

So far, cognitive science research objects have been divided into these five levels, and there are no more than five levels of cognitive ability and object. Only through intersection and integration among the five levels can a number of interdisciplinary and integrated subjects be produced under the framework of cognitive science. The division of the five levels not only makes us see the relationship between the five levels of human cognition, but also has more reasonable and stronger explanatory power in the interdisciplinary and disciplinary aspects of cognitive science research.

4.2 Having a Clear Understanding of the Relationship Between Scientific Research and Subject Development in Cognitive Science

The difference between the scientific structure of five levels of cognitive science (Figure 1) and the structure of cognitive science (Figure 2) is the difference between science and discipline.

Disciplinary structural relations in Figure 2 cannot explain more and more intersections and integrations of cognitive science and the rise and development of comprehensive disciplines. Our proposal of five levels of cognitive scientific structure can not only explain the present emerging interdisciplinary and comprehensive disciplines of cognitive science, but also can predict and explain the potential rise of intersected and integrated disciplines in the future. In the relationship between science and discipline, scientific research and scientific exploration are first, and the emergence and development of disciplines are secondary. Scientific research and scientific exploration determine the emergence and development of disciplines. Therefore, only through the correct understanding of the scientific relationship between cognitive science and its objects, and the correct understanding of the scientific structure of cognitive science, can we correctly understand its academic structure, as well as the emergence and development of disciplines.

The relationship between the five levels of human cognition and the relationship between cognitive science and its interdisciplinary structure is perfectly corresponded. This paper gives the mapping between the various levels of human cognition and the disciplines of cognitive science, as well as the intersection between the various levels and the integration between cognitive science and comprehensive disciplines, and discusses the development of these fields. We see that the intersection and integration of the five levels of cognitive science can produce a much more comprehensive interdisciplinary subjects, some of which are what we have not previously recognized. This shows that the theory of five levels of human cognition not only has scientific explanatory power, but also has foresight of discipline development.

4.3 The theoretical significance and application value of five levels

The division of five levels of human cognition has important theoretical and practical value.

The innovative significance of five dimensions of human cognition: First, it embodies the scientific division of human cognitive levels, and comprehensive cognitive science view of Tsinghua University Cognitive Science Team, which has positive impact on the Chinese cognitive scientific research; second, it reflects the

understanding of human cognitive characteristics, and the essential difference between human cognition and animal cognition and reflects the research direction and characteristics of Tsinghua University Cognitive Science Team, that is, high-level cognitive research on language, thinking and culture, which has positive influence on the development of cognitive science in China; third, it reflects the innovation of research methods. The research method of contemporary cognitive science based on experience and scientific experiment is the important method of cognitive science research, which will have an impact on the development of related disciplines of cognitive science and other disciplines. The theory of five levels of human cognition has practical value in application: First, it promotes research on cognitive science in the field of philosophy and social sciences; second, it propels the construction and development of China's cognitive science, including Tsinghua University cognitive science and related disciplines; third, high-level cognitive research in language, thinking and culture is of important cultural significance and value which promotes the construction and implementation of national cultural development strategy.

Notes

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