

Linguistic Transformation and Cognitive Revolution Amid the Wave of Generative Artificial Intelligence

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Abstract. Since ChatGPT was released in 2022, large language model technology that can generate natural language texts has been widely used in various scenes and fields. It has achieved amazing human-machine communication. But today, "AI Hallucinations" faced by large language models are widely discussed in both industry and academic circles. These problems bring a new round of "cognitive dilemmas" to human beings. As large language models keep "learning", the texts produced by machines have errors and even confusion. Artificial intelligence is still far from having the real natural language ability of human beings. This paper holds that AI hallucinations further show the huge gap between the formal language of machines and real natural language. There are at least three aspects. First, the formation of natural language is related to people's real experience of using language in the physical world. This point is also paid attention to by embodied intelligence. Second, natural language contains intuition that machine language cannot have. This self-evident human thinking instinct reflects the essential differences between humans and machines, and between humans and other species. Third, human language and language ability probably have their internal biological and even organic basis. From the perspective of linguistic research, the rapid development of modern large language models and their hallucination dilemma are more like a modern interpretation of the cognitive revolution that became popular since the end of the 20th century. Combining the above three points and comparing the development paths of machine language and human language, we can put forward contemporary responses and thoughts on the discussion of the nature of language in the last century.

Keywords: AI hallucinations, large language models, artificial intelligence, nature of language, language ability

1. Introduction

When people move from knowing the world to changing the world, they always depend on their mind. In the human mind, language is the most clear and powerful tool for people to form knowledge and take action. Ever since humans started to learn about themselves and the world on purpose, the puzzle of language has existed along with the puzzle of mind. But in the growth of human knowledge and scientific activities, the topics of language and mind have been connected and separated many times in history. These two topics developed with the progress of science and

Western modernization, and finally formed the research situation we see today. This phenomenon is clearly typical in the field of knowledge, so it is worth deep research. Just as Engels said in *Dialectics of Nature*, "The theoretical thinking of each era, and thus the theoretical thinking of our era, is a product of history. It has very different forms in different eras, and therefore has very different contents." What Engels pointed out is exactly the historical factor in it. There is no doubt that the historical process of today's world has been shaped by the computer revolution, with generative artificial intelligence as its main part. In this historical stage, whether we call it the fourth or fifth scientific revolution or not, modern people's thinking and cognition have changed deeply. These changes even affect how we understand and use our own language and mind.

Since ChatGPT was launched in 2022, with the wide use of artificial intelligence, humans have found a huge difference and gap between machine language and human natural language. In today's world, just like probability and statistics, computers have had a basic influence on the formation of scientists' thinking and theories [1]. Now, as artificial intelligence enters all walks of life, this influence becomes even deeper in scientific changes. Human natural language is the model and final goal of artificial intelligence language. And machine language, represented by generative AI such as ChatGPT, imitates and produces human language. This process is also changing the thinking and language habits of modern humans and science.

AI Hallucinations were formally put forward by OpenAI in 2024. The content generated by AI seems reasonable, but it does not match facts or cannot be tested. This has become a serious problem. It also brings "cognitive dilemmas" to humans by breaking people's cognitive shortcuts and trust mechanisms [2]. By studying the simulation, comparison and interaction of language between AI and humans, we can find the major differences between artificial intelligence and the human mind.

2. Differences between machine language and human language

First of all, we need to talk about the basic differences between machine language and human language. There are at least three aspects. First, natural language is closely connected with people's experience in the real physical world. Second, natural language shows the necessary intuition in human thinking, and this kind of cognitive performance is hard for computers to master. Third, human language and language ability have their own internal biological and organic basis. Although direct proof of this is still not confirmed, it is also hard to prove wrong. With the development of biological science, people's natural talent for using language has important connections with the human brain, body and even genes.

2.1. Natural language and real experience

AI hallucinations do not appear because AI language cannot master words and sentence structures of human language. The main reason is that the new generation of generative AI based on tokens still cannot understand human semantics. The reason is that human semantics cannot be separated from the physical world where people live and communicate. In other words, our experience of language is not only an activity in our mind. It happens in the real world all the time. Take brain-computer intelligence as an example. The representations in today's main brain-computer intelligence have two important shortcomings. They lack world semantics and conscious experience. First, the representations in current motor brain-computer intelligence correspond to motion variables such as direction and speed. They do not directly connect with the environment, objects in it and their

"affordance". Second, today's main brain-computer intelligence cannot have conscious experience in bionic limbs [3].

Before computing power could support statistical work, rule-based artificial intelligence had already met difficulties. This proves that it is almost impossible for us to fully describe all the rules of human language [4]. What's more, the "statistics" of human knowledge by computing power still does not deepen our understanding of where human language rules, language knowledge and language ability come from. On one hand, compared with the early stage of rule-based AI, the success of large language models surely benefits from the inclusion of semantics. But on the other hand, there is an important problem. Although tokens carry semantics, they are totally different from the real units that humans use to process and apply semantics. So large models still have not achieved real understanding of semantics.

2.2. Intuition in human thinking and language

When we go deeper into the semantics problem, we will touch a more basic and hidden cognitive function in human thinking and language: intuition. The problem of intuition is mostly studied by consciousness science. Only looking at the connection between language and intuition, scholars from both the West and the East have put forward their own observations and theories. In the West, the study of metaphor has moved from traditional rhetoric to modern cognitive science [5]. People have different views on the nature and role of metaphor. They once thought it was a rhetorical device, a way of interaction, or a tool to pass meaning. Later, people gradually found it may be related to human thinking [6]. In the East, "words" and "speaking" are two dimensions and ways to express different semantic levels. For example, when Xiangshan talked to his students, he did not use rational thinking. He used concepts to show what the "original mind" is as an object. He used pre-conceptual ways to bring his students into the intuition and experience of the original mind without breaking it down [7]. That is to say, in traditional Chinese philosophy and Chinese language, there is a large space for personal understanding and recognition between names and facts, and between words and speaking. This also depends on people's "original mind". Just like intuition, the original mind is a level of understanding and cognitive activity inside human thinking. Computers can never have or master this.

So when we look at the language produced by today's generative AI, besides AI hallucinations, its simple and repeated language meanings are also very typical. It is believed that in the future, the understanding of metaphor in large language models will push the formation of AI concepts. Compared with tokens split by algorithms, machine language with rich meanings and directions will be a more vivid form of language, closer to the true nature of language.

2.3. Biological attributes of human language

By linking the mind with biological basis, the modern view of language research, or its working definition, has changed. It once focused on human behavior and its products, but now it treats language as an important part of the human cognitive system. Based on this, Chomsky set totally different categories and definitions for language research objects, compared with Saussure. Then he built the generative grammar theory around the ideal internal language mechanism. This theory brings back the rational tradition, analyzes abstract language structures, and focuses on grammar rules. Saussure put forward a set of concepts that compare personal and social language, such as "language" and "parole". But Chomsky pays more attention to the difference between concepts inside and outside the human mind. For example, he divides language into "externalized language

(E-language)" and "internalized language (I-language)". He also puts forward concepts like language performance and language faculty [8], as well as "Faculty of language-broad sense (FLB)" and "Faculty of language-narrow sense (FLN)" [9]. With these ideas, Chomsky's language theory has opened a new field for language research.

But Chomsky also pointed out long ago that information cannot fully explain language and the mind. Similarly, in the 1970s and 1980s, other philosophers and linguists, such as John Searle, also began to explain cognition from the perspective of speculation again. This kind of thought has become a necessary part in the scientific and technological wave in recent decades, and it is mostly kept in the cognitive branch of philosophy today.

3. Language changes and cognitive transformation

3.1. The period of behavior science

At first, behaviorism was the main feature of modern scientific research on language and mind. It gradually developed into the situation of "Science of Behavior" [10]. In the first decade of the 20th century, the focus of modern psychology turned from consciousness to behavior. "The shift from mentalism, which defines psychology as the scientific study of consciousness, to behaviorism, which defines psychology as the scientific study of behavior, is an inevitable result of the combined effect of many historical factors" [11]. At the same time, in the field of linguistics, American linguistics represented by descriptive linguistics rose rapidly. It became a strong branch that was more influenced by "the strict positivism of behaviorist philosophy and mechanical physiology" than European and Russian linguistics [12]. It is worth noting that the influence of behaviorism on language research at that time was limited, not fundamental. Its main role was to push descriptive linguistics to develop more strict and specific empirical methods. For the time being, it did not study parts of language that are hard to analyze accurately, such as semantics. As for the connection between language and mind, Sapir and his student Benjamin Lee Whorf developed theories about language, thinking and culture. Their ideas came from the thoughts of Wilhelm von Humboldt from the last century. But in the process of modern natural science, these branches that carry on speculative, humanistic and even romantic ideas did not become the mainstream. This was because people wanted to find out the scientific rules of language. All in all, in this stage, the scientific research on language as a part of the human mind was limited, so it achieved few results.

In the first half of the 20th century, behaviorism spread more and more widely and finally dominated almost the whole field of mind research. Just as Avram Noam Chomsky recalled, "At that time, there seemed to be no reason to doubt the general belief of Leonard Bloomfield, Bertrand Russell, positivist linguists, psychologists and philosophers. They believed that the framework of stimulus-response psychology would expand rapidly enough to give satisfying explanations for the most mysterious human abilities" [13]. In the late 1950s, psychologist B.F. Skinner tried to spread behaviorism to all human behaviors, even language. This made almost all the content of mind research fall into the category of "Study of Behavior". There was a tendency and risk to reduce all aspects of the human mind to only observable behaviors.

Of course, the nearly half-century period of behavior science also had its own creations and achievements. Besides gaining a lot of knowledge about the behavior mechanisms of humans and animals, this period has two main values. First, modern mind research finally moved from armchair thinking into laboratories. Many bold and wide-ranging experiments gave birth to research categories and modes that are still widely used today. Second, this period developed rich behavioral methods and patterns. Now they are often used as important parts and evidence sources in

experiments on mind topics. Besides, the core ideas and explanation methods of behaviorism are mostly kept and developed in applied psychology today.

3.2. The period of cognitive science

Interestingly, the pressure from reflections on language and mind research made Skinner's radical behaviorism become the end of the behaviorism wave. The "cognitive revolution" came. The language problems in the mind that had been put aside for a while were exactly the key of this revolution. From the formation of modern mind science ideas, it is natural for language to be the breakthrough point.

First, from the speculative point of view, wise people in different fields have noticed and stressed the special role of language in the human mind and its expression since ancient times. As mentioned above, Descartes and many rationalist scholars who basically inherited Platonic ideas believed that the mind is far more than a container of experience from human activities. So is language in the mind. In other words, no matter where language and mind come from, rationalists believe that we can at least infer that language is more than one kind of observable human action, based on people's observation and use of language through history. But rational thinking through introspection was very weak in the early days of modern science. Since Descartes, it has always been troubled by the nightmare question: "How can an immaterial mind drive a material body?" It is hard for rational thinking to prove itself. As for the questions about language and mind, although rationalists in the 17th century had philosophical grammars led by the Port-Royal *Grammar*, their achievements had reached the limit at that level. So after entering modern times, with the wave of anti-rationalism in new science, both rational language research and mind research were defeated by the broad behaviorism framework in the 19th century. In the middle of the 20th century, radical behaviorism pushed Chomsky to take the lead in reviewing and criticizing the influence of empiricism, behaviorism and operationalism doctrines at that time. He carried out detailed discussions on language views and mind views in various fields in the past. Taking language as a window, he fully pointed out the limitations of behaviorism to researchers in the mind field. He revived the rational tradition through generative grammar.

Against the background of rapid progress in material conditions that pushes scientific development, this rational revival started by linguists could develop into a widespread and revolutionary cognitive revolution. The reason is that a new logical premise was established: the rational confirmation of the biological basis of the human mind.

Different from the past view that saw language as symbols and reduced psychology to behavior, linguist Chomsky always stressed that language ability is based on the unique biological attributes of human beings. Psychologist Eric Lenneberg clearly put forward that language is based on the basic cognitive functions of the brain in his book *Biological Foundations of Language* [14]. Psychologist George A. Miller cooperated with Chomsky. Finally, the establishment of the premise of the biological basis of human mental ability played a decisive role in making various disciplines "change their directions" in the new century.

Accordingly, in the more than 100 years since the theory of evolution was put forward, discoveries in the life science field around genetics have connected almost all material clues about the nature of life. And the scholars from different fields with rationalist tendencies mentioned above have actually reconfirmed the reliability of human biological attributes and their material basis from the speculative level, directly or indirectly. The theoretical expansion and practical tests of these modern science branches based on this basis have also made almost all members of the human knowledge field unite on the material basis and materialist laws. The research scope has actually

expanded from their own topics to human epistemology. They all take part in building this new modern world view. This is the historical sign that various disciplines "gather together" in the cause of modern science.

4. Language and cognition in the wave of generative artificial intelligence

Today, we are in a digital and intelligent age where generative artificial intelligence is the main trend. We can find that language with information features is clearly one of the most powerful ways of understanding and ideas. This kind of language can connect science and technology, and let technology feed back scientific results in turn. We can see that in today's era, language and mind are united in all aspects. They truly form a research category. It takes biological inheritance and evolution as its root, cognition as its main body, rational ideas as its basis, and scientism methodology as its main method. In the future, with the deepening of research, more and more problems will appear in both language research and artificial intelligence progress. But the potential for development is also hidden in them. Studies show that semantic knowledge is the key cognitive resource that guides human innovation. Semantic knowledge refers to the structured associations in our mind about the relationships between concepts, and the properties and functions of objects. It not only improves the success rate of individual innovation, but also produces a synergistic effect with social learning. Together they promote cumulative cultural evolution [15]. In the future society, researchers' exploration of the nature of language will also push the rapid development and progress of cognition and computing.

5. Conclusion

In the 20th century, artificial intelligence was born in the cognitive revolution. Now, generative artificial intelligence has become the most mainstream scientific and technological progress in human society. The simulation of human language by artificial intelligence essentially reflects the level of human understanding and processing of their own language. It further shows human beings' exploration of their own cognitive ability in the past two centuries.

The problems of hallucinations and errors in generative artificial intelligence are the key entry point for in-depth research on human language and cognition in the future. There is no doubt that many issues between the form and meaning of language are important problems that humans and computers need to face and solve together in the future.

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