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THE TRAJECTORY OF THINKING TRANSFORMATION IN THE ERA OF ARTIFICIAL INTELLIGENCE

Formulation of the problem. The relevance of this research is profound, as it explores the intersection between artificial intelligence and human cognitive processes in the modern age. Given the rapid advancements in AI technology and its increasing integration into our daily lives, understanding how these technological changes impact our thinking patterns is crucial. The research addresses timely and pressing questions about the nature of human cognition in the digital era, making it highly relevant to both academic and practical contexts. By understanding these cognitive shifts, we can better prepare for the future, where AI and humans will increasingly work together.

Purpose and objective of the article. The purpose of this article is to delve into the cognitive transformations that have occurred in the era of artificial intelligence. Its objective is to provide a comprehensive analysis of how human thinking has evolved from linear to nonlinear, from deterministic to uncertain, from closed to open, and from machine-assisted to human-machine collaborative thinking. By doing so, the article aims to contribute to our understanding of the cognitive impact of AI technology and how humans are adapting their thinking to cope with new technological challenges. Additionally, it seeks to identify strategies and frameworks that can be used to optimize human-machine interactions and enhance cognitive abilities.

Novelty. he novelty of this research lies in its multidisciplinary approach to exploring the cognitive impact of artificial intelligence. Unlike previous studies that have focused primarily on the technical aspects of AI, this research takes a deeper dive into the cognitive shifts that have occurred as a result of technological advancements. By combining insights from various fields such as cognitive science, psychology, and philosophy, the research offers a unique and comprehensive understanding of the evolving nature of human thinking in the age of intelligence.

Main part. With the increasing formation of virtual worlds generated by technologies such as virtual reality, cloud computing, big data, and artificial intelligence, humans have built a huge virtual world on the basis of the existing real world, and their practical and cognitive methods have also undergone new changes. "Generative AI will similarly open revolutionary avenues for human reason and new horizons for consolidated knowledge" [17, c. 2]. In recent years, artificial intelligence has achieved increasingly practical results in simulating various human behaviors, such as speech recognition, image recognition, machine translation, etc. Researchers such as Xu Jilin, Cai Shushan, Zhu Zhiting, and Alvin Toffler believe that informatization and intelligence have become an irresistible trend of the times, and people's work, learning, and lifestyle are undergoing profound and subtle changes [3; 23; 26; 31]. Researchers such as Nick Bostrom, Tang Meiyun, and Yu Shengquan believe that technologies such as artificial intelligence and big data have great potential in knowledge transmission and reception, skill training and acquisition, and cognitive improvement [2; 28; 29]. Researchers such as Daniel Kahneman and Herbert A. Simon have pointed out that in situations of information overload, people may find it difficult to make choices, weigh the pros and cons, and make wise decisions [6; 18]. People may adopt simplified strategies to process information, sacrificing the depth and breadth of their thinking. When the big language model serves as an assistant to knowledge services to provide personalized services, such as copywriting, research review, and decision support, users are no longer only faced with knowledge within the scope of personal experience or ability, but also with all the existing knowledge of humanity. These knowledge are rearranged and integrated through technology, and presented in a way that users prefer, which can create a broader perspective and more efficient working methods, but also affect people's

understanding of the world. Due to technical biases, cognitive training models adopted by large language models such as ChatGPT are susceptible to usability, selection, and confirmation biases, which can amplify these biases [30]. The information it provides is not objective or neutral in itself, and may be one-sided or even incorrect, such as ChatGPT's phenomenon of «gibberish» occurring from time to time. When people are accustomed to using this method to acquire, learn, and utilize knowledge to construct a picture about the real world, the impacts it brings are worthy of attention [21]. The changes in technology and even the times have led to constant changes in thinking patterns. We hope to keep up with this change and try to give the changing things an accurate grasp. Therefore, the purpose of this study is to reflect on the impact of technologies such as big language models, big data, and virtual reality on the transformation of human cognitive patterns, based on the analysis of the relationship between artificial intelligence and human intelligence, and to explore the trajectory of the transformation of human thinking patterns in the era of artificial intelligence.

1. Comparison between Artificial Intelligence and Human Intelligence

Concepts, judgments, and reasoning are the fundamental forms of thinking. Human beings are able to generate and use abstract concepts, which is the starting point of thinking. Machines can use certain concepts according to their definitions, but can they generate and use abstract concepts themselves. This is a question. Similarly, humans can use concepts to make judgments and use judgments to reason. So, does AI also have this ability? Obviously, judgment and reasoning are also important standards of artificial intelligence. Undoubtedly, in the fields of chess and Go, where computation and reasoning are the main ways of thinking and decision-making, artificial intelligence has surpassed human intelligence. Moreover, in many other fields characterized by computation, reasoning, and mechanical behavior, such as robots on production lines, artificial intelligence also performs better, more accurately, and more effectively than humans. In addition, generative artificial intelligence models such as ChatGPT4 have established anthropomorphic thinking patterns [26, c. 75]. They are able to better understand language communication between subjects and their intentions, and provide effective responses and feedback. But it cannot be universally concluded that artificial intelligence has reached or surpassed human intelligence.

Cai Shushan, Xue Xiaodi, Zhu Zhiting, and others divided human cognition from primary to advanced levels into five levels: neural level cognition, psychological level cognition, language level cognition, thinking level cognition, and cultural level cognition [4, c. 147; 31, c. 7]. The first two levels of cognition, namely neural cognition and psychological cognition, are shared by humans and animals and are called «low order cognition», while the last three levels of cognition are unique to humans and are called «high order cognition». Like other scientific research, cognitive science is also problem oriented, and the research on neurocognition involves issues such as vision, hearing, touch, smell, and taste. The research on psychological cognition involves issues such as sensation, perception, attention, representation, and memory. The research on language cognition involves syntactic processing, semantic processing, and pragmatic processing. The research on cognitive thinking involves concepts, judgments, reasoning, proof, decision-making, and problem-solving. The research on cultural cognition involves issues such as self, others, society, culture, nature, and evolution. Their classification is based on the cognitive processes that occur in people's minds [3, c. 153].

Among the five levels of human cognition, language cognition occupies a very special position. Human language ability is mainly manifested in the generation and use of abstract concepts through metaphorical methods, and the formation of judgments and reasoning based on these abstract concepts. By applying judgment and reasoning, humans can make decisions and derive rich and diverse thinking, including mathematical thinking, physical thinking, philosophical thinking, literary thinking, historical thinking, artistic thinking, and so on.

The most important theoretical hypothesis of the relationship between language and thinking in the 20th century, the Wolf Hypothesis (B.L. Whorf, 1956), is the viewpoint that language forms thinking. It consists of two parts: one is linguistic determinism, which refers to language determining non linguistic processes, that is, learning a language will change the way a person thinks; The second is linguistic relativity, which refers to the cognitive processes that are determined to be different due to language differences. Therefore, speakers of different languages think in different ways. Language and thinking form knowledge, and knowledge accumulates into culture. The vast majority of human knowledge comes from indirect knowledge created and accumulated by predecessors, and its evolution is not only at the genetic level, but more importantly, the evolution of knowledge [16, c. 32].

2. The transformation of human thinking patterns

Transition from linear thinking to non-linear thinking. In the era of artificial intelligence, with the rapid development of technology and the

explosive growth of data volume, human thinking is undergoing a transformation from linear thinking to non-linear thinking. This transformation not only reflects the need for humans to adapt to new technological environments, but also reveals that the depth and breadth of human thinking are constantly expanding. The dramatic increase in the speed of information dissemination has an impact on human thinking patterns. The rapid increase in information dissemination has greatly improved the efficiency of human knowledge acquisition. In the past, people may have had to spend a lot of time and effort collecting, organizing, and analyzing information, but now, with the help of artificial intelligence technologies such as ChatGPT and big data processing, we can obtain a large amount of information in an extremely short amount of time. This change not only changes the way we acquire knowledge, but also affects our thinking patterns. Daniel Dennett focuses on philosophical issues of thinking, consciousness, and information processing. He emphasized that the mind is an information processing system, and the increase in the speed of information dissemination undoubtedly improves our ability to process information, thereby affecting our cognition and thinking patterns [6, c. 14–27]. Nick Bostrom believes that the rapid increase in the speed of information dissemination is a natural result of technological progress, which helps humans obtain and process information more efficiently, thereby affecting our way of thinking [2, c. 57-69]. J rgen Habermas primarily focuses on social theory and communicative behavior, but he also emphasizes the importance of communication and information dissemination in social development. The improvement of information dissemination speed is regarded by him as one of the key factors driving social progress and changing thinking patterns [23, c. 7–16]. Alvin Toffler believes that the rapid increase in the speed of information dissemination is an inevitable trend in the development of modern society. It not only changes the way we acquire knowledge, but also prompts us to adapt to new modes of thinking [10, c. 3–6].

Linear thinking is a traditional way of thinking that emphasizes the singularity, causality, and linearity of things. In the linear thinking mode, people often solve problems according to fixed logic and order, ignoring the complexity and interactivity between things. However, in the era of artificial intelligence, the problems we face have become increasingly complex, involving more and more factors, and linear thinking can no longer meet our needs. In contrast, non-linear thinking places greater emphasis on the wholeness, relevance, and dynamism of things. It breaks through the limitations of linear thinking and can handle more complex and diverse problems. In non-linear thinking patterns, people are no longer limited to a single causal relationship, but can see the mutual influence and interaction between things, thus gaining a more comprehensive understanding of the problem. The development of artificial intelligence technology has provided strong support for the rise of non-linear thinking. Ray Kurzweil is a renowned futurist and inventor. The book «How to Create Thinking» is one of Ray Kurzweil's works, which mainly explores the changes in artificial intelligence and future thinking patterns. He actively predicts and promotes the development of artificial intelligence, while emphasizing the importance of non-linear thinking in future society. He pointed out that «when the ability of intelligent machines crosses this critical point, human knowledge units, number of links, and thinking ability will enter a dizzying and accelerating eruption state. Traditional and habitual knowledge, concepts, and common sense will no longer exist, and will be replaced by new intelligent devices and new human-machine complexes. This change will profoundly affect our way of thinking, transforming it from linear thinking to nonlinear thinking» [22, c. 75]. Generative artificial intelligence represented by ChatGPT has powerful data processing and analysis capabilities, which can process a large amount of information and data, discover patterns and patterns within it. This ability enables artificial intelligence to cope with complex problems and propose innovative solutions.

The formation process of non-linear thinking is a complex and diverse cognitive process, which usually involves multidimensional and non-linear analysis and resolution of complex problems. The process of using non-linear thinking to solve problems includes: problem reconstruction, multidimensional thinking, finding non-linear relationships, forming hypotheses and models, verifying and adjusting. The formation of non-linear thinking relies on a deep understanding of the problem, a comprehensive grasp of information, and a keen insight into complex relationships. It requires people to be able to transcend traditional thinking patterns and think and solve problems in a more open and flexible way. Among them, problem reconstruction is crucial, as people need to view the problem as a complex system composed of multiple interrelated variables. For example, how to design an effective curriculum to enhance students' innovation ability? Teachers need to re-examine the goals of curriculum design, transforming it from a single knowledge transmission to a complex system that focuses on cultivating students' abilities.

The development of artificial intelligence has prompted us to pay more attention to systematic and holistic thinking, rather than just staying at linear and singular thinking patterns. We are starting to

examine problems from multiple perspectives and dimensions, trying to find more comprehensive and in-depth solutions. Creative thinking has also become more important because we need to constantly propose new ideas and perspectives to cope with the rapidly changing world.

Transition from deterministic thinking to uncertain thinking. In the era of artificial intelligence, with the development of technologies such as big data, algorithms, and machine learning, the nature and processing methods of knowledge are undergoing profound changes. Firstly, the emergence of big data has made knowledge no longer limited to static and fixed forms, but rather fluid and dynamic. The continuous updating and changing of data means that knowledge also evolves, which challenges the stability and certainty of knowledge in traditional knowledge views. The application of algorithms and machine learning techniques makes the generation and dissemination of knowledge more dependent on specific algorithms and models. This means that knowledge is no longer just a reflection of objective facts, but is influenced by various subjective factors such as algorithm design, model selection, and data bias. Therefore, knowledge becomes more subjective and relative.

Philosophers have pointed out that the development of technology has not only changed the nature of knowledge, but also had a profound impact on human cognitive and thinking patterns. They believe that in the era of artificial intelligence, humans need to approach knowledge more cautiously, recognize the dynamics, subjectivity, and relativity of knowledge, and develop cognitive strategies and ways of thinking that are adapted to it. Luciano Floridi, as one of the leading figures in information philosophy, has conducted in-depth research on the impact of big data and artificial intelligence on knowledge and cognition. He emphasized the dynamism, subjectivity, and relativity of knowledge in the era of artificial intelligence, and advocated a more cautious and critical attitude towards knowledge [8, c. 688]. Alvin Toffler emphasized the rapid change and constant updating of knowledge, as well as the challenges this change poses to social and individual cognition [10, c. 5]. Helen Nissenbaum's work also touches on how artificial intelligence can change our understanding and use of knowledge [13, c. 141–178]. The aforementioned philosophers have all been involved in the impact of artificial intelligence on knowledge and cognition. Traditionally, people understand the world through experience, intuition, and logic, but in the era of artificial intelligence, we increasingly rely on big data and algorithms to process information. This makes our cognitive process faster, more efficient, and enables us to identify patterns and associations in massive amounts of information. We have learned to use technical tools to assist thinking, thereby improving the accuracy and breadth of cognition.

In the era of artificial intelligence, with the widespread application of generative artificial intelligence and big data technology, human thinking is undergoing a profound transformation from deterministic thinking to uncertain thinking. This transformation not only reflects our deepening understanding of the complex world, but also reflects our wisdom in adapting to new environments and responding to new challenges. Deterministic thinking is a long-term thinking pattern formed by humans, which is based on fixed rules, logic, and causal relationships to understand and solve problems. In a deterministic thinking mode, we tend to seek clear answers, predict exact results, and rely on stable patterns to guide decision-making. However, with the advent of artificial intelligence and big data, we gradually realize the complexity and uncertainty of the world, and deterministic thinking is beginning to face challenges.

The development of artificial intelligence enables us to process and analyze massive amounts of data, discover hidden patterns and trends within it. However, these data are often filled with noise and uncertainty, making it difficult to interpret them with traditional deterministic thinking. At the same time, the application of artificial intelligence in prediction and decision-making has made us realize that even the most advanced algorithms cannot accurately predict the future. Therefore, we need to shift our way of thinking from deterministic thinking to uncertain thinking.

Uncertain thinking is a more flexible and open way of thinking that acknowledges the complexity and uncertainty of the world, and attempts to find opportunities and possibilities within the uncertainty. Tang Meiyun and Fang Xinxue pointed out that «from a methodological perspective, uncertainty has changed human thinking habits. Uncertainty thinking is beneficial for humans to better face the future. It can overcome the singularity and one-sidedness of deterministic thinking, truly reflect another real state of the world, such as disorder, randomness, fuzziness, instability, and unpredictability. It provides a new dimension of thinking for humans to handle the relationship between humans and nature, humans and society, humans and others, and humans and themselves» [14, c. 95].

Uncertain thinking is not a negative way of thinking. On the contrary, it encourages us to embrace change, be brave in innovation, and seek new opportunities and value in uncertainty. Through continuous learning and practice, we can gradually master the skills and methods of uncertain thinking, improve our adaptability and innovation

ability. The formation process of uncertain thinking is a comprehensive process involving cognition, emotion, and behavior. It requires individuals to be able to flexibly adjust their thinking methods when facing complex and uncertain situations, and accept and handle various possibilities brought by uncertainty. The following are some key stages in the formation process of uncertain thinking: cognitive awakening, acceptance of uncertainty, multidimensional thinking, and adaptive decision-making. In the face of uncertainty, people no longer pursue perfect solutions or exact answers, but make the best judgments based on current information and situations, and are always ready to make adjustments based on new information. The formation of uncertain thinking is a continuous process of learning and reflection. Individuals need to constantly summarize their experiences and lessons, analyze the effectiveness of decisions and actions in uncertain situations, and adjust their thinking patterns accordingly. Through reflection and learning, individuals can gradually improve their cognitive and coping abilities in uncertain environments.

The transformation from closed thinking to open thinking. The transformation from closed thinking to open thinking is an important progress in human thinking. This transformation reflects the expansion of our understanding of the world. The expansion of information dissemination promotes the transformation of thinking patterns. The expansion of information dissemination allows us to have access to more diverse perspectives and information. In the era of artificial intelligence, the types and forms of communication media are constantly enriching and diversifying. In addition to traditional text, images, and audio, new media forms such as video, live streaming, and virtual reality are also gradually emerging. «With the increasing formation of virtual worlds generated by technologies such as virtual reality, cloud computing, big data, and artificial intelligence, humans have built a huge virtual world on the basis of the existing real world, and their practical and cognitive methods have also undergone new changes» [30, c. 23]. John Dewey's pragmatic philosophy emphasizes the influence of experience and environment on cognition [4, c. 64–68]. He believes that people acquire knowledge and experience through interaction with the environment, and new media forms provide people with a broader space for interaction. By being exposed to more diverse perspectives and information, people can enrich their experiences and promote a shift in their thinking patterns. Marshall McLuhan, as a media theorist, believes that the media is not only a transmitter of information, but also a tool for shaping our perception and way of thinking. His viewpoint of «media is information» emphasizes the influence of media form itself on people's cognition. The emergence and popularization of new media forms undoubtedly provide people with new ways of perception and thinking [9, c. 35]. These philosophers or theorists emphasize the influence of environment and experience on people's cognition, as well as the importance of diversity and variability in stimulating imagination and creativity.

In a closed thinking mode, people often limit themselves to their own experiences and cognition, making it difficult to think outside of a fixed framework. This way of thinking becomes increasingly inadequate in the face of the complex and ever-changing era of artificial intelligence. Open thinking has emerged, emphasizing the flexibility, inclusiveness, and innovation of thinking. In an open thinking mode, people are willing to accept new ideas and things, adept at thinking about problems from multiple perspectives and dimensions, and seeking new ideas and methods to solve problems. Firstly, open thinking helps us expand our cognitive boundaries. In the era of artificial intelligence, we need to have an open mindset, constantly absorbing new knowledge and skills to adapt to the development of the times. Open mindedness helps us unleash our potential for innovation. In the era of artificial intelligence, innovation is an important driving force for social progress. Open thinking encourages us to break free from fixed thinking frameworks, be brave enough to try new things and methods, and discover new opportunities and values.

The formation process of open thinking is a complex and profound cognitive transformation, which involves individual psychological adjustment, knowledge accumulation, experiential reflection, and continuous trial and error. The formation of open thinking cannot be separated from the accumulation and learning of knowledge. Individuals need to constantly absorb new knowledge, understand information from different fields, in order to broaden their horizons and cognitive scope. Through extensive learning, individuals can be exposed to more perspectives and ways of thinking, providing rich materials for forming open thinking.

The transformation from machine assisted thinking to human-machine collaborative thinking. The transition from machine assisted thinking to human-machine collaborative thinking is an important leap in human thinking in the development of technology. This transformation is not only reflected in the application of technology, but also profoundly affects human cognitive methods and problem-solving strategies. In the stage of machine assisted thinking, machines mainly play the role of tools, assisting humans in completing tasks such as computation, storage, and retrieval. Human beings rely on the precision and efficiency of

machines to outsource some of their thinking tasks, thereby releasing some of their cognitive load. However, this auxiliary method is still dominated by human thinking, and machines are merely tools for executing human instructions. However, with the rapid development of artificial intelligence technology, machines have gradually acquired more advanced cognitive abilities, such as learning, reasoning, and decision-making. This enables machines to no longer be just tools for executing tasks, but to engage in deeper interactions and cooperation with humans [7, c. 36]. The emergence of human-machine collaborative thinking has become a new way of thinking.

In the human-machine collaborative thinking mode, humans and machines participate in the thinking process together, each exerting their own advantages. Human beings excel in abstract thinking, innovative thinking, and emotional understanding, while machines excel in data processing, pattern recognition, and precise computation. Through human-machine collaboration, it is possible to achieve a dual improvement in the efficiency and accuracy of the thinking process.

The advantage of human-machine collaborative thinking is that it breaks the limitations of human thinking and expands the ideas and methods for solving problems. In the face of complex problems, humans and machines can analyze and reason together, seeking solutions from different perspectives and levels. This collaborative approach not only improves the efficiency of problem-solving, but also increases the likelihood of problem-solving.

At the same time, human-machine collaborative thinking has also promoted the development of human thinking. By collaborating with machines, humans can learn new ways of thinking and problem-solving strategies, thereby enhancing their cognitive abilities. This process of mutual learning and promotion helps to promote the continuous development of human thinking.

3. Challenges Faced by Human Thinking Transformation

Information overload and distraction. The era of intelligence has brought massive amounts of information and content, and people need to process more information, but the cognitive ability of the brain is limited. Therefore, information overload and distraction have become a major challenge in the era of intelligence. People may face decision-making difficulties, lack of concentration, and other issues that affect the depth and focus of their thinking. Phenomenologists such as Edmund Husserl emphasized the importance of direct experience in consciousness [19, c. 19]. His phenomenological approach focuses on how individuals directly experience the world and how they construct their understanding of the world through consciousness. In the era of intelligence, people may be unable to focus on direct experiences due to excessive information input, which affects the clarity and depth of consciousness. This viewpoint echoes the core principle of phenomenology, which emphasizes the purity of direct experience and consciousness. Psychologists have conducted extensive research on distraction. They found that frequent information interference and stimulation can disrupt people's attention, reducing the efficiency and quality of task completion. Cognitive psychologists such as Richard Atkinson and Robert Shiffrin also support this viewpoint [1, c. 89–195]. They conducted empirical research and explored in depth the effects of information interference on attention allocation and cognitive processes. These studies indicate that when external stimuli appear frequently, people's attention is constantly interrupted, making it difficult to maintain sustained focus on the task, thereby reducing the efficiency of task completion. In addition, some psychologists have also studied this issue from the perspective of neuroscience. Michael Posner, a professor of psychology and neuroscience at the University of Oregon in the United States, focuses on studying the neural mechanisms of attention and cognitive control. His research reveals how the brain reallocates attention resources based on environmental needs, and how this reallocation affects cognitive performance [15, c. 1414]. Frequent information interference and stimulation can activate different regions of the brain, leading to the redistribution of attention resources. This redistribution consumes a significant amount of cognitive resources, making it difficult for people to focus on the current task.

Various notifications and social media in the era of intelligence are constantly attracting people's attention, making it difficult for them to maintain long-term focus and deep thinking. American educational psychologist Gagne proposed the Theory of Information Processing Learning, which emphasizes that people's ability to process information is limited. He believes that individuals need to go through a series of cognitive processing processes when receiving and processing information, including attention, encoding, storage, and extraction. In the case of information overload, people may not be able to effectively filter and integrate information, resulting in a decrease in thinking depth and focus. Cognitive psychologists Daniel Kahneman, Herbert A. Simon, and other researchers have pointed out that people are limited by cognitive resources when processing information, and cannot process large amounts of information simultaneously [12, c. 1449; 18, c. 12]. In situations of information overload, people may find it difficult to make choices, weigh the pros and cons, and make wise decisions. People may

adopt simplified strategies to process information, sacrificing the depth and breadth of their thinking. The information overload in the era of intelligence has exacerbated this phenomenon, making people more susceptible to interference from information noise and making it difficult to make rational and evidence-based decisions. In summary, researchers have explored the impact of information overload on individual thinking and decision-making through different theories and research methods. In the era of intelligence, people need to constantly process information from various channels, make decisions and choices. However, due to the increase in information volume and diversity of choices, people face greater cognitive load and decision-making difficulties. This may lead to a decrease in decision-making efficiency and an increase in mental burden.

Cognitive biases and algorithmic influences. In the era of intelligence, people's interaction with intelligent algorithms is becoming increasingly frequent, but algorithms may have some cognitive biases that affect people's decision-making and thinking patterns. For example, personalized recommendation algorithms may trap people in an information cocoon, only seeing information that aligns with their own views, thereby weakening the diversity and openness of thinking. Hannah Arendt pointed out, «Although humans have the ability to destroy all life on Earth, they are controlled by standardized, uniform, and formalized technology. Machines have replaced our thinking and judgment, and we have become mindless working animals» [5, c. 109]. Wu believes that humans are being marginalized by accelerated algorithms and have to hand over decision-making power to technology [25, c. 15]. Generative AI may weaken the user's subjective will, affect their ability to control the object of AI as a tool, and even be exploited by AI. When using traditional search engines, people need to compare, filter, and judge search results, which reflects their ability to think independently and have independent will. «ChatGPT directly generates the answer to the user's question, and most users tend to acknowledge the authority and accuracy of the answer, blindly accepting it, ignoring the possibility that ChatGPT may be telling lies seriously» [24, c. 16]. Over time, the independent thinking and critical consciousness of users based on their subjective will will be weakened, and the diversity and innovation unleashed by free will in human society will also be depleted. For example, in the field of education, assuming that students use content generated by ChatGPT without restrictions to complete assignments, without actively learning to think, this will have a profound negative impact on human thinking will and even subjectivity.

In virtual space, virtual digital humans, as technological bodies, construct users' cognition and experience of the virtual world. However, while technology enhances certain perceptual abilities, it also technically ignores certain elements, thereby changing its overall perception of things. Taking tourism as an example, the sensory enjoyment brought by beautiful scenery and the time and energy costs and physical hardships required to reach the destination are two indispensable components of the tourism experience. Due to individual differences in height, vision, physical strength, experience, etc., everyone's experience is not entirely the same. In the so-called «cloud tourism» and «VR tourism», the lack of depth in space reduces the time and energy required for spatial movement, while technology provides a standardized perception object. Although the experience generated by virtual digital humans during the tourism process is highly embodied and immersive, only beautiful visual shock and high sensory stimulation without physical fatigue cannot bring offline users a real and complete travel experience and pleasure. When people confuse the real world with the virtual world, and even treat the cognition, emotions, and experiences of virtual digital humans as things themselves, and establish emotional and social connections on this basis, cognitive biases or deficiencies may occur.

4. Changes in human cognitive patterns

In the process of human practice, the new changes in cognitive methods are mainly reflected in the changes in human cognitive patterns. In the era of artificial intelligence, information overload has become a common problem, with a large amount of information constantly flowing into people's lives through various channels. However, the ability of the human brain to process information is limited, and excessive information can lead to cognitive overload, thereby affecting people's thinking, decision-making, and action. The cognitive load theory has important guiding significance for solving the problem of information overload in the current era of artificial intelligence. The cognitive load theory was first proposed by cognitive psychologist John Sweller from the University of New South Wales in Australia in 1988. This theory mainly explores the degree to which cognitive resources required for information processing tasks occupy the learner's existing cognitive resources (knowledge and experience) during the learning and problem-solving process. When the required cognitive resources exceed the learner's original level, negative effects such as psychological burden may arise [21, c. 257].

According to this theory, we need to screen, organize, and optimize information reasonably to reduce invalid and redundant information and lower people's cognitive load. The cognitive load theory proposes three types of cognitive loads, including intrinsic cognitive load, extrinsic cognitive load, and

related cognitive load. This provides us with specific guidance when solving the problem of information overload. For example, in response to intrinsic cognitive load, we can alleviate the cognitive burden caused by the complexity of information itself by improving individual information processing abilities, such as cultivating critical thinking and enhancing information literacy. To address external cognitive load, we can reduce cognitive load caused by improper information presentation or overly complex operations by optimizing information presentation methods and simplifying operational processes. In summary, cognitive load theory provides us with a powerful tool to solve the problem of information overload in the era of artificial intelligence.

For example, as a concentrated embodiment of artificial intelligence technology, smartphones provide users with rich functions and services, such as social media, news push, video entertainment, etc. However, these features also bring a lot of information, making users often feel information overload when using their phones. Firstly, the intrinsic cognitive load is manifested in this example as the user needing to process a large amount of information from different applications. Secondly, external cognitive load comes from the complexity of mobile interface design and interaction methods. Some mobile applications may have overly complex operating procedures and interface designs, causing users to feel confused and fatigued while using them. This not only increases the cognitive burden on users, but may also reduce their user experience and satisfaction. Users can reduce cognitive load by cultivating their information literacy and critical thinking. For example, learning how to distinguish the authenticity of information, how to effectively filter and organize information, and how to make reasonable use of fragmented time for learning and entertainment are all effective methods to reduce cognitive load.

Distributed cognition and human-machine collaboration are important concepts in contemporary cognitive science and artificial intelligence, which together provide strong support for enhancing human thinking abilities. Distributed Cognition Theory was proposed by Edwin Hutchins of the University of California in the mid to late 1980s. He cited the ideas of Vygotsky and Minsky, filling the gap in traditional cognitive views that only focus on individual level information processing and neglect the interaction between people and technology to achieve a certain activity [11, c. 174–196]. Hutchins et al.'s cognitive research went beyond the scope of individual brains and began to focus on the influence of the environment, cognitive processes, and socio-cultural factors. At the same time, they also conducted research on cognitive phenomena in complex computing systems such as ship navigation and aircraft cockpits, attempting to understand cognitive phenomena as specific situational behaviors that occur in their work environment, thus developing into distributed cognition. This theory emphasizes that cognitive processes occur not only in the individual's brain, but also in the interactions between the individual and the environment. The distributed cognitive theory suggests that individuals expand and enhance their cognitive abilities by utilizing external resources such as tools, symbols, and others.

The human cognitive style in the intelligent era should be transformed from individual cognition to distributed cognition with human-computer integration, and use AI and the Internet to complete tasks that the human brain cannot or is not good at, so as to adapt to the complexity and uncertainty of the intelligent era. Yu Shengquan et al. proposed the concept of «cognitive outsourcing», pointing out that cognitive outsourcing is a cognitive division of labor that outsources part of human thinking activities and cognitive tasks to external intelligent devices or other organizations to complete a certain task or achieve a certain goal [28, c. 16–23]. This approach aims to improve the efficiency and quality of task completion by utilizing external intelligence and resources to compensate for the deficiencies in human cognitive abilities. Cognitive outsourcing is essentially a way of thinking that involves human-machine collaboration. External intelligence provides, organizes, and processes information, while internal cognition in the human brain generates meaning. The improvement of external cognitive efficiency can reduce cognitive load, make people's thinking more focused on the whole, structure, and value, and thus enhance their ability to handle complex problems as a whole. In recent years, the development of artificial intelligence technology has provided more possibilities for cognitive outsourcing. For example, through human-machine collaboration, the ChatGPT system can generate a high-quality teaching plan for teachers in a very short amount of time. Teachers only need to input information such as teaching content, teaching objectives, student characteristics, and teaching modes, and ChatGPT can quickly generate personalized teaching plans that meet the requirements. This makes the design process of teaching plans more efficient, allowing teachers to focus their thinking on the overall planning and teaching value of teaching, thereby further improving the efficiency and quality of teaching.

The embodied cognitive theory suggests that our cognitive activities are not just internal processes in the brain, but involve interactions and experiences throughout the body. This theory advocates that the

body plays a decisive role in the cognitive process, believing that cognition is an interactive activity based on the social environment, which goes beyond the brain and also beyond the human body itself. This theory provides us with a new perspective to understand human cognitive processes. Virtual reality technology provides us with a new way to simulate and experience different environments and situations. The combination of embodied cognition and virtual reality provides us with more possibilities. In virtual reality, individuals can experience changes in their bodies based on the availability of virtual bodies, and create psychological models or schemas based on virtual bodies. This virtual body and its body schema can create different social meanings based on context and environment. Virtual reality technology actually provides humans with a new creative tool that stimulates their spatial creativity. For example, in the game «Mini World», players can use various materials and tools in the game to fully unleash their imagination and build their own world. Among them, some materials and tools are available in the real world, while others are completely imagined, giving players great freedom and creative imagination space.

In the digital virtual cognitive environment, subjects can freely use various tools and materials in the virtual world to set up experimental conditions for simulation experiments and training, which is conducive to technological innovation and method innovation. For example, in the design of new building styles in complex landforms, professional tests such as material testing, mechanical analysis, and seismic analysis conducted through virtual environments can enable the subject to face difficult environments and dare to innovate design solutions, boldly try new technologies, materials, and construction methods, improve building rigidity, enrich building structural styles, and promote the progress of building technology. In the virtual world, cognitive subjects can work together with the assistance of assistants supported by artificial intelligence technology to complete cognitive and practical activities, avoid detours, quickly grasp the rules and skills of certain things, and improve cognitive efficiency.

The digital virtual cognitive environment provides a brand new cognitive atmosphere and environment for the subject, and the strong sense of freshness and stimulation promotes the germination of the subject's innovative consciousness. The virtual environment can be set as an open space without background, allowing cognitive subjects to focus on completing specific cognitive activities. In the virtual world, not only cognitive tools and assistants can be selected, but also cognitive scenes and environments can be selected and changed [30, c. 30]. Different cognitive subjects have different environmental preferences. Choosing cognitive scenes and environments based on the subject's preferences can help the subject relax and integrate into cognitive activities, promoting the improvement of the subject's innovation awareness.

Souza et al. proposed «The Cognitive Mediation Networks Theory (CMNT)», which is a model of intelligence based on the notation that human beings are dealing with cognitive overload through Mediation, defined as the supplementary information processing obtained by using structures in the environment as auxiliary computational devices [20, c. 1508]. According to the CMNT, when there is the broadband introduction of a new and «disruptive» technology with unknown information processing capacity and modes of functioning, a novel form of Cognitive Mediation emergencies, with important discussions for human alignment It is an excessive positive impact overall, giving the increase in the number and education of logical schema, mental strategies and concepts that one adds [29, c. 21]. Changes in Human Thinking Ability under the CMNT Framework: Enhanced Problem Solving Skills: The logical schema and concepts developed through understanding AI functions could improve general problem solving abilities by promoting structured thinking and the ability to break down complex problems Critical Thinking and Evaluation: The awareness of content accumulation biases, hidden assessments, and logical fallacies can promote a critical mind set application to various sources of information and situations, encoding individuals to question and evaluate the credibility and correlation of the information they encounter.

Conclusion. In the era of intelligence, human beings not only acquire first-hand information and knowledge from practice, but also indirectly acquire the knowledge and experience of others from the Internet, and deal with these knowledge and experience together with intelligent machines. Future intelligent machines are not limited to ChatGPT type generative AI, but more advanced AI may also emerge, which can not only obtain known information and knowledge from network data, but also directly participate in some practical activities. In the era of AIGC technology, artificial intelligence has a tendency to compete with human intelligence in cognitive levels. With the rapid development of technology, human ways of thinking and cognition are also undergoing profound changes. The transformation of human thinking can be summarized as: from linear thinking to nonlinear thinking, from deterministic thinking to uncertain thinking, from closed thinking to open thinking, and from machine assisted thinking to human-machine collaborative thinking. These changes not only reflect the profound impact of artificial intelligence technology on human social cognitive

patterns, but also reflect the self adjustment and evolution of human thinking in the face of new technological challenges. The transformation of thinking usually begins with dissatisfaction with the current situation or a desire for new knowledge. This internal driving force prompts people to reflect on their existing ways of thinking and concepts, and seek change. In the process of encountering these new elements, people may experience cognitive conflicts and confusion because new information contradicts their original way of thinking. As people deepen their understanding and digestion of new elements, they gradually adjust their way of thinking. Ultimately, the trajectory of thinking transformation will manifest as a more mature, comprehensive, and in-depth way of thinking.

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Summary

Sun W. **The trajectory of thinking transformation in the era of artificial intelligence.** – Article.

The era of artificial intelligence has led to unprecedented technological changes, which are not only reflected at the technical level, but also deeply affect the patterns of human thinking. Today, humanity begins the transition to new forms of thinking. This question is not only relevant, but also one that requires a sufficiently new understanding of the possibilities of thinking. The article is devoted to the problems of types of thinking under the conditions of technical and technological changes. The author analyzes modern scientific research, which provides information about new thinking models, based on which to set the goal of displaying, first, these models in a logical connection with each other according to the new conditions of the creation of humanity. Secondly, it tries to trace the possibilities of connections between these models and their development trajectories.

The article reveals the process of transformation from linear thinking to non-linear thinking, from deterministic thinking to indeterminate thinking, from closed thinking to open thinking and from machine thinking to joint human thinking and with the help of a machine in-depth analysis of human cognitive processes in conditions of advanced use of artificial intelligence. These changes not only reflect the profound impact of artificial intelligence technologies on human social cognitive models, but also reflect the self-adaptation and evolution of human thinking in the face of new technological challenges. The results of the study indicate that the transition from linear to non-linear thinking reveals an increase in the complexity of thinking. The transition from deterministic thinking to uncertain thinking demonstrates the fusion and innovation of knowledge. The shift from machine thinking to human-machine co-thinking demonstrates an increasingly close collaborative relationship between humans and machines. The transformation of thinking begins with dissatisfaction with the existing situation. We can use the theory of cognitive load, the theory of distributed cognition and the theory of bodily cognition to solve the problems caused by new technologies, such as information overload, distraction and cognitive bias, promoting the development of human cognitive abilities.

Key words: thinking, thinking models, artificial intelligence, cognitive processes, cognition in virtual reality.

Анотація

Сунь В. **Траєкторія трансформації мисления в еру штучного інтелекту.** – Стаття.

Епоха штучного інтелекту призвела до безпрецедентних технологічних змін, які не лише відбиваються на технічному рівні, а і глибоко впливають на моделі людського мислення. Сьогодні людство починає перехід до нових форм мислення. Це питання є не тільки актуальним, але і таким, що потребує досить нового розуміння можливостей мислення. Стаття присвячена саме проблемі типів мислення за умов техніко-технологічних зрушень. Автор аналізує сучасні наукові дослідження, в яких дається інформація про нові моделі мислення, на грунті чого ставить мету розглянути, по-перше, ці моделі у логічному зв'язку між собою за нових умов існування людства. По-друге, намагається простежити можливі звязки мід цими моделями і траєкторіями їх розвитку.

У статті розкривається процес трансформації від лінійного мислення до нелінійного мислення, від детермінованого мислення до невизначеного мислення, від закритого мислення до відкритого мислення та від машинного мислення до спільного мислення людини та машини за допомогою поглибленого аналізу когнітивних процесів людини в умовах поширеного використання штучного інтелекту. Ці зміни не тільки відображають глибокий вплив технологій штучного інтелекту на соціальні когнітивні моделі людини, але також відображають самоадаптацію та еволюцію людського мислення перед нових технологічних проблем. Результати дослідження свідчать, що перехід від лінійного мислення до нелінійного виявляє збільшення складності мислення. Перехід від детерміністського мислення до невизначеного мислення демонструє злиття та новаторство знань. Перехід від машинного мислення до спільного мислення людини та машини демонструє дедалі тісніші відносини співпраці між людьми та машинами. Трансформація мислення зазвичай починається з незадоволеності ситуацією, що склалася. Ми можемо використовувати теорію когнітивного навантаження, теорію розподіленого пізнання та теорію тілесного пізнання для вирішення проблем, викликаних новими технологіями, такими як інформаційне навантаження, відволікання уваги та когнітивна упередженість, сприяючи розвитку когнітивних здібностей людини.

Ключові слова: мислення, моделі мислення, штучний інтелект, когнітивні процеси, пізнання у віртуальній реальності.