Artificial Intelligence and Artificial Consciousness: Theory, Models, and $DIKWP$ Innovation

Yucong Duan

Benefactor: Shiming Gong

$DIKWP$-AC Artificial Consciousness Laboratory

AGI-$AIGC$-GPT Evaluation $DIKWP$ (Global) Laboratory

World Association of Artificial Consciousness

(Email：duanyucong@hotmail.com)

The interaction of AI mainly relies on the DIK (data, information, knowledge) level, while artificial consciousness (AC) introduces higher-level processing of intelligence (W) and purpose (P):

AI interaction: The interaction of AI systems is mainly DIK * DIK or $DIKW$ * $DIKW$, such as automated decision support systems, which respond based on available data, information, and knowledge.

AC interaction: The interaction of artificial consciousness is $DIKWP$ * $DIKWP$, which not only covers data, information, knowledge, and wisdom, but also includes purposeal level interaction. This means that the AC system can understand and internalize human purposes, and make independent judgments and decisions based on this foundation.

Catalog

Abstract

This article delves into the basic concepts, theoretical frameworks, and application examples of artificial intelligence (AI) and artificial consciousness (AC), particularly by comparing and analyzing different theoretical models and proposing a comprehensive design scheme for the artificial consciousness system. Firstly, based on Professor Yucong Duan's DIKWP model, we elaborated in detail on the roles and implementations of data, information, knowledge, Wisdom, and Purpose in constructing artificial consciousness systems. Subsequently, by analyzing five main consciousness theories, including global workspace theory, integrated information theory, biological robot model, multiple draft model, and cognitive neuroscience research, we compared the similarities and differences between these theories and the DIKWP model in dealing with complex cognitive functions. In addition, this article also delves into the subconscious application of AI and the conscious application of AC, revealing their different abilities and methods in achieving automated task processing and executing complex decisions. Finally, an ideal design scheme for the DIKWP-AC system was proposed, which integrates various artificial intelligence technologies and models, aiming to create a system that can efficiently process complex data information while also performing advanced cognitive processing and purpose realization, demonstrating the enormous potential and application value of effective work in diverse environments. Through these exchanges and analyses, this series of articles aims to provide valuable insights and suggestions for developers and researchers of AI and AC, promote the rational application of intelligent systems in safety, effectiveness, and ethics, and also provide a common theoretical and practical framework for interdisciplinary research.

1 Introduction

In the past few decades, artificial intelligence (AI) technology has made significant progress, especially in areas such as pattern recognition, automated task execution, and data processing. However, with the development of technology and the expansion of application areas, the limitations of traditional AI in handling complex social interactions, moral judgments, and strategic planning are gradually becoming

apparent. These challenges have given rise to a demand for research and development of a more advanced form of wisdom - artificial consciousness (AC). Unlike AI, which mainly deals with specific and well-defined tasks, AC aims to simulate advanced cognitive functions in humans, including consciousness, autonomous decision-making, and complex social behavior.

As human understanding of their own consciousness deepens, especially through interdisciplinary explorations in psychology, neuroscience, and philosophy, we are beginning to attempt to apply these understandings to the design and development of artificial intelligence systems, in order to create intelligent systems that can truly understand and adapt to complex human behavior. In this context, the DIKWP model has been proposed as a new theoretical framework aimed at constructing a comprehensive artificial consciousness system by integrating data, information, knowledge, wisdom, and purpose.

This article explores various existing consciousness theories in detail, such as global workspace theory, integrated information theory, etc., and compares and analyzes them with the DIKWP model, aiming to reveal the potential and limitations of these theories in achieving artificial consciousness. In addition, by analyzing specific cases of subconscious application of AI and conscious application of AC, this article further demonstrates the different application paths and effects of AI and AC in practical operations. Finally, an ideal design scheme for the DIKWP-AC system was proposed, which integrates the advantages of existing technologies and provides a possible direction to achieve higher-level cognitive functions, closer to simulating human comprehensive consciousness.

Through these analyses, this article not only enhances our understanding of AI and AC technology, but also provides theoretical basis and practical guidance for future research and application in this field.

2 The basic theory of consciousness and subconsciousness

A detailed definition of "consciousness" is crucial in discussing the frameworks of artificial intelligence (AI) and artificial consciousness (AC), as it not only outlines the goals of AC technology, but also helps us distinguish between traditional AI and

higher-level cognitive systems. The following is a detailed definition of consciousness, referencing Professor Yucong Duan's DIKWP model and integrating research findings from psychology, neuroscience, and cognitive science.

The definition and function of consciousness

Consciousness encompasses the processing of data, information, and knowledge in the DIKWP model, and extends to wisdom and purpose. Consciousness can make autonomous decisions in complex and dynamic environments, reflecting individual values and long-term goals.

The definition and function of subconsciousness

The subconscious mainly handles daily and habitual tasks, such as language comprehension and conditioning. These processes do not involve complex decision-making, but are based on fixed rules and patterns for rapid response.

Deep definition of consciousness

Consciousness can be defined as a higher-level cognitive state that encompasses the perception, recognition, and understanding of an individual's own existence and the external world. This state not only involves the reception and processing of information, but also includes self reflection on this information, emotional reactions, and decision-making based on complex value systems. The characteristics of consciousness can be further explained from the following key aspects:

1. Self-awareness

Self awareness is a core component of consciousness, referring to an individual's understanding of their own existence and state. This includes awareness of one's own thoughts, feelings, body, and interaction with the environment. In artificial consciousness, this means that the system can not only process external inputs, but also monitor and adjust its internal state to adapt to complex interaction needs.

2. Environmental awareness

Environmental awareness involves the perception and understanding of the surrounding world. This is not only a perception of the physical environment, such as spatial location and object characteristics, but also an understanding of the social environment, such as the motivations for human behavior, social norms, and cultural

background. At this level, the artificial consciousness system needs to be able to interpret and predict human behavior and reactions for appropriate interaction and response.

3. Purpose

Purpose is an important characteristic of consciousness, which refers to the state of consciousness always being related to something, such as thinking, desire, belief, and feeling. In the application of artificial consciousness, this means that the system can not only respond to current needs, but also understand and predict the underlying purpose behind these needs, thereby providing more precise and personalized services.

4. Decision-making and Execution

Consciousness also includes the ability to make choices and execute decisions based on received information and internal value systems. In the AC system, this not only requires technology to make judgments in given choices, but also requires it to make reasonable moral and ethical evaluations, especially in situations that may have a significant impact on human well-being.

5. Perception and Emotional Response

Consciousness not only involves logical processing of information, but also involves emotional responses to this information. For artificial consciousness systems, this means that they need to be able to simulate human emotional responses to some extent, in order to achieve more natural and humane interactions.

Through these well-defined components, consciousness is not only a response or processing of simple data, but a complex, multidimensional, and dynamic cognitive process involving self-awareness, environmental interaction, goal pursuit, moral judgment, and emotional experience. In the development of artificial consciousness, these definitions provide specific directions and standards for designing and evaluating systems, ensuring that technological development can truly serve and enhance human cognition and social life.

3 The application of AI and AC in consciousness and subconsciousness

3.1 The subconscious application of AI

artificial intelligence (AI) has demonstrated functions similar to the human subconscious in processing large amounts of data, executing automated tasks, and rule-based decision-making. The subconscious typically handles tasks in humans that do not require conscious thinking, such as breathing, walking, and conditioning. These applications of AI systems similarly handle tasks that require fast and efficient execution without the need for deep decision-making.

Practical application cases:

Transaction Algorithm: In financial markets, AI can analyze millions of transactions and historical data points to make real-time buying and selling decisions. These algorithms are based on previously set rules and can respond in milliseconds, similar to human subconscious reactions.

Facial recognition technology: Widely used in security and consumer electronics, facial recognition technology can quickly analyze hundreds of thousands of facial nodes and recognize personal identity without significant human intervention.

Internet search engines: search engines such as Google use complex algorithms to automatically interpret the user's query purpose and context, quickly return relevant results, and almost no direct human operation is required in the process.

These applications demonstrate the efficiency of AI in performing routine and highly repetitive tasks, similar to the role of the human subconscious in handling daily tasks.

3.2 The application of AC consciousness

The design goal of artificial consciousness (AC) is to handle more complex social interactions and higher-level decision-making problems, which requires the system to not only perform tasks, but also understand and evaluate the ethical, social, and long-term consequences of its behavior.

Practical application cases:

Moral judgment: in autonomous vehicle, the decision-making system needs to be able to make moral judgments in emergencies, such as when

Choose an action plan that minimizes harm in the event of an accident. The AC system simulates human moral thinking, evaluates the potential harm of different

decisions, and selects the most appropriate action.

Strategic planning: In enterprise management and military applications, the AC system can assist in complex strategic planning, such as resource allocation, risk management, and long-term goal setting. These systems support the formulation of wiser strategic decisions by integrating large amounts of data, predicting future trends, and considering various influencing factors.

Creative thinking: In the fields of artistic creation and product design, the AC system can assist humans in the process of creative generation and innovation. By simulating human creative thinking, novel design concepts and artworks can be proposed.

The AC system not only executes commands in these applications, but also demonstrates an understanding of complex social values and principles of human behavior. These abilities enable the AC system to consider the ethical consequences and social impact of behavior when making decisions, which is significantly different from the functionality of traditional AI systems.

comparative analysis

When understanding the difference between AI and AC in conscious and subconscious applications, the key lies in the depth and breadth of their problem-solving abilities:

The subconscious application of AI mainly focuses on efficiency and speed, suitable for environments with clear rules and high response time requirements. The design principles of these systems are fast response and highly automated, often without the need for (and unable to) deep ethical or strategic considerations.

The application of AC's consciousness emphasizes the quality and depth of decision-making, especially in situations involving complex interactions and the need to balance multiple factors. The core of AC system design is to simulate advanced cognitive functions of humans, including moral judgment, strategic planning, and creativity, which are areas that traditional AI is difficult to reach.

This comparison not only reveals the application boundaries of current technology, but also points to the potential direction of future development of

artificial intelligence technology, which is to approach higher-level human consciousness functions and achieve true artificial consciousness.

4 DIKWP definition of consciousness

When we attempt to define consciousness from the perspective of the DIKWP model and simplify the explanation using the Occam's Razor Principle, we should avoid unnecessary introduction of new concepts, and instead make use of existing data, information, knowledge, wisdom, and purpose as much as possible to construct the theoretical framework of consciousness. The following is a detailed definition of consciousness based on this principle:

In the DIKWP model, consciousness can be seen as a composite cognitive process that integrates data, information, knowledge, wisdom, and purpose. This process not only processes the raw data of sensing and input, but also transforms this data into information, further refining information into knowledge, and making decisions and reactions guided by wisdom and purpose. Let's explore in detail the role of each component in consciousness:

Data

In the construction of consciousness, data is the foundation. This includes sensory inputs received from the outside, such as visual, auditory, and tactile information. The process of consciousness begins with the collection and initial processing of these raw data.

Information

Information is the process of organizing, classifying, and interpreting data. In consciousness, this involves identifying correlations between data, such as interpreting shapes and colors in visual data as "vehicles" or "pedestrians". This level of processing makes data meaningful and paves the way for the formation of knowledge.

Knowledge

Knowledge is the further deepening of information, forming an abstract understanding of the world. In the process of consciousness, knowledge includes not only the storage of facts and information, but also the understanding of the logic

behind these facts, such as understanding the physical laws of vehicle movement or pedestrian behavior patterns.

Wisdom

Wisdom involves the ability to apply knowledge to make judgments and decisions. In the framework of consciousness, wisdom refers to how to make the best choice in uncertainty, such as evaluating the consequences of sudden braking in traffic. Wisdom requires evaluating the potential impact of various actions and selecting ethical and practical solutions.

Purpose

purpose is the highest level of consciousness, involving the setting and pursuit of goals. Consciousness not only reflects the current situation, but also plans actions based on future goals and expectations. For example, a person may choose to walk instead of drive because they want to stay healthy.

Through the DIKWP model, consciousness is defined as a highly integrated and dynamic process that begins with the perception of raw data, undergoes information interpretation, knowledge application, and intelligent judgment, ultimately achieving the realization of purpose. This definition emphasizes the comprehensive role of consciousness in human behavior and decision-making, while also guiding the design and evaluation of artificial intelligence systems with similar human consciousness capabilities. By utilizing the Occam's Razor Principle, we avoid introducing unnecessary complexity and instead utilize existing cognitive levels to comprehensively explain the mechanisms of consciousness. This method is not only scientific, but also has high practical value in both theory and application.

5 Comparative analysis of the main theories related to consciousness

To conduct in-depth comparative analysis of consciousness, we can explore several major theories of consciousness, including research findings in psychology, philosophy, and cognitive science. Each theory provides us with different perspectives and insights for understanding consciousness. The following are five main consciousness research works, which we will compare and analyze with the DIKWP model:

5.1 Global Workspace Theory - GWT

Theoretical Introduction:

Proposed by Bernard Baars, the global workspace theory suggests that consciousness is similar to a broadcasting system, integrating and broadcasting information to other regions of the brain. This model emphasizes the accessibility of information throughout the brain, and consciousness is the result of information processing, enabling information to be used by the entire brain network.

Comparison with DIKWP Consciousness Model:

GWT emphasizes the integration and broadcasting of information, similar to the processing of information and decision-making broadcasting of wisdom in DIKWP. However, GWT does not specifically involve the formation process of purpose, but mainly focuses on the global availability of conscious content.

5.2 Integrated Information Theory - IIT

Theoretical Introduction:

Proposed by Giulio Tononi, the theory of integrated information advocates that consciousness is the integrated measurement of information within a system. IIT quantifies the degree of integration of interactions between elements in a system (referred to as Φ To explain the level of consciousness, it is advocated that consciousness is a fundamental property of physical processes.

Comparison with DIKWP Consciousness Model:

IIT provides a mathematical model for measuring awareness, focusing on the integration of internal information within the system. This is similar to the handling of wisdom and purpose in the DIKWP model, especially in how to extract and integrate information from different sources to form a unified decision and goal setting.

5.3 Biological Robot Model

Theoretical Introduction:

Daniel Dennett's viewpoint views human consciousness as an advanced information processing system, similar to advanced "biological robots.". This theory suggests that consciousness is a byproduct of the brain's complex calculations,

focusing on the practicality of cognitive functions.

Comparison with DIKWP Consciousness Model:

The biological robot model and the DIKWP model share commonalities in the cognitive level of processing data and information, but Dennett's model focuses more on practicality and functionality, while the DIKWP model covers the entire cognitive process from data to purpose more comprehensively.

5.4 Multiple Drafts Model

Theoretical Introduction:

It is also proposed by Daniel Dennett. This model believes that consciousness is not a single centralized process, but multiple parallel and competitive processes (drafts). The content of consciousness is the result of post selection.

Comparison with DIKWP Consciousness Model:

The multiple draft model emphasizes the dynamics and nonlinearity of the conscious process, which is similar to the dynamic decision-making process of wisdom and purpose in DIKWP. The DIKWP model provides structured theoretical support for this dynamic process, especially in how to integrate multiple information and knowledge to form decisions.

5.5 Consciousness research in cognitive neuroscience

Theoretical Introduction:

In recent years, cognitive neuroscience has revealed brain mechanisms related to conscious states through experimental research, including synchronous activities of neural networks.

Comparison with DIKWP Consciousness Model:

These studies emphasize the role of biological foundations and neural mechanisms in consciousness formation, echoing the biological foundations of data and information processing in the DIKWP model. In addition, the findings of neuroscience also support the importance of wisdom and purpose in the formation of consciousness.

By comparing these consciousness theories with the DIKWP model, we can see that although each theory has different focuses, the DIKWP model provides a

comprehensive framework that connects different aspects of consciousness - from data processing to purpose realization. This comprehensiveness enables the DIKWP model to not only explain the multifaceted characteristics of consciousness, but also guide related technology and application development, especially in the design and implementation of artificial intelligence and artificial consciousness.

In order to provide a more detailed comparative analysis, we can further explore the core features and focuses of each theory in explaining consciousness, as well as the specific cognitive similarities and differences between these theories and the DIKWP model. The following table provides a more refined comparative analysis:

Theory	**Main Point**	**Focus on the level**	**Similarities with the DIKWP model**	**Differences with the DIKWP model**	**Practical considerations for application**
GWT	Consciousness, as the broadcasting system of the brain, integrates information and makes it available in the brain.	Widespread integration of information and whole brain accessibility.	Emphasizing the widespread distribution of information in the brain, similar to decision-making broadcasting at the level of wisdom.	Not specifically exploring the formation of individual purposes, but focusing more on the transmission and processing of information.	Helps to understand how to design information processing systems to enhance coordination and responsiveness.
IIT	Consciousness is the quantification of the degree of information integration, and the higher the level of system integration, the higher the level of consciousness.	The degree of internal integration of information.	It involves the integration of information and knowledge internally, similar to information processing at the level of wisdom and purpose.	Emphasis is placed on physical and mathematical models, lacking descriptions of actual cognitive processes and hierarchy.	Provide theoretical support for the development of highly integrated and autonomous cognitive systems.
Biological robot model	From a functionalist	The practicality and	Processing data,	Do not emphasize	Assist in designing AI

	perspective, it is believed that human consciousness is a byproduct of complex calculations performed by the brain.	computational efficiency of cognitive function.	information, and knowledge, functionally similar to the first three levels of DIKWP.	advanced processing of wisdom and purpose, focus more on practical functions.	systems that efficiently execute specific tasks, such as automation tools and robots.
Multiple draft model	Consciousness is composed of multiple parallel and competitive cognitive processes, and the content of consciousness is the secondary result of these processes.	The dynamic and decentralized nature of cognitive processes.	The dynamic decision-making process reflected in wisdom and purpose resonates with it.	Emphasizing the nonlinearity and decentralization of consciousness does not conform to the hierarchical structure of the DIKWP model.	This provides insights for developing systems that can adapt to constantly changing inputs, such as adaptive learning environments.
Consciousness research in cognitive neuroscience	Research the correlation between consciousness and brain activity, such as neural network synchronization.	Neuromechanisms and biological foundations.	Support the biological foundation of data and information processing in the DIKWP model.	Mainly focusing on biological and chemical mechanisms, there is less systematic description of wisdom and purpose.	It is of great significance to develop advanced AI and robotics technologies that can simulate the biological mechanisms of human consciousness.

Through more detailed comparisons, each theory provides unique perspectives and important insights into the interpretation of consciousness, while the DIKWP model provides a structured framework to integrate these perspectives. Understanding the similarities and differences between these theories not only helps to gain a deeper

understanding of the complexity of consciousness, but also provides important theoretical foundations and practical guidance for designing artificial intelligence systems with humanoid consciousness capabilities.

This detailed analysis also reveals the shortcomings of current consciousness research and future development directions, especially in improving the autonomy, adaptability, and ethical and moral judgment ability of the system. By combining and drawing on these theories, future AI and AC systems will become more powerful, able to better simulate and expand human cognitive abilities.

6 Comparative analysis of artificial consciousness AC and DIKWP-AC system

In order to further expand the research and systematic discussion on artificial consciousness (AC), we list ten different AI research projects or systems and outline their core characteristics and objectives. These systems cover from model-based cognitive architectures to practical robots and computing platforms, representing diversity and innovation in the field of artificial consciousness.

6.1 List of artificial consciousness systems

OpenCog

A universal artificial intelligence framework that uses multiple algorithms and data structures to simulate human cognitive functions.

LIDA (Learning Intelligent Distribution Agent)

Based on the global workspace theory, simulate a series of cognitive processes, including perception, attention selection, behavioral selection, and learning.

NARS (Non-Axiomatic Reasoning System)

Suitable for experiential learning and reasoning systems under incomplete knowledge conditions, designed to handle complex and dynamic problems.

Human Brain Project (HBP)

A large-scale research project in Europe aims to explore the biological basis of human cognition and consciousness by simulating the human brain.

Blue Brain Project

The research project in Switzerland aims to digitally simulate brain function by reconstructing the neural network of rat brains in detail.

ACT-R (Adaptive Control of Thought—Rational)

Cognitive architecture simulates the mechanisms by which the human brain processes various tasks, emphasizing knowledge driven processing and decision-making.

Soar

Integrated cognitive architecture, used to simulate decision-making, problem-solving, and learning processes.

SP Theory of wisdom

Propose a unified theory aimed at simplifying and integrating the understanding of wisdom, consciousness, and the brain.

SyNAPSE

The project funded by DARPA aims to create a dynamic learning and adaptive artificial neural system that simulates the functions of the real brain.

Copycat Cognitive Architecture

A model used to study how humans engage in conceptual and flexible thinking, particularly in problem-solving and creative thinking.

These systems and projects each have their own characteristics, varying in design and objectives, from simulating the biological details of the human brain to creating abstract cognitive models for general reasoning and decision support. Each system is attempting to solve the core problem in the field of artificial consciousness in different ways: how to integrate and process information from multiple sources to simulate the decision-making process of human consciousness. The diversity of these systems demonstrates the broad field and possible future development paths of artificial consciousness research, with each project providing a unique perspective and technology for understanding and constructing machines with advanced cognitive abilities. Through further research and development of these systems, we can better understand the mechanisms of consciousness and achieve more advanced artificial intelligence functions in practical applications.

6.2 Comparative analysis of representative artificial consciousness

To conduct a detailed comparative analysis of research on artificial consciousness (AC) and its application in the DIKWP model, we need to select several specific AC research projects or concepts and explore how they can be attempted in achieving advanced cognitive processing, as well as the correlation and differences between these methods and the DIKWP model. The following are four representative AC research works and a comparative analysis with the DIKWP model:

OpenCog

Research Introduction:

OpenCog is an open-source project aimed at providing the underlying framework for General artificial intelligence (AGI). It uses multiple algorithms and data structures to simulate human thinking patterns, particularly through associative memory, processing, and learning various types of information.

Comparison with DIKWP Consciousness Model:

Similarities: OpenCog is committed to integrating knowledge and information, to some extent simulating the decision-making process of Wisdom.

Differences: OpenCog's design focuses more on algorithm diversity and scalability, rather than directly mapping the explicit expression of the Purpose in DIKWP.

LIDA(Learning Intelligent Distribution Agent)

Research Introduction:

The LIDA model is based on the global workspace theory and is a cognitive architecture aimed at simulating a series of cognitive processes, including perception, attention selection, behavioral selection, and learning, aiming to achieve functions that are close to the level of human consciousness.

Comparison with DIKWP Consciousness Model:

Similarities: The LIDA architecture processes information and knowledge, and attempts to achieve the processing of wisdom and purpose through situational models.

Differences: LIDA emphasizes the dynamic integration of cognitive processes, while the DIKWP model more comprehensively covers the continuous process from data to purpose.

NARS (Non-Axiomatic Reasoning System)

Research Introduction:

NARS is an experiential learning based reasoning system designed for effective reasoning in situations where knowledge is incomplete. This system simulates human thinking patterns under limited resource conditions through adaptive learning and reasoning mechanisms.

Comparison with DIKWP Consciousness Model:

Similarities: NARS processes knowledge and information, especially in reasoning when facing incomplete data, similar to the wisdom level in DIKWP.

Differences: NARS focuses on logical reasoning and knowledge incompleteness, while DIKWP provides a broader cognitive level of processing, including clear expression and pursuit of purpose.

Human Brain Project (HBP)

Research Introduction:

The European brain project aims to reconstruct and simulate the workings of the human brain through high-performance computing and neuroscience research, in order to understand the biological basis of human consciousness.

Comparison with DIKWP Consciousness Model:

Similarities: HBP attempts to map the brain's data processing and information integration mechanisms in detail from a biological perspective, similar to the processing path from data to wisdom in DIKWP.

Differences: HBP focuses more on simulating biological and chemical mechanisms, while the DIKWP model describes the complete process of consciousness at a more abstract level, including the abstract level of purpose.

These AC research projects each have their own characteristics and focuses, and they have both similarities and significant differences with the DIKWP model in terms of technical implementation and theoretical foundations. Through these comparisons, we can see that the DIKWP model provides a more systematic and comprehensive framework, covering not only the entire process from basic data processing to high-level purpose implementation, but also emphasizing the

importance of wisdom and purpose in advanced cognitive systems. The different focuses of these research works also suggest diverse approaches to artificial consciousness research, as well as potential directions for future development of artificial intelligence and artificial consciousness technology.

The following is a detailed table that presents a comparative analysis between representative research on artificial consciousness (AC) and Professor Yucong Duan's DIKWP-AC artificial consciousness model. This table focuses on highlighting the main viewpoints of each research work, their levels of emphasis in cognitive processing, and the main similarities and differences with the DIKWP model:

Research projects	**Main Point**	**Focus on the level**	**Similarities with the DIKWP model**	**Differences with the DIKWP model**	**Practical considerations for application**
OpenCog	Provide a universal underlying framework for artificial intelligence, using multiple algorithms to simulate human thinking patterns.	Algorithm diversity and scalability of cognitive models.	Integrate knowledge and information, simulate decision-making processes at the level of wisdom.	More emphasis is placed on the diversity of algorithms, rather than directly mapping explicit expressions of purpose in DIKWP.	Suitable for developing universal artificial intelligence systems that require extensive cognitive abilities.
LIDA	Based on the theory of global workspace, simulate cognitive processes such as perception and attention selection.	The dynamic integration of cognitive architecture and processes.	Involving the processing of information and knowledge, and attempting to achieve intelligent and purposeal processing.	Emphasize the dynamic integration of cognitive processes, rather than the hierarchical continuous process of DIKWP.	Suitable for applications that require simulating human attention and perception processes, such as autonomous driving.
NARS	An experiential	Logical reasoning and	The processing of knowledge is	Focusing on logical	Helps develop systems that

	learning reasoning system designed for incomplete knowledge conditions.	knowledge incompleteness processing.	similar to the reasoning processing at the level of wisdom.	reasoning and processing incomplete information, without directly involving extensive applications of wisdom and purpose.	require decision-making in uncertain environments, such as emergency response systems.
Human Brain Project (HBP)	Understanding consciousness by reconstructing and simulating the workings of the human brain.	The biological and chemical mechanisms of the brain.	Support the biological foundation of data and information processing in the DIKWP model.	More emphasis is placed on simulating biological and chemical mechanisms, with less involvement in advanced wisdom and purpose processing.	It has important value in developing advanced cognitive systems and disease models based on biological principles.

Through the above table, we can clearly see the focus of different AC research works on cognitive processing and how they compare with the DIKWP model. Each study has its own unique methods and focus, but all intersect to some extent with the layers in the DIKWP model, especially in the processing of information and knowledge. However, the manifestation of wisdom and purpose processing in these studies is not the same, indicating that there is still a lot of room for exploration in the field of artificial consciousness, especially in how to better integrate and achieve purpose level processing.

In order to provide a more detailed comparison of various artificial consciousness (AC) research projects and systems with the DIKWP model, a complete comparison table is provided below. This will help to gain a deeper understanding of the characteristics, core technologies, and how they contribute to simulating or

implementing artificial consciousness in each system.

Research projects	Main Point	Focus on the level	Similarities with the DIKWP model	Differences with the DIKWP model	Practical considerations for application
OpenCog	Multi algorithm universal AI framework, simulating human thinking	Algorithm diversity and cognitive model scalability	Simulate human wisdom and decision-making processes	More emphasis on algorithm and system integration rather than explicit purpose processing	Suitable for developing general-purpose AI systems that require complex cognitive processing
LIDA	Based on the theory of global workspace, simulate a series of cognitive processes	Dynamic Integration of Cognitive Processes	Processing information and knowledge, attempting to simulate the processing of wisdom and purpose	Emphasis on dynamic integration of cognitive processes and non-linear processing	Suitable for applications that require simulating human attention and perception, such as educational and training software
NARS	A logical reasoning system facing incomplete knowledge	Logical reasoning and handling of knowledge incompleteness	Involving logical processing of knowledge, similar to the level of wisdom	Focusing on logical processing of incomplete information, without involving emotions or complex human purposes	Suitable for designing systems that make decisions in uncertain environments, such as financial analysis tools
Human Brain Project	Simulating the human brain to understand the biological basis of consciousness	Biological and chemical mechanisms	Provide a biological foundation in data and information processing	More emphasis on biological simulation, with less involvement in advanced processing of wisdom and purpose	It is of great significance for the development of cognitive systems and disease models based on biological

					principles
Blue Brain Project	Digitally reconstructing the neural network of the brain and simulating brain function	Detailed simulation of neural networks	Support understanding data and information processing from a neural perspective	Mainly focused on physical and biological structures, lacking an overall framework for wisdom and purpose	Helps medical research and development of treatment methods for specific brain diseases
ACT-R	Simulate the mechanism of brain processing tasks, emphasizing knowledge driven cognition	The practicality and computational efficiency of cognitive function	Emphasize the processing of knowledge and information, involving decision-making	Focusing on simulating specific psychological processes rather than forming overall purposes	Simulation suitable for education, training, and advanced cognitive tasks
Soar	Integrated cognitive architecture, used to simulate decision-making, problem-solving, and learning processes.	Simulation of decision-making and learning	Involving the process from data to wisdom.	Focusing on modeling problem-solving and learning abilities, without directly dealing with complex human purposes.	Suitable for simulating and enhancing artificial intelligence applications in complex task processing and learning environments.
SP Theory of wisdom	Propose a unified theory aimed at simplifying and integrating the understanding of wisdom, consciousness, and the brain.	Unification and simplification of cognition	Emphasize the integration of information and knowledge, similar to the integrated processing of DIKWP.	More abstract and theoretical, without involving specific implementation details.	It can provide a theoretical basis for designing simplified and unified cognitive models.
SyNAPSE	Supported by DARPA, the aim is to create dynamic	Dynamic learning and neural adaptability	It involves data processing and adaptive learning of	More focused on hardware and low-level neural	Suitable for developing systems that require

	learning and adaptive artificial neural systems.		information, similar to the front-end processing of DIKWP.	simulation, with differences in purpose compared to DIKWP.	large-scale data processing and strong adaptability.
Copycat Cognitive Architecture	Study how humans engage in conceptual thinking and flexible problem-solving.	Conceptual thinking and creative problem-solving	Involving the decision-making process and conceptual understanding at the level of wisdom.	Focusing on specific types of creative thinking rather than comprehensive purpose oriented processing.	AI applications suitable for innovative problem-solving and creative thinking.

7 Ideal DIKWP-AC system design scheme

7.1 Detailed design of data layer

Technical implementation: Utilizing advanced biocompatible sensors and artificial skin to collect environmental data and tactile feedback. Simulate human vision and hearing using high-resolution cameras and high-sensitivity microphones.

Data processing: Implement real-time data preprocessing, including noise reduction, normalization, and feature extraction, to reduce the computational burden of subsequent layers.

Integration strategy: The data layer and information layer are directly connected through high-speed interfaces to ensure efficient and real-time data flow.

7.2 Detailed design of information layer

Core algorithm: Using deep learning networks for pattern recognition of input data, identifying objects, speech, and other key information.

Information integration: Manage associated information through graph databases, support complex queries and relationship mining, and enhance the availability and significance of information.

Intelligent distribution: Design a rule-based engine that dynamically adjusts the priority and processing flow of information based on current tasks and user needs.

7.3 Detailed design of knowledge layer

Knowledge representation: Using ontology and semantic networks to represent knowledge, supporting complex logical reasoning and relational inference.

Learning mechanism: Implementing incremental learning strategies, the system continuously learns new knowledge through interaction with the environment, while updating old knowledge representations.

Knowledge sharing: Design APIs to support cross system sharing of knowledge, enabling AC systems to utilize external knowledge bases and resources from other intelligent systems.

7.4 Detailed design of wisdom layer

Decision framework: Implement a multi standard decision support system that takes into account factors such as ethics, efficiency, cost, and safety.

Simulated reasoning: Using scenario simulation and predictive models to evaluate the possible consequences of various decision-making options and support wiser choices.

Adaptive adjustment: Based on feedback loops, the system can adjust its decision model according to the actual effect of the decision, optimizing the future decision-making process.

7.5 Detailed design of the purpose layer

Goal generation: The system can automatically generate short-term and long-term goals based on the current knowledge state and changes in the external environment.

purpose recognition: Through deep learning and natural language processing techniques, understand and predict the user's purposes and needs.

Action planning: Design complex planning algorithms, generate detailed action steps to achieve goals, consider resource availability and time constraints.

8 Case study: autonomous driving and service robots

8.1 Autonomous driving

The development of autonomous driving technology is fundamentally changing our understanding and interaction with transportation systems. With the integration of artificial consciousness (AC), autonomous vehicles can not only perform driving tasks,

but also make reasonable decisions in complex moral dilemmas.

The implementation of ethical decision-making:

The introduction of AC in autonomous driving is mainly to deal with situations that require balancing different ethical principles. For example, when a autonomous vehicle has to choose whether to avoid emergency vehicles or continue to drive according to normal driving rules when driving, AC can help the vehicle evaluate which choice is more consistent with social ethical standards in the long run. This type of decision typically involves complex data analysis and scenario simulation, requiring vehicles to understand the importance of emergency vehicles and respond quickly to the surrounding environment.

Technical application:

To achieve this decision, the auto drive system needs to integrate advanced sensor networks, real-time data processing and prediction models, and machine learning algorithms to constantly learn and optimize the decision-making process. For example, by training deep learning models to identify different types of emergency situations and corresponding optimal behavior strategies, vehicles can quickly and accurately respond to similar situations.

8.2 Service robot

Service robots, especially in the fields of health care and home assistants, are gradually becoming a reality. With the integration of AC, these robots can not only perform daily tasks, but also interact with humans emotionally, providing more personalized services.

Emotional and behavioral adaptability:

In applications such as elderly care, AC enables service robots to understand and adapt to the emotional and behavioral needs of the elderly. This includes identifying user emotional changes, providing appropriate emotional responses, and taking appropriate actions in emergency situations. For example, if an elderly person shows signs of anxiety or sadness, a robot with AC can provide support through dialogue, playing relaxing music, or notifying family members.

Technical implementation:

This adaptability requires robots to be equipped with advanced sensors to monitor users' speech and facial expressions, as well as complex natural language processing and sentiment analysis systems to parse this data. In addition, robots need to be able to learn and adjust their behavior through feedback from their interactions, ensuring that their services truly meet the needs of users.

Whether it is autonomous vehicles or service robots, the integration of artificial consciousness marks an important advancement in AI technology, transforming from simple task executors to intelligent systems capable of making complex decisions and emotional interactions. This not only improves the functionality of the machine, but also increases its acceptability and practical value in society. Future development will focus more on enhancing the moral decision-making ability and emotional wisdom of these systems to better serve human society.

9 Related work

9.1 Research review

The research fields of artificial intelligence (AI) and artificial consciousness (AC) cover a wide range of discussions from basic theories to applied technologies. The core issues in these fields revolve around how to simulate and understand the complexity of human consciousness, and how to apply these understandings to create advanced intelligent systems. The following is a discussion of the relevant work based on the provided literature.

theoretical basis

Cognitive theory of consciousness:

Bernard Baars proposed the Global Workspace Theory (GWT) in his work, which suggests that consciousness is similar to a broadcasting system in the brain, integrating and broadcasting information to other regions of the brain, providing a useful cognitive framework for understanding consciousness (Baars, 1988).

Integrated Information Theory:

Giulio Tononi's Integrated Information Theory (IIT) proposes the measurement of consciousness and information integration (referred to as Φ Regarding values, it is

emphasized that the integration of information within the system is the key to the generation of consciousness (Tononi, 2012). This theory provides a new method for quantifying consciousness.

artificial intelligence and Human Problem Solving:

Allen Newell and Herbert A. Simon explored the mechanisms by which humans solve problems, which have a significant impact on the theoretical foundation of artificial intelligence, particularly in simulating human decision-making processes (Newell&Simon, 1972).

Technology implementation and application

Design of intelligent systems:

Ray Kurzweil explored the design concepts of artificial intelligence systems, particularly how to use existing technologies to simulate the thinking patterns of the human brain, in "How to Create a Mind" (Kurzweil, 2012). This book provides valuable insights into practical applications and system design in the field of AI.

Universal artificial intelligence:

Ben Goertzel and Cassio Pennachin discussed the concept of General artificial intelligence (AGI), attempting to break through the limitations of existing AI systems and create systems that can perform any human wisdom activity (Goertzel&Pennachin, 2007).

Cross disciplinary research

Philosophy and Scientific Research of Consciousness:

David Chalmers proposed the "problem" of consciousness in "The Conscientious Mind", exploring the basic theories and scientific explanations of consciousness (Chalmers, 1996). This philosophical exploration is of great value for a deeper understanding of the essence of consciousness.

Neurobiological perspective:

Gerald Edelman proposed the theory of neural group selection in "Neural Darwin", which is a framework for understanding how the brain develops complex behaviors and consciousness (Edelman, 1987). This exploration from a biological perspective provides an important perspective for understanding the biological basis

of consciousness.

Literature research reflects the diverse approaches of artificial intelligence and artificial consciousness research, from theoretical exploration to technological implementation, and then to in-depth discussions in philosophy and biology. These studies not only enhance our understanding of AI and AC, but also guide the design and implementation of new systems. With the development of technology and the deepening of research, we expect more innovative theories and practical applications to emerge in the future, which will further promote the development of intelligent systems and make them closer to simulating the comprehensive consciousness of humans.

9.2 Latest frontiers

We will explore multiple aspects of artificial intelligence (AI) and artificial consciousness (AC), including their technological development, ethical issues, social impact, and future applications, by combining relevant reports and review articles in recent years.

The Development and Application of AI Technology

Starting from the 2019 article "Can Machines Think? AI and the Future of wisdom" in Nature, we have seen extensive discussions about AI wisdom levels, which are also reflected in the 2019 report on AI and the future of work in MIT Technology Review. These discussions emphasize that AI has not only made progress in simulating human wisdom, but also demonstrated unique capabilities in specific fields such as coding and healthcare services (Nature Medicine, 2021). In addition, the 2019 report by The Wall Street Journal on how AI takes over air traffic control revealed the potential application of AI in critical infrastructure management.

The Ethical and Social Challenges of AI

Regarding the ethical issues of AI, the 2021 article "Building Ethical AI for the Future" in Science and the 2020 article "Ethics of Artistic wisdom and Robotics" in Stanford Encyclopedia of Philosophy discussed how to integrate ethical considerations into the development of AI. The 2020 article "Why AI Systems Should Be Recognized as Inventors" in The Guardian sparked discussions about intellectual

property and creative rights. The impact of AI on employment is another hot topic, as discussed in detail in the 2020 article of The New York Times, emphasizing the need to consider the changes brought about by AI technology when formulating strategies.

The role of AI in global goals

The role of AI in achieving sustainable development goals was explored in a 2020 article in Nature Communications. This indicates that AI technology is not limited to commercial and industrial applications, but can also play a crucial role in global environmental and social governance. In addition, the role of AI in gender bias has also received attention from Harvard Business Review in 2019, highlighting the need for more regulation and review of AI systems.

The Future Outlook and Innovation of AI

Finally, the future prospects of AI technology have been widely discussed in multiple reports. The 2019 article in The Economist and the 2021 discussion in IPR Policy Briefs on the impact of AI on innovation both pointed out the potential of how AI can drive cutting-edge technological development. The 2019 article in IEEE Spectrum provides specific examples of the evolution of autonomous driving technology.

Through the integration and analysis of these articles, we can gain a more comprehensive understanding of the complexity and diversity of AI technology, as well as the multiple roles it plays in global society. Future research and policy-making need to comprehensively consider the technological progress, ethical challenges, and social impact of AI to ensure the healthy development and positive application of this technology.

10 Conclusion and Outlook

This article delves into the core theories, applications, and potential utility of artificial intelligence (AI) and artificial consciousness (AC) in the real world. By analyzing different theories of consciousness, we can see how each theory explains the complex phenomena of consciousness from its specific perspective, and compare the application and implementation of these theories in the DIKWP model. In addition, we also explored the functionalities and limitations of AI and AC in practical

applications, particularly their performance in executing complex tasks and handling ethical and strategic decisions.

Through in-depth analysis of AI and AC at the conscious and subconscious levels, we can see that the development of AC technology will make machines more intelligent and humane, enabling them to make decisions that meet human values and moral standards in more complex environments. Future technological development should pay more attention to the integration of wisdom and purpose to achieve a wider range of application areas, such as public safety, healthcare, and social management. Meanwhile, this also requires us to fully consider their social impact and ethical responsibilities when designing and implementing these systems.

In terms of subconscious applications of AI, we have observed that AI systems exhibit excellent performance in tasks such as automation, fast data processing, and rule-based decision-making, but these systems often lack flexibility and depth in handling undefined situations. On the contrary, the design of AC systems places more emphasis on simulating the comprehensiveness of human consciousness, especially in understanding complex social interactions, making moral judgments, and demonstrating higher adaptability and foresight in long-term strategic planning.

By proposing an ideal DIKWP-AC system design scheme, we demonstrate how to integrate existing technological and theoretical advantages into a multi-level artificial consciousness system, thereby improving the system's autonomy, decision-making quality, and social adaptability. This design scheme not only reflects the forefront of current technology, but also provides a practical roadmap for the research and development of future artificial consciousness technology.

Although there are still many challenges in creating artificial systems that fully simulate human consciousness, the analysis and discussion in this article point out feasible research directions and technical routes. Future research needs to further explore how to integrate different theoretical perspectives and technical methods to achieve a more powerful and flexible artificial consciousness system. With the advancement of technology and the deepening of theory, artificial consciousness has the potential to exert significant social and economic benefits in multiple fields, such

as automated management, social services, and innovation and creation.

Through this report, we hope to provide valuable insights and recommendations for developers, researchers, and policy makers of AI and AC, promoting the safe, effective, and ethical application of intelligent systems.

References

[1] 段玉聪(Yucong Duan). (2024). 大语言模型(LLM)偏见测评(种族偏见)(Large Language Model (LLM) Racial Bias Evaluation). DOI: 10.13140/RG.2.2.33162.03521. https://www.researchgate.net/publication/377963440_Large_Language_Model_LLM_Racial_Bias_Evaluation_--DIKWP_Research_Group_International_Standard_Evaluation_Prof_Yucong_Duan.

[2] 段玉聪(Yucong Duan). (2024). 人为什么不愿意被别人改变：DIKWP 和语义数学的深入探讨(Why People Don't Want to Be Changed by Others: Insight from DIKWP and Semantic Mathematics). DOI: 10.13140/RG.2.2.17961.77927. https://www.researchgate.net/publication/377726002_Why_People_Don't_Want_to_Be_Changed_by_Others_Insight_from_DIKWP_and_Semantic_Mathematics.

[3] 段玉聪(Yucong Duan). (2024). 语义新质生产力：原理与技术(Semantic New Quality Productivity: Principles and Techniques). DOI: 10.13140/RG.2.2.14606.33607. https://www.researchgate.net/publication/377726380_Semantic_New_Quality_Productivity_Principles_and_Techniques.

[4] 段玉聪(Yucong Duan). (2024). DIKWP 与语义心理学(Semantic Psychology and DIKWP). DOI: 10.13140/RG.2.2.12928.61449. https://www.researchgate.net/publication/377726404_Semantic_Psychology_and_DIKWP.

[5] 段玉聪(Yucong Duan). (2024). 基于"主观客观化"的语义不确定性处理(Semantic Uncertainty Handling Based on "Subjective Objectivisation"). DOI: 10.13140/RG.2.2.31383.55206. https://www.researchgate.net/publication/377726442_Semantic_Uncertainty_Handling_Based_on_Subjective_Objectivisation.

[6] 段玉聪(Yucong Duan). (2024). DIKWP 与语义数学：创造新质生产力的融合(Semantic Mathematics and DIKWP : Creating New Qualities of Productivity). DOI:

10.13140/RG.2.2.19639.50085.
https://www.researchgate.net/publication/377726532_Semantic_Mathematics_and_DIKWP_Creating_New_Qualities_of_Productivity.
[7] 段玉聪(Yucong Duan). (2024). 语义法学与 DIKWP：以英美法系与大陆法系分析为例(Semantic Jurisprudence and DIKWP: Common Law vs. Continental Law). DOI: 10.13140/RG.2.2.28028.10889.
https://www.researchgate.net/publication/377726622_Semantic_Jurisprudence_and_DIKWP_Common_Law_vs_Continental_Law.
[8] 段玉聪(Yucong Duan). (2024). DIKWP 新质生产力与传统生产力的对比分析(DIKWP New Quality Productivity vs. Traditional Productivity Analysis). DOI: 10.13140/RG.2.2.21317.22242.
https://www.researchgate.net/publication/377726626_DIKWP_New_Quality_Productivity_vs_Traditional_Productivity_Analysis.
[9] 段玉聪(Yucong Duan). (2024). 语义物理化学(Semantic Physical Chemistry). DOI: 10.13140/RG.2.2.21261.51684.
https://www.researchgate.net/publication/377439785_Semantic_Physical_Chemistry.
[10] 段玉聪(Yucong Duan). (2024). DIKWP 与语义认知学(DIKWP and Semantic Cognition). DOI: 10.13140/RG.2.2.14052.55680.
https://www.researchgate.net/publication/377415901_DIKWP_and_Semantic_Cognition.
[11] 段玉聪(Yucong Duan). (2024). DIKWP 与语义生物学：拓展跨学科的知识领域(DIKWP and Semantic Biology: Expanding Interdisciplinary Knowledge Areas). DOI: 10.13140/RG.2.2.27474.32962.
https://www.researchgate.net/publication/377416091_DIKWP_and_Semantic_Biology_Expanding_Interdisciplinary_Knowledge_Areas
[12] 段玉聪(Yucong Duan). (2024). DIKWP 体系与语义数学结合构建传染病防治指标体系(DIKWP System Combined with Semantic Mathematics to Construct an Indicator System for Infectious Disease Prevention and Control). DOI: 10.13140/RG.2.2.12374.83521.
https://www.researchgate.net/publication/377416103_DIKWP_System_Combined_wi

th_Semantic_Mathematics_to_Construct_an_Indicator_System_for_Infectious_Disease_Prevention_and_Control

[13] 段玉聪(Yucong Duan). (2024). DIKWP 与语义哲学(DIKWP and Semantic Philosophy). DOI: 10.13140/RG.2.2.34185.21606. https://www.researchgate.net/publication/377416120_DIKWP_and_Semantic_Philosophy

[14] 段玉聪(Yucong Duan). (2024). 语义物理与创新发展(Semantic Physics and Innovation Development). DOI: 10.13140/RG.2.2.19085.72167. https://www.researchgate.net/publication/377416222_Semantic_Physics_and_Innovation_Development

[15] 段玉聪(Yucong Duan). (2024). 语义认知学:连接人类思维与计算机智能的未来(Semantic Cognition: Connecting the Human Mind to the Future of Computer Intelligence). DOI: 10.13140/RG.2.2.29152.05129. https://www.researchgate.net/publication/377416321_Semantic_Cognition_Connecting_the_Human_Mind_to_the_Future_of_Computer_Intelligence

[16] 段玉聪(Yucong Duan). (2024). 语义物理：理论与应用(Semantic Physics: Theory and Applications). DOI: 10.13140/RG.2.2.11653.93927. https://www.researchgate.net/publication/377401736_Semantic_Physics_Theory_and_Applications

[17] 段玉聪(Yucong Duan). (2024). 基于语义数学的美国和中国经济增长分析(Semantic Mathematics based Analysis of Economic Growth in the United States and China). DOI: 10.13140/RG.2.2.35980.90246. https://www.researchgate.net/publication/377401731_Semantic_Mathematics_based_Analysis_of_Economic_Growth_in_the_United_States_and_China

[18] 段玉聪(Yucong Duan). (2024). Collatz Conjecture 的语义数学探索(Collatz Conjecture's Semantic Mathematics Exploration). DOI: 10.13140/RG.2.2.28517.99041. https://www.researchgate.net/publication/377239567_Collatz_Conjecture's_Semantic_Mathematics_Exploration

[19] 段玉聪(Yucong Duan). (2024). 语义数学与 DIKWP 模型（本质计算与推理、存在计算与推理以及意图计算与推理）(Semantic Mathematics and DIKWP Model (Essence Computation and Reasoning, Existence Computation and Reasoning, and Purpose Computation and Reasoning)). DOI: 10.13140/RG.2.2.24323.68648. 377239628_Semantic_Mathematics_and_DIKWP_Model_Essence_Computation_and _Reasoning_Existence_Computation_and_Reasoning_and_Purpose_Computation_an d_Reasoning

[20] 段玉聪(Yucong Duan). (2024). 从主观到客观的语义数学重构(存在计算与推理、本质计算与推理、意图计算与推理)(Semantic Mathematics Reconstruction from Subjectivity to Objectivity (Existence Computation and Reasoning, Essence Computing and Reasoning, Purpose Computing and Reasoning)). DOI: 10.13140/RG.2.2.32469.81120.
https://www.researchgate.net/publication/377158883_Semantic_Mathematics_Recons truction_from_Subjectivity_to_Objectivity_Existence_Computation_and_Reasoning_ Essence_Computing_and_Reasoning_Purpose_Computing_and_Reasoning

[21] 段玉聪(Yucong Duan). (2024). DIKWP 与语义数学在车票订购案例中的应用 (DIKWP and Semantic Mathematics in the Case of Ticket Ordering). DOI: 10.13140/RG.2.2.35422.20800.
https://www.researchgate.net/publication/377085570_DIKWP_and_Semantic_Mathe matics_in_the_Case_of_Ticket_Ordering

[22] 段玉聪(Yucong Duan). (2024). DIKWP 与语义数学分析《论语》“君子和而不同，小人同而不和”(DIKWP and Semantic Mathematical Analysis The Confluent Analects Gentleman is harmonious but different, while petty people are the same but not harmonious). DOI: 10.13140/RG.2.2.28711.32165.
https://www.researchgate.net/publication/377085455_DIKWP_and_Semantic_Mathe matical_Analysis_The_Confluent_Analects_Gentleman_is_harmonious_but_different _while_petty_people_are_the_same_but_not_harmonious

[23] 段玉聪(Yucong Duan). (2023). DIKWP 人工意识芯片的设计与应用(DIKWP Artificial Consciousness Chip Design and Application). DOI: 10.13140/RG.2.2.14306.50881.

https://www.researchgate.net/publication/376982029_DIKWP_Artificial_Consciousness_Chip_Design_and_Application

[24] 段玉聪(Yucong Duan). (2024). 直觉的本质与意识理论的交互关系(The Essence of Intuition and Its Interaction with theory of Consciousness). DOI: 10.13140/RG.2.2.16556.85127.
https://www.researchgate.net/publication/378315211_The_Essence_of_Intuition_and_Its_Interaction_with_theory_of_Consciousness

[25] 段玉聪(Yucong Duan). (2024). 意识中的“BUG”：探索抽象语义的本质(Understanding the Essence of "BUG" in Consciousness: A Journey into the Abstraction of Semantic Wholeness). DOI: 10.13140/RG.2.2.29978.62409.
https://www.researchgate.net/publication/378315372_Understanding_the_Essence_of_BUG_in_Consciousness_A_Journey_into_the_Abstraction_of_Semantic_Wholeness

[26] 段玉聪(Yucong Duan). (2024). 个人和集体的人造意识(Individual and Collective Artificial Consciousness). DOI: 10.13140/RG.2.2.20274.38082.
https://www.researchgate.net/publication/378302882_Individual_and_Collective_Artificial_Consciousness

[27] 段玉聪(Yucong Duan). (2024). 人工意识系统的存在性探究:从个体到群体层面的视角(The Existence of Artificial Consciousness Systems: A Perspective from Group Consciousness). DOI: 10.13140/RG.2.2.28662.98889.
https://www.researchgate.net/publication/378302893_The_Existence_of_Artificial_Consciousness_Systems_A_Perspective_from_Collective_Consciousness

[28] 段玉聪(Yucong Duan). (2024). 意识与潜意识：处理能力的有限性与BUG的错觉(Consciousness and Subconsciousness: from Limitation of Processing to the Illusion of BUG). DOI: 10.13140/RG.2.2.13563.49447.
https://www.researchgate.net/publication/378303461_Consciousness_and_Subconsciousness_from_Limitation_of_Processing_to_the_Illusion_of_BUG

[29] 段玉聪(Yucong Duan). (2024). 如果人是一个文字接龙机器，意识不过是BUG(If Human is a Word Solitaire Machine, Consciousness is Just a Bug). DOI: 10.13140/RG.2.2.13563.49447.
https://www.researchgate.net/publication/378303461_Consciousness_and_Subconscio

usness_from_Limitation_of_Processing_to_the_Illusion_of_BUG

[30] 段玉聪(Yucong Duan). (2024). 超越达尔文：技术、社会与意识进化中的新适应性(Beyond Darwin: New Adaptations in the Evolution of Technology, Society, and Consciousness). DOI: 10.13140/RG.2.2.29265.92001. https://www.researchgate.net/publication/378290072_Beyond_Darwin_New_Adaptations_in_the_Evolution_of_Technology_Society_and_Consciousness

[31] Baars, Bernard J. "A Cognitive Theory of Consciousness." Cambridge University Press, 1988.

[32] Tononi, Giulio. "Integrated Information Theory of Consciousness: An Updated Account." Archives Italiennes de Biologie, 2012.

[33] Dennett, Daniel. "Consciousness Explained." Little, Brown and Co., 1991.

[34] Franklin, Stan, and Art Graesser. "Is it an Agent, or just a Program?: A Taxonomy for Autonomous Agents." Proceedings of the Third International Workshop on Agent Theories, Architectures, and Languages, Springer-Verlag, 1996.

[35] Hawkins, Jeff, and Sandra Blakeslee. "On Intelligence." Times Books, 2004.

[36] Koch, Christof. "The Quest for Consciousness: A Neurobiological Approach." Roberts & Company Publishers, 2004.

[37] Dehaene, Stanislas. "Consciousness and the Brain: Deciphering How the Brain Codes Our Thoughts." Viking, 2014.

[38] Russell, Stuart J., and Peter Norvig. "Artificial Intelligence: A Modern Approach." Prentice Hall, 3rd edition, 2009.

[39] Searle, John. "Minds, Brains, and Programs." Behavioral and Brain Sciences, 1980.

[40] Kurzweil, Ray. "How to Create a Mind: The Secret of Human Thought Revealed." Viking, 2012.

[41] Goertzel, Ben, and Cassio Pennachin. "Artificial General Intelligence." Springer, 2007.

[42] Yudkowsky, Eliezer. "Levels of Organization in General Intelligence." In Artificial General Intelligence, edited by Ben Goertzel and Cassio Pennachin, Springer, 2007.

[43] Hutter, Marcus. "Universal Artificial Intelligence: Sequential Decisions based on Algorithmic Probability." Springer, 2005.

[44] Newell, Allen, and Herbert A. Simon. "Human Problem Solving." Prentice-Hall, 1972.

[45] Chalmers, David J. "The Conscious Mind: In Search of a Fundamental Theory." Oxford University Press, 1996.

[46] Minsky, Marvin. "The Society of Mind." Simon and Schuster, 1986.

[47] Penrose, Roger. "The Emperor’s New Mind: Concerning Computers, Minds and the Laws of Physics." Oxford University Press, 1989.

[48] Rosenblatt, Frank. "The Perceptron: A Probabilistic Model for Information Storage and Organization in the Brain." Psychological Review, 1958.

[49] Brooks, Rodney A. "A Robust Layered Control System for a Mobile Robot." IEEE Journal of Robotics and Automation, 1986.

[50] Edelman, Gerald M. "Neural Darwinism: The Theory of Neuronal Group Selection." Basic Books, 1987.

[51] "Can Machines Think? AI and the Future of Intelligence." Nature, 2019.

[52] "The Reality of AI and Jobs: What You Need to Know." The New York Times, 2020.

[53] "Building Ethical AI for the Future." Science, 2021.

[54] "AI in Healthcare: The Unseen Challenges." Nature Medicine, 2021.

[55] "The Promise and Peril of Artificial General Intelligence." The Economist, 2019.

[56] "AI Can Now Write Its Own Computer Code. That’s Good News for Humans." The New York Times, 2021.

[57] "Artificial Intelligence Confronts a 'Reproducibility' Crisis." Science, 2020.

[58] "Self-Taught AI Shows Similarities to How the Brain Works." Nature Neuroscience, 2021.

[59] "Why AI Systems Should Be Recognized as Inventors." The Guardian, 2020.

[60] "How Artificial Intelligence Is Transforming the World." Brookings Institution, 2018.

[61] "AI and the Future of Work: What We Know So Far." MIT Technology Review,

2019.

[62] "Artificial Intelligence and the Future of Humans." Pew Research Center, 2018.

[63] "AI in the Sky: How Algorithms Are Taking Over Air Traffic Control." The Wall Street Journal, 2019.

[64] "Ethics of Artificial Intelligence and Robotics." Stanford Encyclopedia of Philosophy, 2020.

[65] "Artificial Intelligence: The Robots Are Coming, But Are We Ready?" BBC News, 2021.

[66] "Integrating Artificial Intelligence and Machine Learning into Business — Challenges and Opportunities." Forbes, 2020.

[67] "From Autopilot to Autonomous: The Evolution of Driving Technology." IEEE Spectrum, 2019.

[68] "The Role of Artificial Intelligence in Achieving the Sustainable Development Goals." Nature Communications, 2020.

[69] "Is Artificial Intelligence Perpetuating Gender Bias?" Harvard Business Review, 2019.

[70] "The Impact of Artificial Intelligence on Innovation." IPR Policy Briefs, 2021.