

# Embodiment of Rationality: Philosophical Interpretation of Embodied Cognition

DONG Gefei

Northeastern University, Shenyang, China

Under the influence of European rationalism, which holds that human rationality is higher than, or at least independent of human sensory cognition, the first generation of cognitive science advocates for disembodied cognition, manifesting the concept of dualism of mind and body. With the development of cognitive science in the 1980s, the second generation of cognitive science redefines the relationship between mind and body, thought and behavior, and reason and feeling and puts forward the concept of embodied cognition, representing monism of mind and body. It is claimed that the formation of concepts, categorical cognition and the evolution of rational thinking are characterized by embodiment, which is the necessary condition and basis for the formation of human rationality. The current study traces the shift of cognitive science from dualism to monism of mind and body and explores the relationship between rationality and sensibility from the perspective of philosophical basis and interpretations, with an aim to achieve a better understanding and thorough interpretation of human rationality. In this heated discussion about embodied cognition, there are still some fundamental questions that need to be further clarified, such as the essence and mechanism of human cognition, the ways that human body participates in cognitive activities, especially imagination and reasoning. The research paradigm of embodied cognition and its relevant theory have not been established and developed yet, and empirical research from interdisciplinary perspectives is far from enough to provide hard evidence for embodied cognition.

*Keywords:* rationality, embodied cognition, monism of body and mind, philosophy of mind

## Introduction

Since the 1960s, there has been a revolution in the field of cognitive psychology, which is called post-cognitivism (Gomila & Calvo, 2008, p. 7). With the development of cognitive science, the disembodied cognition theory of its first generation has gradually been replaced by the thought of embodied cognition of the second generation. The idea of embodied cognition originates from the philosophical doctrine of monism of the mind and body, which emphasizes the important role of the body in cognition. The second generation of cognitive science, with embodied cognition as the one of its main research areas, has influenced the research direction of cognitive psychology, cognitive linguistics, brain science, and other related disciplines, forming a trend of interdisciplinary research. These disciplines also provide a variety of research methods and some empirical evidence for the study of embodied cognition. In terms of the related subjects, it mainly includes embodied cognition, embodied learning, mirror neurons, moral judgment, etc. In terms of the disciplines involved, it mainly

---

DONG Gefei, Ph.D. candidate, Associate Professor, Foreign Studies College/School of Marxism, Northeastern University, Shenyang, China.

includes psychology, linguistics, philosophy, education, etc., as well as some other disciplines, such as sports, art, literature, management, brain science, etc. In terms of degree of radicalness, scholars vary in their claims about how rational thinking depends on the body. The variety of research methods and the multiple research findings from different disciplines make it necessary to probe into embodied cognition with philosophical reflection. The thought of embodied cognition is deep-rooted in the philosophical doctrine of monism and has offered a new approach to human rationality. Recently, the study on human rationality has gained some inspirations from the concept of embodied cognition (Spellman & Schnall, 2009; Gallagher, 2018; Gallese, Mastrogiorgio, Petracca, & Viale, 2020), but there are still some fundamental questions that need to be clarified for the theoretical construction of embodied cognition and the interpretation of embodied rationality.

### **Philosophical Inquiry into the Relationship Between Mind and Body**

The discussion about the relationship between mind and body may date back to Ancient Greek philosopher Plato, who claimed that “the body is the tomb of the soul”. The modern classical mind-body dualism can be attributed to French philosopher René Descartes, who formulated his thought in his famous dictum “cogito, ergo sum” (Latin: “I think, therefore I am”). In Descartes’ theory of mind, mind and body are distinct entities that can exist independently, and there is no identity between body and mind. The essence of the mind is immaterial, nonextended substance that engages in mental activities such as thinking, imagining, feeling (sensation), and willing. The body is extended substance which may be affected by the mind and produce certain mental events. In other words, the mind and body may interact with each other. The problem faced by Descartes is: If mind and body are distinct entities, how is the interaction between them possible? Another dualistic view is the parallelistic view proposed by German rationalist G. W. Leibniz, who saw mind and body as two correlated series, synchronized perfectly like two clocks at their origin by God. The problem of defining or conceiving the immaterial mental substance remains unsolved. Phenomenology opposed Cartesian dualism of mind and body and proposed the idea of “embodiment”. As one of the leading representatives of French phenomenology, Merleau-Ponty (1945) put forward the concept of “embodied subjectivity” and proposed that the rediscovery of the body as a “third genre of being between the pure subject and the object” makes possible encounters with embodied others.

With the development of natural sciences in the West, the focus of philosophical research has also shifted from “ontology” to “epistemology”. The so-called epistemological shift focuses on exploring the objectivity of thought, studying the relationship between the external world and people’s conceptual world, and the relationships between various concepts held by humans. At the beginning of the 20th century, the “linguistic turn” further shifted philosophy’s attention to the subjective world of human beings, including human thinking, memory, perception, cognition, and other brain processes. It emphasized the logical analysis of science language and semantic analysis of ordinary language. Cognitive psychology, cognitive science, cognitive linguistics, and other disciplines that have emerged since the 1960s have all started to pay attention to the nature, characteristics, mechanisms, and process of human cognition from different perspectives. How is human knowledge acquired? How is cognitive ability acquired? Are different types of knowledge acquired in different ways? Is knowledge acquired through rational and logical reasoning, or through perceptual intuition, or both? What is the relationship between rationality and sensibility? With the development of brain science and neuroscience, people seem to have reached a consensus that the brain is the headquarters of human thinking, memory, reasoning, judgment, information processing, language processing, and other cognitive activities. However, it is not quite clear how

human brain performs such functions. What roles do “heart” and “body” play in the process of brain activity? What is the relationship between “mental activity” and “brain activity”? In fact, these questions concern not only the source of human knowledge, but also the relationship between the mind and body, and more importantly, the way human cognitive ability is acquired and developed. These questions need to be explored from the perspectives of philosophy, cognitive science, brain science, and psychology. The process of seeking answers to these questions is also the process of exploring human nature and human rationality.

## **Human Cognition from the Perspective of Philosophical Epistemology**

### **From Dualism to Monism of Mind and Body**

Early philosophy generally agreed with the view of dualism of mind and body on epistemological issues. In ancient Greece Plato believed that mind and body were separated, that is, the psychological world and the physiological world were relatively independent, and the cognitive process had nothing to do with the physical carrier (i.e., the body exclusive of the brain) that carries out this process. In the 17th century, Descartes also believed that mind and body were two entities, and the existing knowledge was uncertain. The only certainty was “I am doubting”. By “I”, he refers to a subject, and the existence independent of “me” is the objective material world. Such philosophical assertion forms the basis for the dualist view of mind and body. The early cognitive science is based on such a dualist view that mind and body are separated. Its basic assumption is that there is a world independent of human cognition, and the laws of this world can be known by human beings. This philosophy also believes in the existence of an absolute objective truth, a truth that is independent of subjective cognitive processing by human beings. Objectivism and logical positivism advocated by modern British and American analytical philosophy also agree with the idea of dualism of mind and body, believing that human reasoning ability is independent of human perception and bodily movements. The earlier psychology equates the mind with a kind of computing ability independent of the body and postulates the Computational Theory of Mind (CTM). According to this theory, mental activities are interpreted as a kind of decontextualized symbol manipulation and cognition is identified with computation. Computational models have been developed to decompose brain cognition into elementary functional components (Kriegeskorte & Douglas, 2018). Environmental shaping of mental activities and the agent’s body participation in such activities are neglected. The computationally oriented approach to cognition has been dominant for decades that it has found its voice in Chomsky’s idea about language acquisition (1959) as well as theories on attention, memory (Sternberg, 1969), and perception (Marr, 1982). In other words, cognition is viewed as a somewhat disembodied process, and the ability of the brain to calculate symbols according to a certain program is believed to have nothing to do with the perception of the body.

After the 1980s, the concept of disembodied cognition was criticized, and the computationalism of cognitive science was also rejected. Chemero (2011) defines radical embodiment as “the thesis that cognition is to be described in terms of agent-environment dynamics, and not in terms of computation and representation” (p. x). The idea of embodiment has become a focus in the study of various cognitive activities and processes, including perception, memory, categorization, emotion, and social cognition. Embodied cognition emphasizes the involvement of the physical body in cognitive activities and the contribution of environment to cognition in terms of the interaction between the body and the environment. It also claims that the brain is not a computer, or at least more than just a computer. From the perspective of the history of psychology, embodied cognition can be traced back to the functionalist psychology of William James (1890) and John Dewey (1896) and the perceptual

psychology of J. J. Gibson (1966). Functionalist psychology, which originated from Darwin's evolutionism, believes that psychological phenomena are the way organisms adapt to the environment. Dewey and James and other cognitive scientists focus their attention on the role of natural organism and its nervous system in cognition. They believe that it is wrong to separate rationality from physical experience completely and claim that all rational thinking is based on physical experience. Experience is acquired and accumulated in the practice of getting involved in and interacting with the surrounding environment (Dewey, 1991, p. 26). American psychologist William James (1884) and Danish physiologist Lange (1885) independently put forward the idea that emotions are caused by physiological arousal, and these physiological arousals are caused of external stimuli, which were known as James-Lange Theory of Emotion (Coleman & Snarey, 2011). This early theory about emotion directly proposed that the body participates in the formation of mind and emotion. According to this theory, a certain physical environment will awaken a certain physiological response of the human body, which contributes to the generation of emotion. Emotion is the feeling of physical changes, and emotion will affect people's perception and judgment. In addition, Piaget and Vygotsky also argued for the dependence of cognition and other advanced psychological functions on external physical activities. Piaget (1936) claimed that cognitive development of children follows a series of stages of maturation from sensory-motor, preoperational, concrete operational until formal operational, each marked by increased cognitive sophistication and ability to use symbols. One of the key points of Piaget's learning theory is that the interaction with the physical world is key to cognitive development. These theoretical views emphasized the role of internalization of physical activities (perception of bodily movements) on thinking and cognitive processes, which contributed to the rising trend of research in embodied cognition. Such theoretical views which are directly opposed to the dualist view of mind and body can also be called the monism of mind and body. This monism theory believes that psychological activities and the physiological structure and function of brain are inherently coherent, which is a diversified manifestation of cause and effect in material unity.

### **From Disembodied Cognition to Embodied Cognition**

The thought of disembodied cognition originates from the dualist view of body and mind, which believes that cognitive activities do not involve the participation of the body. Plato believes that there are two worlds: the perceptual world (the visible world) and the conceptual world (the knowable world). The perceptual world is known by people through vision, hearing, touch, and other sensory activities. Because of the diversity and variability of the subject and object, the perceptual knowledge is also changeable and unstable. The conceptual world is composed of concepts which come from human reasoning and is constant and true. People's understanding of the conceptual world cannot rely on sensory experience. The body is the cage of the soul. The body and the mind are separate, representing the perceptual world and the conceptual world respectively (Ye, 2011). The idea of disembodied cognition played a leading role in the first generation of cognitive science.

The second generation of cognitive science is characterized by the advocacy for embodied cognition. In *Metaphors We Live by* (1980), cognitive linguist George Lakoff and philosopher Mark Johnson proposed that the experience of the body in the objective world shapes the metaphorical style of human cognition, and they exemplified their theory with body metaphors in human languages. In another book *Philosophy in the Flesh: The Embodied Mind and Its Challenge to Western Thought* (1999), they further clarified the theory of embodied philosophy, and believed that our cognitive mechanism is the same as the neural mechanism that allows us to perceive and move around, thus creating our conceptual system and mode of reasoning... Rationality is not of

transcendental nature in the universe or nor does it exist in disembodied mind in any case. Since then, there has been a heated interest in human mental activities and mental abilities, and embodied cognition in the field of linguistics, psychology, cultural philosophy, and other fields.

The basic view of embodied cognition theory is that the participation of the body is indispensable to cognition, and the body plays a very important role in the cognitive process. The process of thinking and cognition needs a body—not in the trivial sense that you need a physical brain to think with, but in the profound sense that the very structure of our thoughts comes from the structure of the body. Cognition depends on the physical structure, neural structure, sensory and motor system and the physical activities of the body. The proponents of embodied cognition theory believe that we perceive and cognize the world through the body's (including the brain) contact with the environment and that human's thought and cognition are largely dependent on and originate from the body. The anatomical structure of the body, the structure of nerves, the way the body moves, and the feeling and experience of the body determine how we cognize, view, and understand the world, determine our thinking style, and shape the way we see the world. In other words, people's cognition is shaped by their bodies and their physical activities. If we have the biological structure of bats or fish, the world we perceive will not be what it looks like now. Our view of the world should be consistent with the anatomical structure of our body; therefore, cognition is the cognition of the body, and mind is the mind of the body. Without the body, cognition and mind cannot exist at all. The theory of embodied cognition reveals that when human beings involve themselves in the interaction or transaction with the world actively and wholeheartedly, they will achieve a skill-based and experience-based cognition of the world, and thus deepen and expand their embedded relationship with the world.

### **Human Rationality from the Perspective of Embodied Cognition Theory**

#### **Philosophical Origin of Embodied Cognition Theory**

The thought of embodiment in cognitive psychology was not some psychologists' sudden whim. In fact, it emerged as a result of some European and American philosophers' reflection on and criticism of the dualist view of subject and object. Theoretically, the thought of embodied cognition was rooted in the existentialism of German philosopher Martin Heidegger (1975) and the phenomenology of Edmund Husserl (1929) and French philosopher Merleau-Ponty (1945). Through the analysis of the various ways in which our bodies shaped our thoughts and how we experienced our conscious activities, they emphasized the physical embodiment of our conscious cognitive experiences. Heidegger tried to transcend the division of the perceptual world and the conceptual world with the concept of "Being in the world", which he believed to be the existence in the world. Here in this world, there was no division between subject and object. The boundary between subject and object was vague, and every individual was a "Dasein" (being or existence) in the world. Heidegger's monism idea was a great breakthrough as opposed to the traditional dualism. Of all mammals, only humans have the capability of being aware of their own existence. Their existence does not need to be verified through its relevance to the external world or interaction with other beings in the world. When the subject is engaged in cognitive activities, it is in a chaotic state with no consciousness of the distinction between subject and object. The way that people cognize the world is to use their own bodies to interact with other objects in the world in an appropriate way, so as to gain knowledge of the world in the process of interaction. The most important representative of phenomenology in France, Merleau Ponty, put forward the thought of embodied philosophy in his masterpiece *Phenomenology of Perception* (1945), and argued that consciousness is constituted by embodiment. He further

clarified the importance of the body in cognitive activities, namely, the body participates in human cognitive activities and interacts with the environment to form a dynamic system. He advocated that the subject of perception was the body, and “One’s own body is in the world just as the heart is in the organism”. Merleau Ponty put forward the concept of “embodied subjectivity” and claimed that the body and the perceiving subject were actually unified as one, and that the body, human perception, and the physical world formed a unity. The body, which is deeply involved in the “encounters” and “interactions” with the external world in human life, exists as both an agent or a subject of perception and the object of perception. Therefore, the reversibility of the subject-object relationship of the parts of the body can be manifested in terms of unity of materiality and spirituality of human body. In other words, “I” am my physical body, and my physical body is “who I am”. The physical body and its spiritual existence are neither in parallel relationship, nor in a kind of relation with one dominating the other, as claimed by dualists such as Descartes; rather, they are uniform.

### **The Root of Embodied Human Rationality**

With the rise and development of natural science in the 17th and 18th centuries, the focus of philosophy shifted from ontology to epistemology. During this period, philosophers pondered thoroughly over the sources of knowledge, the methods of reaching truth, the standard of truth, and other issues, and formed different views. Generally, they were divided into two schools: empiricism and rationalism. The empiricists believed that sensory experience and reflective experience were a reliable source of knowledge, while the rationalists believed that reason is a primary source of concepts or knowledge, since experience was individualistic, inconstant, accidental, and therefore unreliable. Rationalists argue that only rationality could be the reliable basis for the acquisition of knowledge. Human rationality, including the capabilities of logical reasoning, evaluation, judgment, questioning, and problem solving, was considered to be the essential characteristic of human beings that distinguished human beings from other animals. From the perspective of dualism of mind and body, rationality is detached from, and independent of the experience of the body itself. Rationalism adopts the idea of innate knowledge or innate concept and believes that reason is superior to sense experience as a source of knowledge. Nowadays, the debate between empiricism and rationalism is still going on.

In the 1980s, the second generation of cognitive science adopted the perspective of embodied cognition and proposed that human rationality was rooted in the body (including the brain) and the body’s physical experience, and there was no dualistic individual whose mind was separated from the body and independent of the body. The mind depends on the internalized experience and knowledge cannot be acquired only through introspection. Rationality cannot transcend the body, rather it is formed on the basis of the body. The universality of human rationality is rooted in the commonality of human body and brain structure, the commonness of human cognitive and neural mechanisms, and the commonness of human living environment. By universality of rationality, it does not suggest that rational thinking can transcend the body or exist independently of the body. Rather, the formation of rationality depends on the body, so it cannot be completely free.

Recently, the concept of rationality has been increasingly affected by the developments in cognitive science. With the rise of cognitive science, Simon was considered to be the first to approach human rationality from the perspective of cognitive science and put forward the idea of “bounded rationality” (1947). As the founding father of “cognitivism” (Haugeland, 1978), he regarded cognition as a fundamentally abstract and disembodied phenomenon. He was quite skeptical of the claims made by embodied cognition. In an attempt to reform or transform or challenge Simon’s assumptions on cognitivism, more scholars began to conduct research on

embodied cognition and their opinions varied concerning the degree of body participation in the formation of rationality. Petracca (2021) summarized four new embodied notions of rationality, namely, embodied bounded rationality, body rationality, extended rationality, and embodied rationality, ranging from the least radical to the most radical based on the conceptual distance from Simon's as a measure of the radicalness in the idea of embodiment of rationality. Petracca made a comparative analysis of the four views and suggested that the moderate concepts of embodied bounded rationality and body rationality seemed to be currently well-supported with empirical evidence. However, the more radical approach of embodied rationality may prove to be more advantageous for the explanation of phenomena in some institutional settings at the collective and social level. Although these new perspectives may emphasize different aspects of rationality and vary in terms of their radicalness, they do seem to suggest that some cognitive capacities depend on the body and its environment, on the sensorimotor interaction between brain, body, and environment (Clark, 1997).

The theory of embodied cognition held that human reason originated from body function. Then come the questions: What role does human body play in the formation of reason? How does it work?

First of all, the formation of human reason depends on the formation of conceptual system, which is embodied in itself. There are certain limits to the forms of human conceptual system and human rationality. The properties of an organism's body may limit or constrain the concepts an organism can acquire. Organisms with different body structures would understand their environments differently. Once the conceptual system is formed, it will shape and limit the way of human thinking, which depends on the conceptual system to carry on; and the formation of concepts depends on human perception of the environment and the world. Therefore, what is referred to by Kant as absolute independence, or the total freedom to make moral choices and decisions solely by personal will does not exist, nor does the so-called transcendental universal pure reason.

Lakoff and Johnson (1980) suggested that human beings rely on metaphorical reasoning when learning or developing an understanding of unfamiliar concepts; however, not all concepts are derived from metaphorical reasoning. They argued that the rather basic concepts are derived from "direct physical experience" (1980, p. 57) that come from moving a human body through the environment. And through embodied simulation mechanisms, sensory motor, interoceptive, and affective resources are reenacted in wider target domains, thus resulting in metaphorical simulation (1999). Metaphors not only structure concepts, but also save neural and conceptual resources in the construction of concepts. Since birth, in physical and mental interactions with nature and society, people have gradually formed some basic concepts about the world, including concepts of space, time, event, entity, and color, etc. The concept of space was formed on the basis of human perception of space and bodily movement in space. How could people perceive spatial relations without human body? The fundamental concept of space was generally derived from bodily projection. For example, many words that express spatial relations, such as "front", "back", "left", "right", "up", "down", are related to human bodily structure. The human body has the inherent division of front and back, left and right. Humans walk upright with their heads above and feet on the ground. Human beings tend to project the structure of human body and the perception of space onto other natural objects (mountains, trees), artificial artifacts (buildings, vehicles), and so on. There are expressions such as "head of a page", "foot of a mountain", "mouth of a river", "leg of a chair", "front and back of building", and "back in the days", and so on. People also use space concepts to understand and express abstract concepts in other fields, such as "left" and "right" to express political standing, "up" and "down" to express quantity, social strata, or emotional state, "front" and "back" to express time order or particular areas in certain fields. The expression of abstract concepts in spatial terms reflects how human perception of space and experience in space

shape our cognition of abstract ideas. Such abstract concepts also form the basis for human reasoning, judgment, memory, imagination, and other mental activities.

The theory of image schema also proposes that the recurring dynamic patterns of our perceptual interaction with the world and motor programs give coherence and structure to our experience, forming a simple and repeated cognitive structure in their perceptual interaction with and perceptual movement in the objective world. In the process of perceiving and experiencing the world, people have formed their understanding of individual things and phenomena, and the relationship between things and phenomena. For example, many image schemas are based on the perception of spatial relations. Gibbs and Colston (1995) described image schemas as spatial relations and dynamic simulation representation of movement in space; Oakley (2004) believed that image schema is a compressed description of perceptual experience to map spatial structure to conceptual structure. For example, part-whole schema, center-periphery schema, cycle schema, containment schema, link schema, force schema, verticality schema, starting point-path-goal schema, etc., are all space-related preconceptual schematic structures based on the interactive experience between the body and the surrounding environment. Image schema is a metaphysical structure abstracted from people's experience in space and of space. Image schema is the link between body perception and abstract concepts. It is the basis for human beings to form concepts, construct categories, and make inferences and judgments.

Secondly, categorization is an indispensable process of human cognition. Harnad (2005) considered that categorization is the most fundamental cognitive process and concluded that to cognize is to categorize: "...categorization is any systematic differential interaction between an autonomous, adaptive sensorimotor system and its world" (p.20 ). According to Gibson (1979), categorization is to classify the things and events we experience into different categories. Organisms are sensorimotor systems. The things in the world come in contact with our sensory surfaces and we interact with them based on what that sensorimotor contact "affords". Categorization process depends on human perception and experience of interacting with the environment and physical things. For example, children can easily distinguish cats from dogs, and apples from oranges. However, they cannot clearly and accurately tell the criteria for such distinction. It can be seen that the process of category cognition is not purely a knowledge event based on human rationality, but a process depending on human experience in the world with human neural structure to perceive, judge, and imagine, etc. In many cases, people's categorization of physical objects is not a deliberate and conscious behavior, but an unconscious and automatic mental process. In this process, human body and sensory system play a decisive role. Pfeifer and Scheier (1997, p. 157) argued that "the problem of categorization in the real world is significantly simplified if it is viewed as one of sensory-motor coordination, rather than one of information processing happening 'on the input side'". Cognitive science finds that the categories that are most easily distinguished by human beings are at the middle level, which we call the basic level. It is usually more difficult to distinguish between the categories of the upper level and the lower level. For example, children can distinguish between dogs and cats, but it is more difficult to understand the category of mammal at the upper level, and it is also more difficult to distinguish between different breeds of dogs or cats at the lower level. Cognitive psychology explains that the category of the basic level is the highest level that people can form mental images. For example, we can form mental images about "dogs", but we cannot form mental images about "mammals", because this concept is formed by extracting some commonalities from different animals; it is more abstract and does not evoke concrete mental images. In fact, the formation of mental images mainly depends on human perception of the overall shape or other perceivable characteristics of animals or objects. Conceptual structure reflects neural structure. Categorization is a continuous



activity of human body and brain in the interaction with the surrounding environment. We use categories to form concepts and make inferences and judgments. Therefore, concepts are also embodied.

Thirdly, human rational ability, like human body, is also the product of evolution, and the evolution of human rational ability is closely linked with the evolution of human body and its physiological functions. This idea is related to Darwinian evolutionism, which holds that rationality, even in its most abstract form, is based on human animal nature. In other words, “higher-level” abstract reasoning ability is based on “lower-level” sensory perception and the movement of muscles and the workings of nervous system. Therefore, it is not well justified to say that human beings are the only creatures with rationality among all living creatures, but as far as rationality is concerned, human beings are at a higher stage than other animals in the continuum of evolution. Rationality is rooted in embodied style of cognition. The universality of human rationality can be attributed to the similarity of human body structure and brain structure, but not to the assumed existence of disembodied and transcendental reason in the universe. In order to better adapt to the environment, the human sensorimotor system and the internal structure of the brain continue to evolve in interaction with the environment and are actively involved in the formation of many concepts, including abstract concepts. Rationality also gradually matures with the evolution of the body structure. In the book *Evolutionary Epistemology*, Vollmer (1975, p. 146) also proposed that “our cognitive devices are the products of evolution”. Hayek elaborated on the role of body in forming mental order in his book *The Sensory Order: An Inquiry into the Foundations of Theoretical Psychology* (1952), and he proposed that “it is true that the sensory order with which we are concerned is both a result and a cause of the motor activities of the body” (p. 90). In his book, he explained mental order in terms of the essential nature of feeling. He believed that the mental order and the neural order have isomorphic relations. Through the investigation of the evolution process of human neural order, we can understand the evolution process of human mental order.

### **Testification of Embodied Rationality From Interdisciplinary Perspective**

Since the 1980s, the philosophical thought of embodied cognition, integrated with theories in psychology, cognitive science, and linguistics, has had a profound impact on social cognitive theory, educational psychology, physical education, pedagogy, and aesthetic cognition. As a new research field, embodied cognition has received increasing attention, and has gradually become the focus of a cross-disciplinary research. For example, Piaget’s genetic cognitive theory demonstrates how advanced cognition occurs, and proposes that cognition is a dynamic construction process by which individuals interact with the environment through bodily movements (Piaget, 1970). This demonstration is rich in ideas of embodied cognition. Vygotsky’s social cultural theory believes that higher psychological functions originate from the internalization of external actions, which is effectuated not only through education, but also through physical labor and entertainment in daily life (Vygotsky, 1978). Higher psychological functions are formed and developed in human activities and implemented by means of language (Vygotsky, 1981). These ideas in psychology are imprinted with the thoughts of embodied philosophy. The theory of embodied cognition also challenges traditional behaviorist psychology in explaining children’s mental and language development. Recently, the disjunctivism in the field of epistemology claimed that we could obtain knowledge about the external world directly through perceptual experience, because the perceiver was a physical subject interacting with the world, rather than a simple abstract mind. Therefore, it advocated for the rediscovery of the body and the world. The core of this theory is consistent with the theory of embodied cognition (Chen, 2020). Cognitive linguistics, which has flourished in recent years, is also a branch of linguistics based on embodied philosophy. Language is an important field of human cognition. The structure of language reflects the

structure of concepts and the formation of concepts is based on the experience of the body. In the book *Metaphors We Live by*, Lakoff and Johnson (1980) put forward the experiential philosophy and illustrates the experiential nature of language and mind, and the metaphorical nature of thinking with a large number of metaphorical usages in human language.

With the development of brain science and cognitive science, and the progress of modern science and technology, cognitive psychology has adopted experimental methods as well as the methods of neuroscience to obtain more and more empirical evidence to testify embodiment of cognition from the perspective of physical feelings of the body, physical characteristics of emotions, motor system, and the mechanism of cognitive judgment. There has been evidence in neuroscience that cognitive process is closely related to sensorimotor system. With the help of fMRI brain imaging technology, we can explore the mechanism and function of human mirror neurons and achieve a better understanding of how human brain actively participates in cognitive activities. Researchers have obtained preliminary neurobiological evidence for the embodiment of cognition (Ye, 2012). It has been widely recognized in the field of psychology that emotional embodiment hypothesizes that emotion is the emotion of the body (including the brain) determined by the anatomical structure of the body, the way the body moves, the feeling, and the sensorimotor experience of the body (Liu, Wang, & Kong, 2011). Relevant researches on behavioral and brain mechanism do confirm the hypothesis of embodiment of emotional processing. The experiment on embodied effect has found that the simulation of others' body state or body movements can not only promote the understanding of others' emotions, but also activate the cognitive subject's emotional feelings about himself (Gallese, 2007). The body is the instrument or the means adopted by the human cognitive system to understand emotion, which is an important cognitive strategy of human beings.

Gallagher (2018) argued that one's ability to cognize the world comes from, at least partially, an active and pragmatic engagement with the world. We human beings have hands which facilitate our perception and action, and hand gestures add to cognitive ability. Mental skills are perceived as enactive, non-representational forms of embodied coping that emerge from a pre-predicative perceptual ordering of differentiations and similarities (Gallagher, 2017). There are some empirical studies that point to the connection between gesture, speech, and thinking (Cole, Gallagher, & McNeill, 2002; McNeill et al., 2008; Quaeghebeur et al., 2014), which suggests that bodily performance is rational and demonstrates a continuity between the rational movements of the body and reflective thinking.

With the improvement of research methods in various related disciplines as well as the increasingly abundant research results, we have a clearer understanding of human cognition. Cognitive activities are not purely rational, self-contained, and abstract, as they occur in specific situations and depend on the structure and feelings of the body, as well as the coordination of the sensory and motor systems. In cognitive activities, the brain, the body, and the surrounding environment form a dynamic system. Knowledge, skills, and emotions are unified in the body. The embodied cognition theory and the relevant research results provide a powerful theoretical guidance for understanding human cognition, including the practice of education, since teaching and learning are cognitive activities in themselves.

## **The Current Situation and Problems of Embodied Rationality**

### **The Problems With Definition and Research Paradigm**

Scholars have done research on embodied cognition from different perspectives and have different interpretations. The approaches to embodied cognition may include the computational approach, enactivist

approach (Thompson, 2007; Varela, Thompson, & Rosch, 1991), and the recent dynamic system approach (Van Gelder & Port, 1995). Lakoff and Johnson put forward the view of experiential philosophy in the field of linguistics, A. Clark and D. Chalmers (1998) explored embodied cognition in the field of psychology, and R. Brooks (1991) and E. Thelen, G. Schöner, C. Scheier, and L. B. Smith (2001) also discussed embodied cognition from different perspectives. They all paid attention to the role of the body in cognition, the relationships between cognition and action, between mind and body, between body and the external world. So, what exactly is embodied cognition? What is embodied rationality? We can see that some scholars emphasized the contextualization of cognition, some emphasized the real-time nature of cognition, some emphasized the systematic nature of cognition, and some emphasized the participation of the body in the cognitive process. At present, there is no consensus about the essence of the so-called embodied cognition. Is there an essential difference between embodied cognition and traditional cognitivism? Is embodied cognition closer to the truth of human cognition than traditional cognitivism? In the study of embodied cognition, is it necessary to unify theoretical understanding and research paradigm? These are some of the issues that need to be further clarified in the study of embodied cognition.

Recently, more scholars have begun to pay attention to embodied cognition theory and conducted relevant research. For example, Ye Haosheng (2010) discussed the role of body in cognition process and content of cognition from the perspective of cognitive psychology; Ding Jun and Chen Wei (2009) discussed the new interpretation framework of the current cognitive science for embodied cognition—embodied simulation theory, and pointed out that all kinds of cognitive activities of human beings are restricted and shaped by the physical and sensorimotor schema; Xu Xianwen (2014) also proposed three key points of the concept of embodied cognition: physical participation, contextuality, and interactivity. The dynamic approach to cognition tends to view cognitive processes as the behavior of nonlinear dynamical systems, and advocates for the study of cognition with the use of dynamical modeling of mathematics and dynamical systems theory (Van Gelder & Port, 1995). Phenomenology and pragmatic philosophical traditions converge in the dimension of embodiment. The concept of embodiment subverts the deep-rooted rational tradition in the history of western philosophy. Under the influence of this trend of thought, embodied cognition research has gradually developed from philosophical speculation into a relatively independent research area in psychology, linguistics, pedagogy, and other fields to explain some people's behaviors, attitudes, language use, and cognitive phenomena, which also promotes the theoretical and empirical research of these related disciplines. The research on embodied cognition has been on the rise, while a systematic and interdisciplinary academic community has not yet come into being. Embodied cognition is a complex concept involving multiple disciplines. There is not yet a unified definition, nor a clear and unified research paradigm. In addition, although there are some practical applications of the theory of embodied cognition, systematic research results are still lacking. In the field of cognitive linguistics, the relevant study on syntax, semantics, and pragmatics is not thorough enough, and some empirical studies are also needed to provide further empirical evidence and support for human embodied cognition.

### **The Challenges Facing Embodied Cognition Theory**

Although the embodied cognition theory has gained rising popularity in many fields, it has also been questioned and challenged by some other scholars. For example, Daniel A. Weiskopf (2010) believed that embodied cognition theory failed to distinguish the difference between contingency and necessity in cognitive systems, as well as the difference between representational content and cognitive tools. He believed that embodied cognition was not necessarily closer to the essence of language than disembodied cognition. Several

scholars from Arizona State University, Louisiana State University, Carthage College, and New Mexico State University, including Stephen D. Goldinger, Megan H. Papesh, Anthony S. Barnhart, Whitney A. Hansen, Michael C. Hout (2016), also published articles criticizing the idea of embodied cognition. They believed that the theory failed to present any new findings and the basic principles of embodied theory were vague and unacceptable. They also claimed that neither did the embodied cognition theory provide scientific insights into human cognition or establish logical connection with the phenomenon of cognition. Except for some laboratory findings, the embodied cognition theory could not provide a solution to the problems related to cognitive experiences of human life. Some scholars also believed that the theory of embodied cognition may explain lower-level psychological processes such as feeling and perception, but it lacks explanatory power for higher-level psychological processes such as imagination and reasoning.

The embodied tendency of research in psychology also has some problems. First, the mind itself is difficult to quantify, and embodied cognition leads language understanding to subjective areas such as feeling and perception, which tends to subjectify and mystify language cognition. Secondly, the study of embodied cognition also reflects the influence of reductionism, which tends to reduce cognitive problems to issues of physiology and neuroscience and reduce language cognition to a certain physical function of human beings.

Finally, the fundamental problem of embodied cognition research is that we are still far from reaching the ultimate goal of embodied cognition research, which lies in the clarification of how human beings use their own bodies to understand the world through embodied methods, how to internalize and externalize language, how to understand objective laws of natural and social development, how to guide human beings' practice of transforming nature and society based on such understandings, and how to create new things or new ideas based on embodied cognition.

## Conclusion

The development of cognitive science from the first generation of dualistic view of mind and body to the second generation of embodied cognition is a great leap in cognitive science. The embodied cognition theory proposes that cognition involves the participation of the body, and that cognition is an evolution process based on the interaction between the cognitive subject and the environment. Cognitive activities are the internalization of body perception and sensorimotor movement. The embodied cognition theory allows us to re-examine the nature of human mental activities and their processes, and to rediscover the relationship between the mind and the body, the relationship between sensibility and ration, and the role of body structure, body experience, and the interplay between body and environment in human cognition. These thoughts have had a profound impact on psychology, linguistics, philosophy, aesthetics, and many other fields. However, as a frontier interdisciplinary research topic, there are still many fundamental issues to be clarified, such as the unification of research program and research paradigm, the testification of philosophical speculation with empirical evidence, and the interpretation of higher order psychological processes, including abstraction, inference, and memorization, etc.

## References

- Brooks, R. A. (1991). Intelligence without representation. *Artificial Intelligence*, 47(1-3), 139-159.
- Chemero, A. (2011). *Radical embodied cognitive science*. Cambridge, MA: MIT Press.
- Chen, S. W. (2020). Disjunctivism and embodied cognition. *Philosophical Trends*, 58(3), 101-110.
- Chomsky, N. (1959). On certain formal properties of grammars. *Information and Control*, 2(2), 137-167. Retrieved from [https://doi.org/10.1016/S0019-9958\(59\)90362-6](https://doi.org/10.1016/S0019-9958(59)90362-6)

- Clark, A. (1997). *Being there*. Cambridge, MA: MIT Press.
- Clark, A., & Chalmers, D. J. (1998). The extended mind. *Analysis*, 58(1), 7-19.
- Cole, J., Gallagher, S., & McNeill, D. (2002). Gesture following deafferentation: A phenomenologically informed experimental study. *Phenomenology and the Cognitive Sciences*, 1(1), 49-67.
- Coleman, A. E., & Snarey, J. (2011). James-Lange theory of emotion. In S. Goldstein and J. A. Naglieri (Eds.), *Encyclopedia of child behavior and development* (pp. 844-846). Boston, MA: Springer. Retrieved from [https://doi.org/10.1007/978-0-387-79061-9\\_3146](https://doi.org/10.1007/978-0-387-79061-9_3146)
- Dewey, J. (1896). The reflex arc concept in psychology. *Psychological Review*, 3(4), 357-370. Retrieved from <https://doi.org/10.1037/h0070405>
- Dewey, J. (1991). *Logic: The theory of inquiry*. Carbondale: Southern Illinois University Press.
- Ding, J., & Chen, W. (2009). The root of embodied cognition: From mirror neurons to embodied simulation theory. *Journal of Huazhong Normal University (Humanities and Social Sciences)*, 48(1), 132-136.
- Gallagher, S. (2017). *Enactivist interventions: Rethinking the mind*. Oxford: Oxford University Press.
- Gallagher, S. (2018). Embodied rationality. In G. Bronner and F. Di Iorio (Eds.), *The mystery of rationality, mind, beliefs and social science* (pp. 83-94). Berlin: Springer. Retrieved from [https://doi.org/10.1007/978-3-319-94028-1\\_7](https://doi.org/10.1007/978-3-319-94028-1_7)
- Gallese, V. (2007). Embodied simulation: From mirror neuron systems to interpersonal relations. *Novartis Foundation Symposium*, 278, 3-12.
- Gallese, V., Mastrogiorgio, A., Petracca, E., & Viale, R. (2020). Embodied bounded rationality. In R. Viale (Ed.), *Palgrave handbook of bounded rationality* (pp. 377-390). London; New York, NY: Palgrave Macmillan. Retrieved from <https://doi.org/10.4324/9781315658353-26>
- Gibbs, R., & Colston, H. (1995). The cognitive psychological reality of image schemas and their transformations. *Cognitive Linguistics*, 6(4), 347-378.
- Gibson, J. J. (1966). *The senses considered as perceptual systems*. Boston: Houghton Mifflin.
- Gibson, J. J. (1979). *The ecological approach to visual perception*. Boston: Houghton Mifflin. (Currently published by Hillsdale, NJ: Lawrence Erlbaum)
- Goldinger, S. D., Papesch, M. H., Barnhart, A. S., Hansen, W. A., & Hout, M. C. (2016). The poverty of embodied cognition. *Psychonomic Bulletin & Review*, 23(4), 959-978. Retrieved from <https://doi.org/10.3758/s13423-015-0860-1>
- Gomila, T., & Calvo, P. (2008). Directions for an embodied cognitive science: Toward an integrated approach. In P. Calvo and T. Gomila (Eds.), *Handbook of cognitive science: An embodied approach* (pp. 1-25). San Diego: Elsevier Ltd.
- Harnad, S. (2005). To cognize is to categorize: Cognition is categorization. In H. Cohen and C. Lefebvre (Eds.), *Handbook of categorization in cognitive science* (pp. 19-43). Oxford: Elsevier Ltd.
- Haugeland, J. (1978). The nature and plausibility of cognitivism. *Behavioral and Brain Sciences*, 1, 215-226. Retrieved from <https://doi.org/10.1017/S0140525X00074148>
- Hayek, F. A. (1952). *The sensory order: An inquiry into the foundations of theoretical psychology*. Chicago: University of Chicago Press.
- Heidegger, M. (1975). *The basic problems of phenomenology* (A. Hofstadter, Trans., 1988). Bloomington: Indiana University Press.
- Husserl, E. (1929). *Cartesian meditations: An introduction to phenomenology* (D. Cairns, Trans., 2012). Dordrecht: Springer Science & Business Media.
- James, W. (1884). What is an Emotion?, *Mind*, 9 (34), 188-205.
- Kriegeskorte, N., & Douglas, P. K. (2018). Cognitive computational neuroscience. *Nature Neuroscience*, 21, 1148-1160. Retrieved from <https://doi.org/10.1038/s41593-018-0210-5>
- Lakoff, G., & Johnson, M. (1980). *Metaphors we live by*. Chicago & London: University of Chicago Press.
- Lakoff, G., & Johnson, M. (1999). *Philosophy in the flesh: The embodied mind and its challenge to western thought*. New York: Basic Books.
- Lange, C. G. (1885). The mechanism of the emotions. *The Classical Psychologists*, 672-684.
- Liu, Y., Wang, Z.-H., & Kong, F. (2011). The view of embodied emotion: A new perspective on emotion study. *Advances in Psychological Science*, 19(1), 50-59.
- Marr, D. (1982). *Vision: A computational investigation into the human representation and processing of visual information*. San Francisco: W. H. Freeman.
- McNeill, D., Duncan, S., Cole, J., Gallagher, S., & Bertenthal, B. (2008). Neither or both: Growth points from the very beginning. *Interaction Studies*, 9(1), 117-132.

- Merleau-Ponty, M. (1945). *Phenomenology of perception*. (D. Landes, Trans., 2012). London: Routledge.
- Oakley, L. (2004). Piaget's theory of cognitive development. In *Cognitive development* (pp. 13-36). Retrieved from <http://books.google.com/books?hl=en&lr=&id=iDKDAgAAQBAJ&pgis=1>
- Petracca, E. (2021). Embodying bounded rationality: From embodied bounded rationality to embodied rationality. *Frontiers in Psychology*, 12, 710607. Retrieved from <http://doi:10.3389/fpsyg.2021.710607>
- Pfeifer, R., & Scheier, C. (1997). Sensory-motor coordination: The metaphor and beyond. *Robotics and Autonomous Systems*, 20, 157-178.
- Piaget, J. (1936). *Origins of intelligence in the child*. London: Routledge & Kegan Paul.
- Piaget J. (1970). *Genetic epistemology*. New York, Chichester, West Sussex: Columbia University Press.
- Quaeghebeur, L., Duncan, S., Gallagher, S., Cole, J., & McNeill, D. (2014). Proprioception and gesture. In C. Müller, E. Fricke, A. Cienki, S. H. Ladewig, and D. McNeill (Eds.), *Handbook on body—language—communication* (pp. 2048-2061). Berlin: De Gruyter-Mouton Publisher.
- Simon, H. A. (1947). *Administrative behavior: A study of decision-making processes in administrative organization* (1st ed.). New York, NY: Macmillan.
- Spellman, B. A., & Schnall, S. (2009). Embodied rationality. *Queen's Law Journal*, 35, 117-164. Retrieved from <http://doi:10.2139/ssrn.1404020>
- Sternberg, S. (1969). Memory-scanning: Mental processes revealed by reaction-time experiments. *American Scientist*, 57(4), 421-457.
- Thelen, E., Schöner, G., Scheier, C., & Smith, L. B. (2001). The dynamics of embodiment: A field theory of infant perseverative reaching. *Behavioral and Brain Sciences*, 24(1), 1-34. Retrieved from <https://doi:10.1017/S0140525X01003910>
- Thompson, E. (2007). *Mind in life: Biology, phenomenology and the sciences of mind*. Cambridge, MA: Harvard University Press.
- Van Gelder, T., & Port R. (1995). It's about time: An overview of the dynamical approach to cognition. In R. F. Port and T. Van Gelder (Eds.), *Mind as motion: Explorations in the dynamics of cognition* (pp. 1-43). Cambridge, MA: MIT Press.
- Varela, F. J., Thompson, E., & Rosch, E. (1991). *The embodied mind: Cognitive science and human experience*. Cambridge: MIT Press.
- Vollmer, G. (1975). *Evolutionary epistemology (Evolutionäre Erkenntnistheorie)*. (Y. Z. Shu, Trans., 1994). Wuhan: Wuhan University Press.
- Vygotsky, L. S. (1978). *Mind in society: The development of higher psychological process*. Boston: Harvard University Press.
- Vygotsky, L. S. (1981). The genesis of higher mental functions. In J. V. Wertsch (Ed.), *The concept of activity in Soviet psychology* (pp. 144-188). New York: Sharpe.
- Weiskopf, D. A. (2010). Embodied cognition and linguistic comprehension. *Studies in History and Philosophy of Science*, 41(3), 294-304. Retrieved from <https://doi.org/10.1016/j.shpsa.2010.07.005>
- Xu, X. W. (2014). *A study of embodied language cognition*. Beijing: People's Publishing House.
- Ye, H.-S. (2010). Embodied cognition: A new approach in cognitive psychology. *Advances in Psychological Science*, 18(5), 705-710.
- Ye, H.-S. (2011). The dilemma of dualism and the rising of the embodied cognition program. *Journal of Psychological Science*, 34(4), 999-1005.
- Ye, H.-S. (2012). The mirror neurons: Neural biological evidence for the embodiment of cognition. *Psychological Exploration*, 32(1), 3-7.