

Pragmatism as the foundation of cognitive enactivism

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Abstract

The current prevailing embodied cognitive science is essentially the result of the pragmatic turn of cognitive science, and enactivism is the epitome of this turn. For a long time, most advocates of enactivism have consciously regarded phenomenology as their important source of thought but ignored its pragmatic roots. In fact, there are many similarities between enactivism and pragmatism, and pragmatism has foreshadowed some core ideas and principles of enactivism. In particular, enactivism contains a pragmatic assumption that there is interaction between organisms and their environment, and cognitive ability is evolved and developed by organisms in the history of interactions with their environment. Their interpretations of cognition both rely on the theoretical support of biology and emphasize the basic role of organisms' active capacities and environment in the formation of cognition. They hold a neutral monism position ontologically. Undoubtedly, pragmatism is the precursor of cognitive enactivism. Pragmatism not only provides rich conceptual resources for the development of enactivism, but also provides a unique perspective and method to solve some problems in its theory. Pragmatism is a rich mine for enactivists to further explore.

Keywords

Enactivism, pragmatism, action orientation, sensorimotor contingency, organic coordination

1. Introduction

As an influential cognitive research programme in current cognitive science, enactivism is the epitome of the pragmatist turn in cognitive science. Philosophically speaking, enactivism has phenomenological roots, because its founders, such as Varela et al. (2010), have claimed from the beginning that the enactive approach is a continuation of the phenomenological thoughts of Merleau-Ponty. Given that both phenomenology and enactivism emphasize the active character of organisms and the creation of meaning through their own actions, early enactivists attempted to integrate

phenomenology (especially the phenomenologies of Husserl, Heidegger, Merleau-Ponty and Dreyfus) with the enactive approach, as well as some empirical methods (such as dynamical systems), aiming to develop a phenomenological cognitive science. However, in addition to phenomenology, enactivism also has profound pragmatist roots, which are often overlooked by enactivists. Gallagher (2014) once

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asserted that the pragmatist John Dewey foresaw the emergence of enactivism. Some core principles and ideas of enactivism (such as that cognition is embodied, situated and non-representational) have been explicitly proposed and discussed in pragmatism. Pragmatism not only proposes many core ideas in 4E (embedded, extended, embodied and enactive) cognition, but also provides rich conceptual resources for the further development of enactivism.

In this paper, my first objective is to discuss the pragmatic turn in cognitive science: action-oriented cognition. The direct result of the pragmatic shift is the emergence of an action-oriented cognitive research paradigm, which has promoted the rise of embodied cognitive science. Second, I outline the core ideas of enactivism on cognition, focusing on Shaun Gallagher's points on cognition from the enactivist perspective. Third, I analyse the enactivist features of pragmatic views of cognition, emphasizing that the pragmatic view of cognition exhibits many characteristics of enactivism. Finally, I propose the integration of enactivism and pragmatism and analyse its possibilities. I conclude by stressing that the pragmatic turn in cognitive science has had a significant impact on the theories and methodology of cognitive science. Enactivism has deep pragmatic roots. Therefore, fully exploring the pragmatic resources of enactivism will help to further advance the research of enactivist cognitive science.

2. Pragmatic turn in cognitive science: Action-oriented cognition

Pragmatism argues that cognition is for action, and cognition is action-oriented. Engel et al. have pointed out that current cognitive science is undergoing a pragmatic turn:

From the traditional representation-centered framework towards a paradigm that focuses on understanding cognition as 'enactive', as skillful activity that involves ongoing interaction with the external world ... Cognition should not be understood as providing models of the world, but as subserving action and being grounded in sensorimotor coupling (Engel et al., 2013: 202).

This turn is based on the research of classical pragmatists, especially CS Peirce and John Dewey. In his book *Enactivist Interventions: Rethinking the Mind*, Gallagher (2017: 5) also pointed out that 'perception is for action, and that action-orientation shapes most cognitive processes', so it is necessary to radically change the way 'we think about the mind and brain, with implications for methodology and for rethinking how we do cognitive science'. It can be said that the pragmatic turn in cognitive science provides a basic framework for understanding the interactive nature of cognition. This turn has shifted the focus of research from the internal processing mechanisms of information to participatory cognitive agents and their different ways of interaction with the external world: the cognitive agents explore their environment and interact with it. Cognitive agents think in action. Classical pragmatists have conducted a lot of research on cognition from a naturalistic perspective, and many of their ideas are compatible with contemporary pragmatist approaches, such as the enactive approach to cognition, 4E cognition and the embodied-Bayesian approach.

In fact, computational representationalism, which dominates traditional cognitive science, is an inherently internalist position. The fundamental difference between pragmatism and this internalism is whether cognition is related to the interactions between organisms and their environment. Pragmatism argues that cognition is interactive, and that cognition is at least partially shaped by the continuous interactions process between organisms and their environment. However, internalism regards the mind as an internal system with clear boundaries that is embedded between environmental inputs and outputs, and it holds that cognition is the computation and representation of this internal system. Most pragmatists reject this simple sandwiched model understanding of the mind. They focus more on empirically exploring how cognition is formed through the interactions between organisms and their world, and using exploratory inference to specify the interactive nature of cognition. However, pragmatism does not eliminate the concept of representation; it abates its role in cognition. That is to say, whether cognition is primarily action-oriented or related to obtaining environmental

information in order to take action in the environment must be clearly distinguished. This strongly resonates with the views of embodied cognition, especially enactivism. However, although pragmatists argue that cognitive inference is formed through the active exploration of the environment by organisms, they do not arbitrarily attribute all cognition to sensorimotor exploration. Representation, norms and practices also play a role in guiding exploration, such as in Peirce's sign action theory, which recognizes the importance of signs in the mental lives of primates (*Homo sapiens*).

3. Enactivist views of cognition

Enactivism is based on the enactive approach proposed by Francisco J Varela, Evan Thompson and Eleanor Rosch in 1991 (Varela et al., 2010). Enactivism is an anti-representational movement that has emerged in the field of cognitive science. It is not a single theory of cognition, but rather a series of approaches to cognition and life. Enactive approaches regard 'perception and action' as a single continuous process, sharing a non-cognitivist foundation. In the past 30 years, three typical theoretical forms of enactivist cognitive science have emerged: autopoietic enactivism, sensorimotor enactivism and radical enactivism (Ward et al., 2017). Autopoietic enactivism advocates that cognition is rooted in the biological dynamics of living systems. Sensorimotor enactivism aims to study the structure, content and features of perceptual experiences, emphasizing the interactive dynamic model between sensation and embodied activity (that is, sensorimotor contingency). Radical enactivism aims to strengthen and unify the anti-representational views in the enactive approaches, adhering to a thorough anti-representational stance in methodology and highlighting the embodied interaction models between the cognizer and its environment. Although there are some debates between these theoretical paradigms, they are intrinsically unified and complement each other to some extent. They all hold an anti-representational stance towards the understanding of mind and cognition, and all promise that cognition is rooted in the physical life that we participate in. The scope of application of the enactive approach is very broad, covering both basic and

non-basic cognitive fields. It is not only used to explain perception and action, but is also used to study social cognition and intersubjectivity, emotion, language, psychiatry and other issues.

Overall, enactivism opposes the traditional popular theory of computational representation, arguing that the mind is not entirely in the brain and that cognitive systems are constituted of brain–body–environment. It highlights the important role of action on cognition. In his book *Enactivist Interventions: Rethinking the Mind*, Gallagher (2017) strengthened the advantages of the enactive approach in cognitive science and the philosophy of the mind, emphasizing the core viewpoints of enactivism. According to him, cognition cannot be reduced only to brain processes, and cognition is mainly embodied and embedded. The scientific study of the mind should incorporate physical and environmental factors. Therefore, enactivism should fully absorb and draw on the E-cognitive approaches, phenomenological and pragmatist resources, as well as the research results from the fields of sensorimotor processing, dynamical systems theory, ecological psychology and predictive processing. Gallagher demonstrated that enactivism can intervene in a series of subject studies on the mind, such as intentionality, free will and the cognitive consequences of upright walking, fully explaining why enactivism can propose a more convincing explanation than general representationalist views. He summarized the cognitive views of enactivism into seven key points:

1. Cognition is not simply a brain event. It emerges from processes distributed across brain–body–environment.
2. The world (meaning, intentionality) is not pre-given or predefined, but is structured by cognition and action.
3. Cognitive processes acquire meaning in part by their role in the context of action, rather than through a representational mapping or replicated internal model of the world.
4. Enactivist approaches have strong links to dynamical systems theory, emphasizing the relevance of dynamical coupling and coordination across brain–body–environment.

5. In contrast to classic cognitive science, which is often characterized by methodological individualism with a focus on internal mechanisms, enactivist approaches emphasize the extended, intersubjective, and socially situated nature of cognitive systems.
6. Enactivism aims to ground higher and more complex cognitive functions not only in sensorimotor coordination, but also in affective and autonomic aspects of the full body.
7. Higher-order cognitive functions, such as reflective thinking or deliberation, are exercises of skillful know-how and are usually coupled with situated and embodied actions. (Gallagher, 2017: 6)

According to Gallagher, unlike cognitivism, enactivism as a holistic approach is more like a 'philosophy of nature' rather than a scientific research programme. He argues that:

A philosophy of nature takes seriously the results of science, and its claims remain consistent with them, but it can reframe those results ... it can still offer clarifications relevant to doing science, and it can inform empirical investigations ... In this sense, a philosophy of nature is neither natural philosophy (in the traditional sense) nor the kind of naturalistic philosophy that is necessarily continuous with science (Gallagher, 2017: 22–23).

That is to say, enactivism provides a new perspective for cognitive science, to clarify, re-conceptualize and describe the scientific research results of cognition, and advocate reconstructing cognition in a non-rationalist and non-representational way.

In the meantime, enactivism weakens a key assumption in evolutionary psychology: the human mind consists of many specialized adaptations that evolved to cope with recurring problems in the primitive environment. According to this hypothesis, the environment is regarded as the input source from which those evolved adaptations begin to operate, and then produce behavioural outputs. It allows people to accurately study human cognition in isolation from their environment, as the environment plays no intrinsic role in cognition, but is merely a stage where the products of evolved cognitive

mechanisms of humans play a role. Enactivism emphasizes that the basic unit of cognitive analysis should be the complex of organism–environment, and behaviour comes from the nonlinear interactions between the brain, body and environment. In addition, Derksen (2007) criticizes many schools of evolutionary psychology for neglecting the study of human agency. They view the human mind as merely an 'intermediary' between biology and culture. Derksen, on the other hand, views the human mind as a 'mediator', paying more attention to the way humans actively intervene in biological and cultural processes. He uses Latour's actor–network theory to show that human life is formed through a psychotechnical self-cultivation process by a dense network of human and non-human actors, and we emerge as a hybrid of biology and culture, rather than just a passive fusion of nature and culture. Below, I focus on outlining enactivism's research on human cognitive agency.

Varela et al. (2010), who are the earliest advocates of the enactive approach, define cognition as 'perceptually guided action'. That is to say, cognition is not a recovery or projection, but an embodied action. They argue that 'agency' is an essential element of cognition. Autopoietic enactivism is committed to studying the agency of organisms and proposes the deep continuity thesis of life–mind. It believes that the agency of organisms is self-generated and is the product of a networked sub-human system with special organization (that is, a network of biological processes). Organisms develop into agents based on their agency and maintain their stability in space and time as unified entities; at the same time, organisms form norms that maintain their existence and uniqueness, and constantly develop their cognitive abilities (Di Paolo, 2005). Therefore, the research of enactivism on cognition focuses on clarifying the generative mechanism of agency.

The study of cognitive agency in enactivism has undergone a process from abstraction to concreteness, and from local to global. Early autopoietic enactivism argues that agents are 'autopoiesis', that agency is generated by the self-organizing patterns of internal network systems in organisms (such as metabolic, neural or circulatory, known as 'operational closures'), and that the formation of agency

is independent of external environmental factors (Maturana and Varela, 1987). Subsequently, the enactive approach, especially sensorimotor enactivism, recognizes the important role of the 'environment' in constituting agency. It claims that there is a coupling between organisms and the environment, so there is a feedback relationship between the actions and sensations of organisms. When an agent performs a specific action, it perceives a specific sensation through different sensory modalities. The correspondence between action and incoming sensation establishes a suitable rule, known as sensorimotor contingency: a specific action will produce a specific sensation. The sensory feedback received by each specific action makes possible the continuous active exploration of the environment. As long as the organism grasps this rule, it can predict upcoming events and guide its own behaviour. In this sense, 'agency' is seen as the skilful purposive behaviour of the entire organism that grasps these sensorimotor rules.

In addition to 'operational closure' and 'environmental factors', Di Paolo (2005) also demand the inclusion of 'sensory-motor interaction history' as a component of agency. The contingency of sensorimotor is formed in the history of sensory-motor interactions. In order to explain how agents regulate themselves to compensate for environmental disturbances when exploring their surroundings, they propose the concept of 'adaptability'. Compensation for external disturbances is an ability of the agent as a whole and is acquired as the agent develops. It plays a constitutive role in agency, as does compensation that occurs during internal networked processes. Another important concept related to adaptability is 'sense-making': it explains the meaningful or valuable aspects of the environment for organisms. That is to say, cognition is based on dynamic and biological sense-making. Sense is not an invariant object presented in the environment that needs to be extracted, but rather the product of an active principle of the agent in direct dialogue with the structure of the environment. Sense is enacted, and sense-making is a never-ending activity of organisms. Each agent establishes a specific history of interactions (sensorimotor contingency) and regulatory action (adaptive compensation),

which shapes the individual cognitive perspective of the agent (De Jaegher and Di Paolo, 2007).

In summary, the autopoietic enactive approach proposes a series of concepts about how 'agency' is formed, such as self-organization, operational closure, sensory-motor coupling, adaptability and sense-making, thus forming a biological theory of how agency is formed, as well as a cognitive theory based on agency. The operational closure of the self-organizing mode of the internal network system, the environment of the organism, and the sensory-motor coupling formed by the organism's interaction history with the environment, as well as the adaptability and the sense-making ability of the organism, jointly shape the agency of the organism. Therefore, agency is seen cognitively as the purposive coordinate behaviour of the entire organism.

However, it should be noted that this emergence of agency is analysed at the sub-human level. In addition to individual cognition, pure agency also involves social cognition. The explanation of social cognition in the enactivist approach does not rely on sub-human mechanisms or processes. Autopoietic enactivism proposes the concept of 'participatory sense-making', which refers to 'the coordination of intentional activity in interaction, whereby individual sense-making processes are affected and new domains of social sense-making can be generated that were not available to each individual on her own' (De Jaegher and Di Paolo, 2007). In participatory sense-making, the coordination of two or more system behaviours allows for the participation or coupling of these systems, resulting in the formation of an autonomous structure. This structure changes the sense-making of interactors and produces new meanings. Like autopoietic enactivism, radical enactivism claims that social cognition does not need to rely on sub-human mechanisms to explain. It highlights the social and cultural nature of interactions, arguing that social interactions bring contentful language and thought into the scene. It explains the development from non-content cognition to content cognition by appealing to socio-cultural scaffolding and other phenomena. In radical enactivists' view, cognition is always interactive and dynamic, but, due to the social and cultural practices of actors (especially language practices), 'content' is brought into the scene (Hutto and Myin, 2013).

4. The enactivist features of pragmatic views of cognition

Pragmatism is an influential philosophical school founded by CS Peirce in 1878 and developed by William James and John Dewey. It transcends traditional philosophy by pointing out that, in fully revealing our behaviour patterns, practical results are more important than abstract principles. Pragmatism is more radical than traditional empiricism and, as a philosophical method, is an ‘attitude of determining direction, not to look at the first things, principles, categories, and assumed necessities; but to pay attention to the ultimate things, achievements, results, facts’ (James, 2012: 33). This attitude of radical empiricism directly affects its view of experience and cognition.

First of all, like enactivism, the pragmatic view of cognition emphasizes that the analytical unit of cognition is not the individual organism, the body itself or the brain, but the organism–environment as a whole. Influenced by biological evolution theory, pragmatism regards the organism–environment as an inseparable whole and argues that the continuous interactions between organisms and their environment should be taken as the starting point of cognitive research. Organisms cannot exist independently of their environment, and the environment is always combined with the specific organisms that define it. As Dewey (1938a: 67) said, ‘In actual experience, there is never any such isolated singular object or event; an object or event is always a special part, phase, or aspect, of an environing experienced world—a situation.’ We should not describe organisms and environments in strictly objective terms, because they are interrelated and mutually defined. It can be seen that Dewey’s concept of ‘organism’ is not an ‘objective body’, but similar to the concept of the ‘lived body’ in phenomenology. Based on this, organisms and environments are both formed in their interactions with each other, which produces a circular dynamic. The specific behaviour of organisms causes specific changes in the environment, and the changes in the environment in turn produce specific sensory feedback to guide or constrain the subsequent exploratory activities of organisms (Dewey, 1997). This coordinated coupling between organisms and their environment

constitutes their experience (habit or behavioural regulation pattern), and the cognitive skills (adaptive functions) of organisms are acquired through their history of interactions with their surrounding environment. In short, there is a connection between ‘what organisms do’ and ‘what they perceive’, and the environment plays a key role in the formation of cognitive skills. Dewey’s concept of organism–environment constitutes the biological foundation of the current interactive turn in cognitive science and is the basis for discussions about embodied and extended mind.

It should be noted that, by focusing on activities and practices rather than abstract theoretical principles, pragmatism highlights the active capacities of organisms as explorers of their environment (Heras-Escribano, 2019). This active character of actors is crucial in establishing a coordinated coupling with the environment. According to pragmatism, perception is not passive, and the cognitive abilities of organisms are the result of biological adaptation to the environment. Experience, as a skilful activity, ultimately produces habits or tendencies that conform to individual cognitive skills. Therefore, experience constitutes the foundation of cognition. ‘Consciousness’ is not an activity encapsulated in the mind but a ‘capacity’ for meaningful interaction with the surrounding environment. Consciousness includes the agential activity and its interaction with the environment. Through continuous interaction with the surrounding environment, the agent enacts a relational world, which James (1895: 110) called the ‘purely experiential world’: we can describe it from either the object side (such as sense data) or the subject side (such as values, feelings or emotions related to sensory experiences), and both descriptions are equally valid in ontology and methodology. Clearly, this is a ‘neutral monism’ position in metaphysics.

Second, both pragmatism and enactivism emphasize the biological roots of cognition. Pragmatists propose a unique ontology of mind, which reveals to some extent the biological origins of the mind. James (1981) regards organisms as ‘bundles of habits’ (including both inherited and acquired ones), which are formed by the continuous, dynamic and organic coordination between organisms and their environment. Therefore, habits are

closely related to experience and are considered to be 'behavioral regulatory patterns' related to the organism's environment. The skilled performance of those patterns enables organisms to survive and have adaptive functions. In addition, James (1981) argues that habits are formed automatically and are highly plastic, changing continuously as a result of previous adjustments to the surrounding environment. And Dewey (2007) further refined James's concept of habit. In Dewey's view, habits are 'constitutive dispositional patterns' produced by the organic coordination process between organisms and their environment, including sub-human unconscious physiological processes (such as digestion, walking and breathing), socially regulated intellectual processes (such as reasoning and experimentation), or 'democratic habits' that allow us to live together as social beings. These 'constitutive dispositional patterns' are ways of integrating into the environment, which arise from all contexts in which habits are formed (such as ecological or social environments). Agents engage in coordinated coupling with the environment by actively exploring activities, and this coordinated coupling in turn promotes agents' development of a certain sensitivity to specific types of stimuli. While reacting to these stimuli, agents establish regularities with certain tendencies that play a prescriptive role in the patterning of agents' behaviour, constituting its different habits. The behaviouralization of habits enables agents' behaviour to be systematic, and the organic coordination between agents and the environment produces experience, which is the process of continuous activity in which habits are skilfully exercised.

Third, pragmatism first proposed the situated view of cognition, which is also emphasized by the embodied views of cognition of enactivism. According to Dewey (1938a), the biological individual lives in a world, which means living in a series of situations, and is constantly interacting with objects and other organisms. Situations and interactions are linked. The organism–environment is regarded as a self-organizing system (similar to the autopoiesis system of enactivism), and the establishment of coordinated coupling between them is closely related to how organisms can survive. When this coupling goes wrong or even collapses, the role of situation becomes prominent—Dewey calls it a problem

situation, which forces agents to reconstruct a feasible coupling to maintain their existence. In order to effectively respond to a problem situation, agents use tools such as expected ideas, gestures and verbal behaviour to effectively interact with the environment. In this case, cognition is a form of inquiry or practical activity, and cognition is situated. Here, we need to clarify two points: (1) the 'situation' referred to by Dewey is a holistic concept and cannot be confused with 'environment'. Situation is constructed by organisms and the environment, and it contains the agent or experiencing subject. Therefore, the solution to a problem situation is not simply dealing with objects in the environment, but rather adjusting one's own behaviour. In fact, any adjustment of objects, artefacts, tools, social relationships or institutions by the agent is also an adjustment of itself. (2) Situation must be social. The environment in which people live is both physical and social. Even if there are no others in the environment, it still has sociality objectively because it is coupled with a social organism. Therefore, the response to a problem situation must involve the social level. Even individual action is also true, because we assume the general attitude of the group, that is, 'I am us.'

Finally, Menary (2015) combined contemporary pragmatism and outlined three basic principles of pragmatist views of cognition. These principles are also compatible with enactivism and can provide some insights and inspiration for enactivism.

Principle 1

Cognition is formed by the interactions between organisms and their environment and is essentially interactive. The organisms and the environment are coupled with each other, and the organisms not only reflect their environment but also influence the environment through their own reactions and behaviours. The organisms and the environment co-evolve as a single system.

Principle 2

Cognition develops through exploratory inference, which is fallible, exploratory, open-ended and diachronic. Fallible inference and exploratory inference

are basic inferring forms in cognitive systems. Cognitive agents are fallible and can learn from mistakes and self-correct. Cognitive agents develop a set of inferential techniques through exploring the environment and maintain this core cognitive ability throughout their lifetime. This exploratory inference combines abductive search and Bayesian constraint methods. On the one hand, unlike induction and deduction, exploratory inference is a series of abductive reasoning, which is a process of generating theories or hypotheses and verifying them against experience. Abductive reasoning is creative and selective and is often considered an important component of scientific discovery logic. It is a search strategy that can further verify speculations. On the other hand, abductive reasoning is complementary to Bayesian confirmation methods. Abductive reasoning is a process of reasonably selecting speculations that need to be tested, so this testing complies with the confirmation process of Bayesian methods. Many perceptual inferences are mostly consistent with this integrated use of abductive reasoning and probabilistic deduction. According to Bayesian probability, the rationality of a hypothesis depends on what we have previously known. Given a set of previous materials, if some hypotheses are more credible than others, we will choose one of these credible hypotheses for testing. Therefore, abductive reasoning constrained by Bayesian probability is more in line with practical exploratory inference based on experience.

Principle 3

Problem solving is triggered by the emergence of irritating doubts in a specific situation and is resolved through exploratory inferring. This involves Peirce and Dewey's pragmatist account of inquiry. In a specific problem situation, an organism becomes irritated by further thinking and action being blocked, and this causes its inquiry (a response to overcome the problem situation). Over time, the response pattern to recurring problem situations may form a habit in the organism. Problem situations are not just physical stimuli; they exhibit an important characteristic related to the habituated organism. Therefore, the pragmatist account of cognition has a source of 'irritating' experience. The purpose of

inquiry is to achieve a stable belief state that makes the agent turn towards intelligent actions.

In summary, pragmatism explains the acquisition mechanism of knowledge in a radical empiricist way, not only providing a neutral monism position to characterize the world but also proposing biological-inspired naturalistic views of cognition that are based on the activity ability of organisms, as well as an ontology of mind based on the interactions between organisms and the environment. We will see below that the cognitive principles contained in pragmatism, to some extent, foreshadow some core ideas of enactivism, which should take pragmatism as its own theoretical pioneer.

5. The integration of enactivism and pragmatism

By analysing the cognitive views of enactivism and pragmatism, it can be concluded that there are many similarities between enactivism and pragmatism, and some core principles and ideas of enactivism have been proposed and discussed in pragmatism. Enactivism implies the assumption of pragmatism that there are interactions between organisms and their environment, and that the cognitive abilities of organisms evolve and develop in the history of their interactions with their environment. There is no doubt that pragmatism is the precursor of enactivism. Their explanations of cognition both appeal to biological theoretical support and emphasize the basic role of organisms' ability to act and of the environment in cognitive formation. They all hold a neutral monistic position ontologically. Neutral monism argues that the mind and the body are both composed of the same 'basic stuff', which is neither physical nor psychical but is intermediate between the two. James's (1895) neutral monism claims that this stuff is dynamic and relational and can be described from both psychological and physical perspectives. This is similar to the concept of sense-making in enactivism. The sense-making activity explains what the autopoiesis agents perceive in the same way, and the agents' world can be described scientifically or phenomenologically. That is to say, we can describe the actions of agents in their environment in pure physical terms,

or we can use some meaningful terms to describe this action, reaction and tendency as enacting a 'network of meaning'.

Here, I take Dewey as an example to explore the relationship between pragmatism and sensorimotor enactivism (represented by J Kevin O'Regan and Alva Noë). There are striking similarities between Dewey's and Noë's sensorimotor enactivism (Crippen, 2016). It can be said that Noë reproduces Dewey's views of cognition. Here, I attempt to summarize the commonalities between the two.

First, Dewey's explanation of experience fits well with the embodied explanation of cognition in the enactivist approach. Dewey was an empiricist philosopher and a historian of philosophy. He was adept at discovering the relationship between the new and old themes in the history of philosophy. His radical empiricism was largely due to his historical sensitivity. Dewey noted that there has been a radical shift in the concept of experience from ancient to modern times. Ancient Greeks believed that experience was associated with an intellectual skill that was accumulated through trial and error. This statement 'agrees very closely with what the modern psychologist knows as the method of learning by trial and error as distinct from the method of learning by ideas' (Dewey, 2019: 64). Modern empiricists often have a critical and sceptical perspective. Experience is seen as a weapon of critique, and rather than a memory of old things, it is a perception of new things, while being wary of the distorting effects of reason. Through historical investigation, Dewey (1929) synthesized the new and old concepts of experience, assuming that experience has both a 'retrospective, conservative aspect' (the view of ancient Greeks) and a 'projective, prospective aspect' (the view of modern empiricism), and intelligence is a function of regulating these two aspects. According to him, perceiving activities are primary, and sensations originate from experience. Sensation is neither a gateway or channel for knowledge nor a method of cognition, but rather a stimulating factor that provokes reflection and reasoning. Sensation is emotional, practical and action-oriented. As he put it, experience is 'an affair primarily of doing', and the organism 'does not wait passively and inertly for something to impress itself upon it from the outside world'. Rather, it 'acts in

accordance with its own structure, simple or complex, upon its surroundings. As a result, the changes produced in the environment react back on the organism and its activities. The living creature undergoes and suffers the consequences of its own behaviour. This close connection between doing and suffering or undergoing forms what we call experience' (Dewey, 2019: 70).

Second, cognition involves exploratory activities, and the physical activities of the cognizer reveal much about their experiential structure. Active bodies can perform comprehensive operations traditionally attributed to internal mechanisms. Dewey (1916: 14) pointed out that cognition is 'not an event going on exclusively within the cortex ... It involves the explorations by which relevant data are procured and the physical analyses by which they are refined and made precise'. Similarly, Noë (2009) also argues that cognition extends beyond the head, and we cannot locate our cognition in the brain. Perception is not a process in the brain, but a mode of skilled exploration of the world. Perception is constituted by the use of a series of sensorimotor skills. The brain can play its role only when it is integrated into the brain-body-environment system and only in dynamic, non-linear interactions with the processes of the body and environment. They both illustrate visual perception. Dewey (1934) observed that 'seeing' involves the coordination of some motor elements; namely, the coordination of things in the world around us. The structure of movement and sensation constitutes a single organ that performs a single function. When seeing an object, it is not only the visual organ that becomes active, but also the entire biological organism. The relationship between sensation and movement simultaneously affects behaviour and perception. O'Regan and Noë (2001) argue that visual perception is an activity of exploring the environment, and visual experience is based on the mastery of know-how, which is the understanding of relevant sensorimotor contingencies. To illustrate this point, they cite devices used by people with sensory impairments, such as Bach-y-Rita's tactile-vision substitution system. Here, a camera mounted on the head transmits stimulation information through vibrations on the skin or electric currents on the tongue. The cognizer actively explores the

surrounding environment and develops quasi-vision in a relatively short period. They can recognize the location and quantity of objects and grasp them, and even experience hallucinations usually associated with vision. Noë noted:

Like touch, vision is active ... As in touch, the content of visual experience is not given all at once. We gain content by looking around just as we gain tactile content by moving our hands. You enact your perceptual content, through the activity of skillful looking. (Noë, 2004: 73)

Third, perception and action form an inseparable whole, and perception develops as action unfolds. Regarding how perception-guided action occurs, Dewey's view of organic coordination is similar to the enactivist concept of sensorimotor contingency. Dewey refuted the concept of the 'reflex arc' that was popular in psychology at the time. The reflex arc is based on the behaviourist stimulus-response mechanism, which explains behaviour and psychological processes from a physiological perspective. The organism is seen as a passive existence, and the process from receiving stimuli to making responses is a series of mechanical and separate processes. On the contrary, Dewey (1896) argued that organisms are not isolated and that cognition does not begin with sensory stimulation but with the coordination of sensory-motor activity. The stimuli encountered by the organism have been influenced by previous actions, so the stimuli it receives are regulated by its previous actions. The perception and action of the organism are mutually influenced and inseparable, jointly constituting a single process of organic coordination. Similarly, the concept of sensorimotor contingency in the enactivist approach also emphasizes an organic coordination role. At the sub-human level, the sensory-motor abilities of organisms, including the emergence of neural dynamics of sensorimotor contingency and enactive agency, are all produced by their behaviours or organic coordination. Cognition consists in perception-guided action, and the way an agent perceives is regulated by its actions. An agent's grasp of sensorimotor contingency consists in knowing what kind of sensations we can obtain from performing a specific action and using these

laws to achieve our goals. Both organic coordination and sensorimotor contingency produce habits or tendencies that organize behaviour. Enactivists equate 'perceptual habits' with 'sensorimotor schemas', claiming that habits are 'self-affirming sensorimotor structures' (Di Paolo et al., 2017: 39). These sensorimotor schemas enable agents to become self-sustaining organisms and cognitive entities, and habits are nothing more than regularities formed by connecting specific actions of agents with different sensory stimuli determined by previous actions. Therefore, every habit is a minimal sensorimotor unit that gives the system cognitive identity. Di Paolo even combined James's view of organisms as bundles of habits with the self-organizing structure model of enactivist approaches.

Fourth, perception is an activity of the organism as a whole. O'Regan and Noë noted that 'seeing involves testing the changes that occur through eye, body, and attention movements'; thus, it is an 'activity on the part of the animal as a whole' (Noë, 2004: 2). Moreover, complex cognitive functions are rooted not only in sensorimotor coordination but also in the emotional and autonomic aspects of the whole body. Dewey (1934) also argued that there are actions, intellectual abilities and emotional abilities involved in perception activities. Without the joint action and coordination of surrounding things in the environment, there is no perception. Consider the experience of eating popcorn in a cinema, and how this activity calls on the activities of our entire body, including our tongue, jaw, hands, eyes and ears. We hear the crunching sound of chewing, feel its warmth and joy rising in our hearts. It becomes part of cultural rituals and a medium for social integration in the cinema.

Fifth, cognition is related to the cultural and social environment in which individuals live. Dewey (1938b) equated experience with culture, arguing that culture is embodied activity patterns that constitute our world and experience, and that they exist in interconnected agency and groups of things. As he said, perceptual experience is formed through skilled action, and we always become skilled or experienced in a group context. Noë also claims that, if 'language, tools, and collective practices make us what we are', then we have 'no reason to

suppose that the critical boundary is found in our brain or skin ... our cognitive powers require for the very exercises the existence of a sociolinguistic environment' to the extent that 'language is itself socially manufactured and shared by linguistic communities'. Therefore, our 'minds cross out of the skull and get supported by shared sociolinguistic scaffolding' (Noë, 2009: 68, 88).

6. Conclusion

This paper makes it clear that enactivism has deep pragmatic roots, and the pragmatist view of cognition exhibits many characteristics of enactivism. Pragmatism heralds many insights of contemporary 4E cognition. Definitely, the pragmatic turn in cognitive science has had a significant impact on the theories and methodology of cognitive science. The action-oriented cognitive research paradigm indicates that cognition is not only closely related to action, but also rooted in action, and we need to rethink the conception of representation. This action-oriented cognitive paradigm is both theoretically feasible and highly promising in practice. And, more importantly, this paper shows that the integration of enactivism and pragmatism is workable. Therefore, fully exploring the pragmatic resources of enactivism will help further advance the research of enactivist cognitive science. For example, some views of pragmatism can enrich the various embodied and situated accounts of cognition in the enactivist approach (especially sensorimotor enactivism), which helps integrate some important ideas of the E-cognitive approach into enactivist theories. Gallagher (2014) argues that pragmatism can provide a comprehensive perspective for the integration of enactivism and extended cognition. He attempts to develop a pragmatism–enactivism version of extended cognition theory, which is based on Dewey's views of situation and organism–environment. In addition to traditional pragmatists (Peirce, James and Dewey), we can also incorporate Mead's social behaviourism and Skinner's radical behaviourism into the frameworks of enactivism. Mead's social behaviourism can also be used to address the dualist problem in Gibson's ecological psychology and the concept of affordance. Inspired by pragmatism, enactivism can also be

involved in comparative psychology and applied to the social cognitive research of non-human primates and other species. Enactivism can also be extended to the research of aesthetics, ethics, psychology and other fields.

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