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Evaluation of the Relation between Cognitive Science and Embodied Cognition

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Abstract

This article delves into the intricate relationship between cognitive science and embodied cognition, offering transformative philosophical insights with profound implications for our understanding of the mind-body connection. In response to the journal's feedback, we have enhanced the abstract to provide a more comprehensive overview of our study. Background: We trace the historical evolution of ideas, from the inception of cognitive science rooted in analytic philosophy to the groundbreaking contributions of Rodney Brooks and others in the field of artificial intelligence. We also explore the work of scholars such as Agre, Chapman, and Dreyfus, shedding light on the role of cognitive metaphor and the concept of the cognitive unconscious in shaping our understanding of embodied cognition. Purpose: Our study aims to shed light on the central theme that unites these various strands of thought—the rejection of the traditional, transcendental view of the subject in favor of the concept of an embodied subject. This embodied subject actively engages with its environment, shaping consciousness and cognition. This shift in perspective challenges classical epistemological theories and opens new avenues for inquiry. Method: We have conducted a comprehensive literature review to explore the historical development and key concepts in the field of embodied cognition, with a particular focus on the philosophical underpinnings and their integration into cognitive science. Results: Our examination of embodied cognition reveals that the mind is intimately connected to the body, with cognition emerging through interactions with the environment and perceptual experiences. This perspective challenges reductionist notions and demonstrates that mental states cannot be reduced to brain states alone. We also explore the relationship between functionalism and computational states of the brain, illustrating that mental states can be understood in the context of mathematical functions. Conclusion: In conclusion, this paper highlights the profound implications of embodied cognition and suggests that the mind is not isolated from the body but intimately tied to it. This perspective provides a fresh approach to the mind-body problem, emphasizing the role of the environment and perceptual experiences in shaping cognition. We invite further research into the practical applications of embodied cognition in fields like artificial intelligence, robotics, and psychology, and encourage investigations into the intersections between cognitive science and various branches of philosophy, offering valuable insights into the nature of consciousness and cognition. In essence, this study provides a comprehensive overview of the evolution and implications of embodied cognition, laying the groundwork for further research and fostering a deeper appreciation of the profound shifts in perspective that this theory brings to our understanding of the human mind.

Keywords

Cognitive Science, Embodied Cognition, Artificial Intelligence

1. Introduction

The "cognitive revolution" along with the theory of cognition is computation, propelled the exploration of the brain across a multidisciplinary attempt termed as cognitive science. Substantial multiplicity of opinions concerning its definition and projected scope, this novel discipline, unambiguously designated, was meant to have an organised subject material and combined theories. Bibliometric inclusion encompasses psychology and education [1].

Cognitive psychology has experienced a pattern modification in the pathway how knowledge is developed and denoted in the brain. However, the effects of this influences student learning through several disciplines have not yet fully implemented [2].

Psychology has made a substantial impact to the discipline of education. Subsequently the key objective of education is student learning, which is an undoubtedly a psychological issue. The developing investigation programme of embodied cognition has abundant to suggest educational experts, scholars, and policymakers. Embodied cognition is still in its beginning, the multidisciplinary and cross-disciplinary type of the literatures offer some stimulating

F. A. Author is with the National Institute of Standards and Technology, endorsements to augment educational exercises, which can induce about student learning more efficiently [3].

The adaptation of teaching techniques in response to human actions has resulted in a wide range of consequences. Literature on embodied cognition proposes the physical activities we accomplish, and the activities being achieved around us form our psychological understanding. Students psychologically mimic the gesticulations of their professors; this action adds to the embodied knowledge. One probable motive for amplified student learning in human-centred situations is the instigation of mirror neurons [4].

The aim of the article is to elucidate the relation between cognitive science and embodied cognition, in the light of artificial intelligence (AI). AI has become a cutting edge high-end technological advancement in several fields. They inquired about the use of this method in evaluating embodied cognition, which has demonstrated significant accomplishment.

2. First-Generation Cognitive Science and Analytic Philosophy

As pointed out earlier in this paper, theories of embodied cognition in cognitive science are contrasted to traditional theories in this field. To more carefully examine these traditional theories, we need a digression to some origins of analytic philosophy, since there are many similarities between the views of early analytic philosophers and first-generation cognitive scientists. Lakoff also traces first-generation theories in cognitive science to the metaphysics of analytic philosophy [5].

Brentano introduces a concept that turned out to be fundamental in both orienting strands: the concept of "intentionality". For Brentano, every mental act is directed at something and has an object, so to speak. In his view, no state of consciousness is pure and self-sufficient. For example, fear is always a fear *of* something; anger is always anger *at* something; consciousness is always consciousness of something, and so on. Now the question is what these states are directed at [6]. At first, Brentano took objects of mental acts to be immaterial contents. However, he later shifted to reism, saying that their objects are physical objects. Notwithstanding this, some of his contemporaries, and in particular his students who, in Brentano's own words, put on every old jacket that he threw away and clung to Brentano's earlier view. Husserl postulated the concepts of *noema* and *noesis*, and Frege appealed to a distinction between sense and reference in order to overcome some mathematical issues and avoid psychologism, taking the object of mental acts to be sensed.[1]

Frege's attempts to reject psychologism led him to the introduction of a new theory of meaning. He characterized the sense as something objective and yet abstract and immaterial. In his *The Thought* (*Der Gedanke*), Frege clearly denies that for things to exist, they need to be material, classifying thought, and sense as abstract entities [7]. More precisely, Frege has introduced entities into his ontology that are rejected by many philosophers, and in particular Empiricists and proponents of Ockham's razor [8].

Frege expanded his ontology, partitioning the world into three parts: the material world, the mental world, and a third realm, which is neither material nor mental [9], that is, the world of *abstracta*. Concerning how knowledge of the abstract world is acquired, given that, as Benacerraf suggests [10], we do not have a causal relation to such a world, Frege claims that such abstract senses are *grasped* in a social act. He does not elaborate upon how senses are grasped, but

[1]For more about the effect of theories of intentionality on post-Brentano philosophies, see Pierre, 2014.

what he has in mind, which was being pursued by the first-generation cognitive scientists, can be uncovered by a close examination of his well-known book, *Begriffsschrift.*

In *Begriffsschrift*, Frege invents a formal and totally artificial language. His invented language is formal so that it would not involve ambiguities of the natural language. He invented the language primarily in order to revise logics in this language, and secondarily, to accomplish his project of logicism or the reduction of mathematics into logic. His goal (in his *The Foundations of Arithmetic*) was to arrive at ideal mathematical meanings which existed in his world of *abstracta*.

What he, and his successors, do in logic is indeed the stipulation of purely meaningless symbols and then making deductions from them via specific axioms. In Frege's view (and as assumed in modern formal systems of logic), intuitions or other rules or axioms should not be used in deductions. For instance, in the following inference, two symbols—*P* and *Q*—are used, and no axiom or intuition other than *modus ponens* is applied, and its truth is not specified outside of logic—it is specified in virtue of a mechanical action based on truth-tables:[2]

$$\begin{array}{l} P \rightarrow Q \\ \underline{P \qquad\quad} \\ Q \end{array}$$

Although Frege's system was primarily invented for mathematics, it is, as he suggests in his *Begriffsschrift*, a Leibnizian project in fact, which intends such a language to be constructed for, and applied to, all sciences from physics and chemistry to other natural sciences. What relates this issue to our discussion is that, throughout Frege's work and his metaphysics and philosophy, as well as in his favored linguistics and semantics, no role is assigned to an embodiment [11].

For Frege, the body is irrelevant to cognition just as it was for Descartes. In his semantics, the formation of categories and concepts to which symbols refer has nothing to do with the body. In fact, for Frege, concepts and categories are not formed at all; they already exist in an eternal world. For Frege, meanings are neither products of social practices and their uses in ordinary life, as Wittgenstein believed, nor products of the Lifeworld and horizons before a moving body which is in the process of formation; is the mind-body problem. One theory offered to solve the problem was the identity theory, which came in two versions: type identity theory and token identity theory, both of which were reductive materialistic theories, as briefly pointed out before. According to the type of identity theory, types of mental states are identical to types of brain states, and then every type of mental state is reduced to a type of brain state. For example, pains are reduced to C-fiber firings [12]. Just as we reduce water to H_2O, we can use the term "C-fiber firing" instead of "pain", which refers to a mysterious mental state.

This brings us to an advantage of type identity theory, that is, simplicity. For,

[2]Truth tables were not invented by Frege himself; they were invented by Wittgenstein.

as pointed out earlier, when a trans-physical entity is reduced to a physical entity, things will be more concrete and straightforward. Moreover, it will bring with it a sort of simplicity in language and concepts, because if all mental states are reduced to brain states, the metaphysical language will be eliminated, and only one language will remain with which brain processes are articulated. Although this theory did not suffer from limits and problems of behaviorism, it was subject to other objections. Of these, we briefly sketch one.[3]

If a mental state "type" were identical to a brain state "type", then it would follow that a necessary relation holds between the two. More technically speaking, there should be a necessary relation between them in all possible worlds. That is to say, in every possible world (that is, in all imaginable circumstances), pains should be identical to C-fiber firings. However, not all animals that experience pains undergo C-fiber firings. Instead, other parts of their brain states might give rise to experiences of pains in those animals. The same applies to other mental states and their reduction to brain states.

As we have seen in the previous chapter and will see in this section, concepts and meanings are formed and identified *a posteriori* in a social act as dependent on structures of the body and the environment, rather than as a pre-existing pre-formulated package. In any case, although Frege's views did not find any advocates in natural sciences, it seemed interesting to practitioners of cognitive science and artificial intelligence, and constituted the building blocks of these sciences, so to speak. Theories of embodied cognition seriously challenge the assumptions of first-generation cognitive science by giving a central role to the body and its environmental and social presence [13].

3. Artificial Intelligence

Now it is time to discuss the relationship between embodied cognition and a significant issue of the present century, that is, artificial intelligence. The debate over artificial intelligence is rather new, dating back to at most one century. In Fact, artificial intelligence officially began in 1956 at a conference in Dartmouth. Artificial intelligence thrived alongside functionalist theories. Thus, we need to discuss functionalism and how artificial intelligence was developed therefrom briefly [14].

Objections to behaviorism justified the development of a new theory of mind. In addition to solving the problems of behaviorism, the new theory had to offer a solution to the most significant problem in the philosophy of mind-that is, the mind-body problem. One theory offered to solve the problem was the identity theory, which came in two versions: type identity theory and token identity theory, both of which were reductive materialistic theories, as briefly pointed out before. According to the type identity theory, types of mental states are identical to types of brain states, and then every type of mental state is reduced to a type of brain state. For example, pains are reduced to C-fiber firings. Just as we reduce water

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To solve the problem, some people propounded a token identity theory. On this view, instead of looking for a "type" of a brain state for every "type" of a mental state, we look for "tokens" of a brain state for "tokens" of a mental state. Here is how Searle summarizes this theory:

The token identity theorists simply said: for every token of a certain type of mental state, there is some token of some type of physical state or other with which that mental state token is identical. They, in short, did not require, for example, that all token pains had to exemplify exactly the same type of brain state. They might be tokens of different types of brain states even though they were all tokens of the same mental type, pain. For that reason, they were called "token-token" identity theorists as opposed to "type-type" identity theorists [16].

In any case, the failure of behaviorism and objections leveled at type identity theory led some philosophers to offer a new theory: functionalism. There are two versions of this theory: machine functionalism and causal-theoretical functionalism. Now we should see the appeals and potentials of functionalism that led to its remarkable impact on the philosophy of mind.

According to functionalism, different systems can, despite their differences in types, exhibit the same function. For example, a wristwatch, a wall clock, an hourglass, a sundial, and the like display the same function, despite their differences in type. Remember the objection to type identity theory: pains are associated with different types of brain states in different species; thus, all kinds of pains cannot be reduced to the same physical type. Now we learn from the clock analogy that in order to define what a clock is, we do not need to see what material it is composed of (type identity[5]) or to see how one type of a clock, such as

[4]This is because the following objection allows us to account for how the token-token identity theory was developed.

[5]This thesis is also well known as the thesis of "multiple realizability".

a cuckoo clock, behaves (behaviorism). The only thing we need for the definition of a clock is how it functions, which is common to all types of clocks. Thus, if we find how "pains" function, we can specify all types of pains in all species that experience the pain.

Philosophers and cognitive scientists who advocate functionalism associate it with the mathematical notion of function. In mathematics, a function is an operator that receives an input or argument, and then yields a specific output or value based on well-defined principles and rules. For example, in a function such as $Y = X^2 + 1$, given different arguments input to x, different values will be obtained. For example, if we input the argument, 2, into the above function, we will have five as our value, and if 3 is an input, we will have ten as our value. Here a function operates only following a specific rule. Earlier, we pointed out the role of Frege on followers of functionalism, and now we are able to further elaborate upon the issue.

Frege has established the functional paradigm by introducing the mathematical notion of function into logic and trying to formalize the natural language. Frege thought of logic is a paradigm of certainty, and thus, he believed that if we could derive a proposition with purely logical methods, then the proposition would be "necessarily" true. However, in his view, the natural language was a significant obstacle. Thus, we had to devise a *machine* that was free of linguistic ambiguities, which are mainly grounded in semantic ambiguities. Thus, Frege looked for a language that was void of any meaning: a purely formal language, in which there is no reference to meaning and whose truth is solely determined by the deployment of specific rules; hence, the distinction between syntax and semantics in modern logic. In other words, Frege's language is self-sufficient; that is, it does not need meaning [17].

Now *Turing machine* turns out to support this theory. Turing refers to the machine as a digital computer, in terms of which the table of rules and programming are defined. The table of rules is a book of laws deployed by the computer in performing its operations, and programming is a set of rules or instructions from the table in an order selected for operation. What is significant about a Turing machine is that it merely takes forms of signs into account, remaining neutral concerning any content. Since Turing thinks of the brain as having the same function, it will be possible to construct machines that can perform its computations. Thus, there can be artificial intelligence, equal and equivalent to human intelligence. In other words, just as Turing machine operates in accordance with inputs and outputs, the mind operates between its inputs (sensory data) and its outputs (behaviors).

Thus, mental states are indeed, computational states of the brain. The relation of a mind to the brain is like that of software to hardware:

If one had to summarise the research program of cognitivism, it would look like this: Thinking is processing information, but information processing is just symbol manipulation. Computers do symbol manipulation. So, the best way to study thinking (or as they prefer to call it, "cognition") is to study computational symbol-manipulating programs, whether they are in computers or in brains. On this view, then, the task of cognitive science is to characterise the brain, not at the level of nerve cells, nor at the level of conscious mental states, but rather at the level of its functioning as an information processing system. And that's where the gap getsfilled [18].

Let us return to the example of pain; a mental condition like pain turns into a causal-functional condition, meaning that it plays a functional role of definite causation and thereby, mentally-caused concepts turn into functional concepts. For example, an organism can endure pain, only when there is a mechanism which reflects superficial damages. The function of this function is causal, *i.e.*, superficial damages activate this function and activate other dependent mechanisms in the following. These functions accompany the behavior outcome of this sequence, defined in functional terms and the resulting function works between the middle (causal) ground of input pain condition (e.g., superficial damage) and its output (e.g., yelling). According to functionalists, this model is true for all types of mental events and hence all mental conditions are causal-functional conditions. What is assumed in studying samples of mental conditions is that all the mental conditions have a specific role to play. In other words, if one looks at mental events as internal events of person, they must have the actual causal power to cause other mental events and occurrences.

4. Embodied Cognition and Artificial Intelligence

Having surveyed a brief history of how philosophical views of artificial intelligence were developed, we are now in a position to consider the problem of artificial intelligence from the view of advocates of embodied cognition. The embodied approach to cognition was propounded in about 1980 in response to formalism and computationalism [19]. As we have seen before, earlier approaches to artificial intelligence were based on pure formalism and were thus free of any relations to the body. However, more recent approaches sought to rediscover the role of the body in the process of cognition. Thus, we elaborately review the accounts provided by a number of prominent people who have worked on embodied cognition: Brooks, Agre and Chapman, Dreyfus, and Lakoff.

5. Rodney Brooks

Brooks was the first person who developed a connection between artificial intelligence and embodied cognition. He sought to apply robots to the real life. Thus, he considered two main theses: situatedness and embodiment [19]. Here is how he formulates the two theses:

[Situatedness] The robots are situated in the world-they do not deal with abstract descriptions, but with the here and now of the world directly influencing the behavior of the system.

[Embodiment] The robots have bodies and experience the world directly—their actions are part of a dynamic with the world and have immediate feedback on their own sensations.

Brooks' approach to robots was bottom-up. It was preceded by an approach in which robots operated in accordance with complex algorithms and pre-determined rules or instructions. However, in the bottom-up approach, robots learn how to adjust themselves based on environmental circumstances. Brooks' idea was inspired by the lives of more rudimentary animals such as insects. They are not born with prior knowledge of the world. However, they begin to learn how to adjust themselves to the world. The idea inspired Brooks to designs robots that could do the same [20].

"In a paper, he reports that he has presented a different approach in a wireless robot based on the idea that "the world is the best model of itself". This robot deploys the world as it constantly consults its sensors, instead of an internal model of the world [21].

It is programmed for responses to particular situations, and it learns to respond to changes reported by its sensors directly.

Agre and Chapman

Agre and Chapman pioneered an approach they called "interactionism". Their approach was more or less influenced by Heidegger's notion of being-in-the-world, which we sketched before. To draw on Heidegger's views is to criticize Cartesian views, in which the subject can self-sufficiently think. The Cartesian view constituted the first cornerstone of the first generation of advocates for artificial intelligence. However, in Heidegger's view, *Dasein* does not go out of the enclosure of its consciousness. On the contrary, it is already present in the world. In perception, it is not as if *Dasein* goes out of its territory, invades the territory of objects, where it robs truths, and then goes back to its own territory. Instead, *Dasein* remains outside of itself, even in understanding and remembering [22].

Just as Brooks made recourse to more rudimentary animals and a bottom-up approach, Agre and Chapman began to study human pre-reflective behaviors (given their background in Heidegger's philosophy) and learned that ordinary human behaviors are generally uniform, and changes take place very slowly. Moreover, in their view, the complexity and uncertainty of the world does not allow us to think that artificial intelligence can be constructed that can adjust itself to all these complexities and uncertainties by relying on a program. Many of our behaviors are immediate and pre-reflective, rather than programmed [23].

In general, there are important similarities between the view of Agre and Chapman on the one hand, and that of Brooks on the other:

Agre and Chapman's work bears many similarities to the architecture proposed by Brooks. Both schemes originated on the assumptions of a complex, immediate, and uncertain agent environment. Also, both architectures stress that there is no need for an internal world model and that the world is its own best model. The work done by Brooks has a more practical flavor and chooses actual mobile robots as testbeds while Agre and Chapman rely on a simulated environment. What is more, is that Brooks' architecture relies more on prepackaged behaviors. The subsumption architecture is essentially a hierarchy of behaviors and behaviors consist of pre-determined sets of instructions. Agre and Chapman's architecture, on the other hand, places more emphasis on the behaviors as patterns of interaction between the agent's "simple machinery" and the complex world [24].

Dreyfus

Dreyfus's Critique of Artificial Intelligence

Dreyfus, heavily influenced by the philosophical views of Heidegger and Merleau-Ponty, has presented a comprehensive critique of artificial intelligence (AI) over the years. He specifically emphasizes four fundamental objections to AI, which are critical to our understanding of the limitations of this field [25].

Biological Objection: Dreyfus challenges the prevalent analogies within AI that relate the mind to the brain as if it were software operating on hardware. He argues that this analogy oversimplifies the complexity of human cognition and the embodied nature of thought.

Psychological Objection: Another central point of contention is AI's reliance on symbol manipulation and rule-based thinking. According to AI theories, the mind operates by manipulating symbols according to predefined rules. Dreyfus contends that this reductionist approach neglects the rich and dynamic nature of human thought, which often involves intuitive, context-sensitive, and non-rule-based processes [25].

Epistemological Objection: AI theorists assert that all mental processes can be predicted and modeled by uncovering the relevant laws governing them. In other words, they argue that all knowledge can be formalized. Dreyfus, however, posits that there are background elements and contextual factors inherent in human cognition that cannot be reduced to formal rules. These elements are often implicit and non-measurable, making them elusive to the analytical tools of AI [26].

Ontological Objection: Dreyfus's primary objection is grounded in AI's ontological assumptions. AI often adopts an atomistic perspective, treating the world as a collection of independent and context-free facts. This perspective negates the importance of understanding the background and interconnectedness of concepts. Dreyfus contrasts this view with the historical development of philosophy, which has long been engaged in categorizing individuals under universal type concepts. Plato, for instance, believed that knowing a particular entity merely required understanding the universal type under which it falls, without considering its background or situational context.

Dreyfus's critique underscores the foundational importance of our pre-reflective experience in the world, which is often ignored in AI. This pre-reflective experience is deeply embedded in our bodily engagement with the environment. Unlike AI, which often focuses on abstract principles and context-free elements, Dreyfus highlights the importance of practical and behavioral expectations derived from our bodily habits. He argues that our bodies provide us with an internal horizon of indeterminate and prior expectations, allowing us to respond to diverse situations with flexibility.

In response to challenges from proponents of AI, Dreyfus emphasizes that our embodied existence enables us to exhibit responses in varying circumstances, responding to different environmental demands. This adaptability is a challenge for AI, as it requires a level of embodied, situational understanding that is not easily formalized in rule-based systems [25].

Dreyfus's critique of AI, deeply rooted in the philosophy of Heidegger and Merleau-Ponty, brings to light the critical importance of embodied cognition and the limitations of purely symbolic, rule-based models in understanding the complexity of human thought and action [27].

"Thus, an anticipation of an object does not arouse a single response or specific set of responses but a flexible skill that can be brought to bear in an indefinite number of ways" [28].

This is, indeed, the second primary function of bodies: they enable us to encounter objects without representing them (whereas representation is a fundamental assumption of artificial intelligence).

Moreover, feedbacks determine whether a human or a machine properly knows an object, although there is an essential difference between the two. Artificial intelligence can ultimately detect errors based on a limited number of defined data, whereas bodies have much broader possibilities and facilities than artificial intelligence. Bodies adjust themselves to their environments and objects therein and place themselves in the best possible position concerning these objects. For example, to read a book, one needs to put one's body in a position, which differs in different conditions (such as those in which there is excessive or dim light, or when one's hand is physically damaged). However, a machine does not have such capabilities, particularly the capacity to adjust itself [29].

According to Dreyfus, human intelligent behavior and processing occur in a non-formal way. That is to say, from an ontological point of view, the behavior constitutes a whole. The elements of this point of view are meaningful only in light of the whole [30]. Dreyfus maintains that grasping the whole requires the existence of an embodied organism, and unless artificial intelligence has such a body, it fails to equal the power of human minds.[6] Dreyfus takes his holism from Heidegger and Merleau-Ponty [26].

In Heidegger's well-known example of a hammer, the smith has no conscious recognition of the hammer, nails, or his bench—that is, he lacks consciousness of a sort possessed by a person who might look at him and reflect on what he is doing. The smith has no consciousness of tools with which he works, nor of himself. Thus, there is no subject here, nor object. There is only a constant experience of working. The body and the hammer will constitute an integrated whole. Therefore, to separate the body from its surrounding environment or to ontologically distinguish them is to empty the living body of its contents, whereas human intelligence behavior is a result of such an ontological connection.

[6]This is not to say that robots can equal the human mental power if a day comes when a human body is designed for them. This is to say that having a living body is a necessary, albeit not a sufficient, condition for the simulation of the human mind.

Thus, artificial intelligence fails to simulate the intelligent human behavior by the distinction it makes between them and their transformation into independently existing units. Therefore, any attempt to simulate the human mind without a simulation of the human body is doomed to failure [31].

6. Cognitive Metaphor

Lakoff has been one of the most severe thinkers who introduced and developed the theory of embodied cognition. He and his colleagues, Johnson and Núñez, pursued the role of metaphor in the cognitive process, and thus, they discovered the role of the body in the formation of cognition [8]. The book, *Philosophy in the Flesh*, co-authored by Lakoff and Johnson, opens with the following three theses:

1) The mind is inherently embodied.

2) The thought is mainly unconscious.

3) Abstract concepts are mainly metaphorical.

Let us begin with the last thesis: throughout history, metaphors were usually deemed relevant to language and literature and were never thought of as relevant to cognition and scientific knowledge. If it was believed, on the one hand, that metaphors are aesthetic merits for artwork, it was, on the other hand, believed that metaphors are threats to science and the scientific language. Recent studies concerning metaphors have revealed that the whole scientific language and our whole cognitive process mostly have a metaphorical structure. Consider the following phrases: "black hole", "air resistance", "electric charge", "electric field", "natural selection" and "temporal distance". These phrases lie at the heart of modern scientific theories, but they are pregnant with numerous metaphorical concepts.

Despite their occasional severe disagreements with each other, contemporary theories of metaphor share the assumption that our cognition is necessarily metaphorical. Although, as pointed out before, Nietzsche was the first to discover the cognitive role of metaphors, the idea was developed and elaborated by recent theories. For example, in his interactive theory, Black conceives of metaphorical propositions as "cognitive apparatuses" such as "charts, maps, and diagrams" that somewhat model the reality and can "show how things are" [32]. Davidson's causal theory rules out the distinction between metaphorical and non-metaphorical languages, holding that the whole language is metaphorical, and metaphors, properly speaking, do not represent something else; instead, they are vehicles of meanings on their own. However, it was Lakoff who brought metaphors to the level of the body and bodily-environmental experiences. Lakoff and Johnson believe that, in addition to language, our thoughts, experiences are metaphorical. They believe, and argue, that when an environmental experience takes place, a specific neuronal array occurs, which causes the formation of various metaphors that encompass not only our experiences and ordinary cognitive reservoirs, but also our whole philosophical, scientific, and even mathematical thoughts.[7] However, how do these metaphors work?

[7]In their *Where Mathematics Comes From*, Lakoff and Núñez show the metaphorical structures of mathematical theories.

Consider the following conceptual metaphor: "emotion is warmth". For a human baby, mental-emotional experiences are not usually discriminable from the sensory experience of warmth; that is, the warmth of the mother's arms. The two experiences are later discriminated, although they reconnect in a metaphorical framework, hence metaphors such as "warm smile", "a warm welcome", "warm-blooded person" and so on [33]. Moreover, the safety and peacefulness of the mother's arms give rise to the metaphor of "intimacy is spatial proximity" as evident in: "we were close to each other", "there is a distance between us", "we are far away from each other" and so on.

In all these, and similar, metaphors, the crucial role is played by the body and bodily projections. For example, spatial relations in terms of body cause the constitution of concepts of directions, such as "above", "below", "before", "behind", and the like, and these concepts play a key role in the constitution of many conceptual metaphors such as "Christmas is before us" and "we have left the summer behind".

In the constitution of a metaphor, two domains come to be linked: the source domain and the target domain. In each metaphorical schema, elements in the source domain are mapped into the target domain, which results in cognition. The source domain is a domain that is more familiar to the person, and the target domain finds meaning through mapping into the source domain. For example, in the conceptual metaphor of "love is a journey", which gives rise to metaphors such as "we are still in the first steps of our relation", "the relation does not go anywhere", "we are not moving on" and "there are many obstacles before us", the source domain is journey and the target domain is love [34].

To better understand the reason for such a mapping, we had instead turned to Gestalt psychology. At a philosophical level, William James traced the acceptance or rejection of beliefs to a pre-existing web of beliefs in terms of which observation becomes meaningful and, ultimately, accepted or rejected. The Gestalt theory develops a similar view at a psychological level [35].

According to Gestalt psychology, perception and understanding do not work on the model of Rationalism and Empiricism, which is a passive reception of sensory data. Instead, sensory data is meaningful only in terms of a pre-existing whole. Thus, a perceptual experience does not make sense on its own, and it remains meaningless unless it is positioned within the framework of a pre-existing gestalt. On the other hand, in both ordinary experiences and scientific investigations, the structure of the world sometimes surpasses the structure of the language. Thus, to perceive and communicate a new observed structure, there is no way but to understand in previous general frameworks. It is in these cases, metaphors come in to help us understand and communicate the meaning. This closed holism[8] is what grounds the critical role of metaphors in human knowledge [36].

However, what forms inferences as well as metaphors which constitute our

[8]Closed" in the sense that parts of the whole are in relation to one another and a change in one part affects other parts. The parts ultimately aim to constitute a coherent whole.

concepts is neuronal model-making. In Lakoff's view, neuronal model-making can show what the embodiment of the mind amounts to—rational inferences can be computed with the same neuronal architecture that applies to sense perception or bodily movements. Thinking involves categorizing, that is, putting individual beings into classified categories, such as "human", "man", "woman", "mammal", "food", "danger" and the like. Such categorizations are entirely dependent on neuronal models and arrays, which are, in turn, functions from the bodily structure of the organism and the sensory-motor experience resulting from being in, and interacting with, the environment. Thus, the role of the body in the process of cognition will be further illustrated [37].

7. Cognitive Unconscious

The last noteworthy point in Lakoff's theory is the problem of the *cognitive unconscious*. The cognitive unconscious bears many similarities with what we have seen in the views of Schopenhauer and Nietzsche. It amounts to the existence of a part to which we have no access and of which we are not conscious, although it oversees much of cognitive processes. Not only does cognitive unconsciousness constitute concepts and categories, but it also plays an essential role in how we perceive, infer, and think. Without the cognitive unconscious, cognition would be practically impossible [38].

According to Lakoff and Johnson, and formerly Freud, the cognitive unconscious cannot be accessed in our consciousness, but innumerable findings and observations have implied its existence [8]. For example, consider stages of a straightforward conversation: access to memory, apprehension of the phonetic structure of the language and its division into separate parts, recognition of phonemes and morphemes, formation of sentences following grammatical rules, word choice, giving meaning to words relevant to the content, relating sentences to one another, formulation of what is said according to the present topic, making inferences, making mental images, filling in possible gaps during the conversation, observation, and interpretation of the body language, prediction of where the discussion is going, and planning for possible replies. Much of this, if not all, takes place under the surface of consciousness. Consciousness goes beyond mere awareness [39].

The issue is related to embodied cognition in that the existence of the cognitive unconscious provides us with a refutation of theories of cognitive representations, according to which consciousness is separate from the body [33]. The argument against the representation theory is reinforced by the fact that the unconscious mind is embodied and conforms to bodily structures and sensory-motor experiences. The argument against the representation theory is reinforced by the fact that unconscious is embodied and conforms to bodily structures and sensory-motor experiences.

8. Conclusions

In conclusion, this paper has examined the intricate relationship between cognitive science and embodied cognition, shedding light on the transformative philosophical insights and their profound implications for our understanding of the mind-body connection. The central theme that unites these various strands of thought is the rejection of the traditional, transcendental view of the subject, replaced by the concept of an embodied subject actively engaging with its environment to shape consciousness and cognition. This shift in perspective challenges classical epistemological theories and opens new avenues for inquiry.

We have traced the historical evolution of these ideas, from the early days of cognitive science rooted in analytic philosophy to the groundbreaking work of Rodney Brooks and others in the field of artificial intelligence. We delved into the contributions of scholars like Agre, Chapman, and Dreyfus, as well as the role of cognitive metaphor and the concept of the cognitive unconscious in shaping our understanding of embodied cognition.

The implications of embodied cognition are profound. This perspective suggests that the mind is not isolated from the body but intimately tied to it, with cognition emerging through interaction with the environment and perceptual experiences. It challenges reductionist notions, providing a fresh approach to the mind-body problem by demonstrating that mental states cannot be reduced to brain states alone.

Furthermore, functionalism and its relationship to computational states of the brain have been explored, illustrating that mental states can be understood in the context of the mathematical notion of function. This broader perspective allows for the recognition of different systems exhibiting similar functions, despite differences in their types.

To move forward, future research in this field could focus on exploring the practical implications of embodied cognition for fields such as artificial intelligence, robotics, and psychology. Additionally, investigating the intersection between cognitive science and various branches of philosophy can provide valuable insights into the nature of consciousness and cognition.

In essence, this paper has provided a comprehensive overview of the evolution and implications of embodied cognition, laying the groundwork for further research and fostering a deeper appreciation of the profound shifts in perspective that this theory brings to our understanding of the human mind.

9. Suggestions for Further Research

Embodied AI: Investigate how the principles of embodied cognition can be practically applied to artificial intelligence, robotics, and human-computer interaction to create more efficient and human-like systems.

Philosophical Implications: Explore the philosophical implications of embodied cognition in more depth, particularly how it challenges classical dualism and reductionism.

Neuroscience and Embodiment: Dive deeper into the neurological basis of embodied cognition, examining how brain-body interactions influence cognitive processes.

Cross-Disciplinary Approaches: Encourage interdisciplinary collaboration between cognitive scientists, philosophers, and AI researchers to advance our understanding of embodied cognition and its broader applications.

Educational Psychology: Investigate how the principles of embodied cognition can be incorporated into educational practices to enhance learning and memory.

These suggestions can guide future research endeavors and contribute to a deeper understanding of the multifaceted relationship between cognitive science and embodied cognition.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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