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To What Extend Do Abstract Concepts Can Be Understood Through Embodied Cognition

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Abstract

Embodied Cognition is a relatively new and revolutionary idea in the field of cognitive sciences. EC means that there is a strong connection between physical experience and mental state. To be more specific, one's physical experiences will activate mental sensations and vice versa. What's more, in this paper, we will review how abstract concepts can be understood through embodied cognition.

Keywords

Embodied Cognition; Abstract Concepts; Metaphor; Emotion; Situating.

1. Introduction

Embodied Cognition means that the body and mind are not just connected but the mind is affected by the body and what happens to the body, In general, Embodied Cognition illustrates that human cognition and human bodies are interacting with and influencing each other. It focuses on the bodily aspects of an agent and their impacts on cognition. The view of EC opposes the traditional opinion that "Cognition is computable." The cognitive process is similar to the processing process of computer, which can be also regarded as the processing and manipulation of information. Though computers and the human brain have different structures and motivations, both of them have computation functions. The computer carries out symbolic computation according to the logical rules set by people, while the cognitive process is based on the rational rules acquired by people. The processing and operation of the information is actually a computational process. Therefore, "the essence of cognition is computation". Traditional view differs from the EC, since it holds that although cognition is performed in the brain, it is an independent part of the body and functions independently. However, EC claims that cognition includes one's body part, brain. What's more, how abstract concepts pose a challenge to the theory of embodied cognition? This claim has been challenged because abstract concepts, in contrast to concrete concepts, abstract concepts, are something that we cannot perceive by senses or act; however, senses or act is the foundation of EC theory. To be more specific, concrete words refer to non metaphorical concepts, and they are those concepts that come from people's experience and can be defined as a certain term. However, metaphorical concepts are those which cannot be understood and defined by their own terms. The understanding of these concepts need the help of other non metaphorical concepts [1]. So, how to understand abstract concepts by EC theory becomes a problem. This work is going to examine the relation between the abstract concepts and the EC theory and propose a solution to the problem.

In this paper, we will review how abstract concepts can be understood though embodied cognition. There are three main theories that try to address the problem of abstract concepts and the embodiment of cognition. (Matheson and Barsalou, 2018). [2] The first one suggests that abstract concepts are grounded by metaphorical mapping of an abstract domain [3]. The

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second theory explains the abstract concepts as grounded by emotional or interoceptive states [4]. The third theory suggests that abstract concepts are grounded by events and situations [5].

1.1. Metaphor Theory

The philosophy of metaphors recycles meaningful language to express abstract ideas (Casasanto, D, 2020, Human Brain and Mind). The metaphor words always go beyond the actual literal meaning of the words. Metaphorical concepts are those terminologies that have been comprehended or established. A metaphor can serve as a vehicle for understanding a concept only by its experiential basis. The use of the A is B formula to explain metaphors as isolated instances ignores the fact that no metaphor can be interpreted, or even sufficiently described, independently of its experiential basis [6]. Most of the metaphor is understood by its experience. There are three kinds of metaphorical concepts which indicate a great amount of language expression: 1) orientational metaphors, which suggest linear orientation of these structure principles with reference to non-metaphorical linear orientations; 2) the projection of object or material status to someone that does not have that status implicitly requires ontological metaphors; 3) in terms of some type of experience or action, systemic metaphors include arranging one kind of encounter or activity [6]. An example of an orientation metaphor is someone who has control over others or in an outstanding position. In this case, if individuals are in control of someone or an organization, governors are more likely to stay in the upper position. An example of ontological metaphors is that the mind is tankage. Even though the inside of the brain contains many organs without any apparent meaning, it has many glamorous ideas. In addition, structural metaphors mention the importance of personal opinion. From a different personal perspective, life is a big playground, and it combines with many elements from daily life. The abstract concepts represent the untouchable or unseen stuff; meanwhile, the simulation based.

In the experiment of the neural evidence from both hands, right-handers activate the left premotor cortex during lexical divisions on manual-action verbs, and the left-handers activate right premotor areas. The experiment tested the relationship among different handedness comprehension about verb meaning during the determination of vocabulary tasks on manual and non-manual verbs. During a lexical-decision task, our key study examined a three-way relationship between handedness, hemisphere, and verb form using manual-action and non-manual action verbs in subject-specific ROIS within the premotor cortex. We separately evaluated whether the action is manually to responses and confirmed that this three-way interaction was guided by the expected difference in the manual-action response. During the mental-imagery task, the control task data was analyzed using a method similar to the lexical-decision task. Both comprehension of the whole-brain analyzed and full discussion of the mental imagery data are out of the range of this research and will be published somewhere else. Due to clear imaging, the ROI analysis findings for the imagery task are mainly reported here as a control for activation during the linguistic task [7]. As a result, if the metaphor theory is correct, the right-handers activate the left premotor cortex, whereas left-handers activate the right premotor areas. On the other hand, in "Metaphors We Learn By: Directed Motor action Improves Word Learning," there are three experiments to indicate improving memory strategies. After researching them, in the first experiment, where to put vocabulary flashcards in metaphor-congruent positions will help respondents learn the meanings of terms of good and bad emotional valence. Overall, the motor actions that participants performed during encoding had a very substantial influence on their realization memory, based on an collective separate impact on binary logistic retrogradation with subjects and objects as repeated random variables and the encoding state as a vector quantity [8]. In the second experiment, the intention of the second experiment was to expand the use of mental metaphors to a wider range of vocabulary. Participants were asked to react either a positive or negative correlation with

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each word and put them in the right locations based on the connections. In the third experiment, the test tends to prove if the word up or down can represent the same meaning as good is up or down. In fact, both the first and second experiment didn't offer strong evidence that motor actions impact the memory or thinking up or down. However, the outcome of the third experiment pointed out that motor actions played a significant role in enhancing or deducting memory. These findings include a first demonstration that mental metaphors can be triggered tactically to promote (or fix) word learning if the metaphor hypothesis is correct: we call this the strategic use of mental metaphor influence [8]. In addition, when people think metaphorically, it is activating source-domain representations when thinking target domains, that is, using non-linguistic mental representations in source domains when constructing non-linguistic mental representations in target domains (Casasanto, D, 2020, Human Brain and Mind)

Additionally, metaphor theory plays a critical role in the experiment of morals. It tends to prove when participants do evil things, the mouth will taste awful. The expression of its idea is when we record facial EMG data while participants try to drink some flavor liquids such as bitter, salty, and sour [9]. It's said that the action leads to the activation of the bitter taste in the mouth. Like taste or drink may lead to an unpleasant odor in the mouth, we recorded EMG data from the levator labii region while participants viewed photographs of dirty and pollution-related disgust stimuli, including excrement, wound, bugs, etc [9]. Both sensory and vision unpleasantness can lead to sour in the mouth. As an overview of the experiments, it tends to prove that bad action leads to a bitter taste in the mouth. Indeed, the metaphor theory exists under this circumstance and it is how we process the abstract concepts.

Of course, metaphor theory has some negative effects on the aspect of ideas. Each of them describes some facets of an idea's concept; however, these metaphors together do not provide a cohesive description of an idea's concept [6]. The contradictions between metaphors are in certain situations, cases in which properties and functions are contradictory. Yet in other ways, the contradiction is far more radical [6]. Unsurprisingly, inconsistency in metaphorical theory is a problem for running the properties or functions of an experiment. Besides, mental metaphor contains target domain and source domain, those domains include raw feelings, perception, actions. Indeed, none of these are touchable, and it provides the abstract idea. Nowadays, when unrealistic things appear in the real world, people may have a hard time to deal with it and make mistakes. On the other hand, it's hard to comprehend when news or papers contain abstract elements for the audience to read.

1.2. Emotion Theory

The second theory is the abstract concepts are actually grounded by emotional interoceptive states [4]. Also, Kousta et al. (2009, 2011) [10, 11] demonstrated that abstract words influence more emotional aspects than concrete nouns. Recently, many research has demonstrated the interconnection between emotional and cognitive processes in human functioning [12]. Several emotion theories were proposed that hypothesize abstract concepts can evoke more emotions than the concrete concepts [11]. These theories emphasize affective experience and emotional development for abstract concepts, accordingly suggests emotions contribute to offering a bootstrapping mechanism, by which the involvement of the feeling process provides human abstract concepts [4]. Emotion theories generally adopt a dual process theory as the framework. A dual process theory hypothesizes that there are two different types of emotion processing, which include the automatic process and controlled process. People might have automatic affective reactions that direct their quick reactions with no specific requirement of cognitive effort. According to Jacoby (1991) [13], automatic processes may contribute to some extent to the choice of the correct answer because it involves people's unconscious behavior. More importantly, the finding of the correct answer requires individuals to engage in deeper

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thoughtful reasoning about their emotions. Although the role of automatic processes has not been fully revealed, most people agree for the automatic component in emotional experience [14].

Despite that the problem of emotion concepts is always associated with more general questions about the nature of emotion. Emotion theories in this field mainly focus on their role for somatosensory, interoceptive and motor content (Ebisch et al., 2008) [15]. In the past, people held the belief that they acquire abstract cognition through self perception of bodily state [16], more recently people tended to focus on neural resources, suggesting emotions involve a cascade of events with somatosensory wheres motor resources recruited at multiple time points in perception, understanding, experience and production [17]. Large amounts of studies have emphasized metaphor when understanding emotion concepts. According to Lakoff and Johnson (1980) [1], abstract concepts are grounded metaphorically in embodied and situated knowledge. In other words, people gain knowledge about their bodies (e.g., eating) and situations (e.g., verticality), and that abstract concepts draw on this knowledge metaphorically. Previous studies have demonstrated that acquisition of emotional abstract concepts would be easier than neutral abstract words, whereby linking abstract concepts to embodied cognition.

On the basis that the body plays a role in human cognition, the grounded cognition was proposed to explain the cognitive effect caused by bodily states. Based on this theory, the brain can create cognition if working together with modal representations, therefore the examination of grounded cognition significantly depends on simulation in cognition. People subjectively experience their emotions when imaging, during which they are able to acquire abstract concepts. While grounded cognition demonstrates the significance of somatosensory and motor resources in conceptual processing, accordingly offers useful insights into emotion concepts, the context-dependent embodied simulation model [18] emphasize the contextual factors that predicts the correlation between concepts and somatosensory resources, suggesting concept-sensory resource relation can be dynamically shaped when a specific text is given. Based on the context-dependent embodied simulation model [18], embodied simulation is able to produce triggers when semantic processing accesses the tasks. people tend to attach meaning to emotional sentences in their representation such as ‘every time she thought about that day, she felt very happy’. Obviously, emotion concepts contribute to illuminating the larger issue of the representation of abstract concepts. For instance, Kousta et al. (2011) [11] has indicated an advantage in lexical decision of abstract over concrete words when imageability and contextuality are manipulated, while the similar results were also demonstrated by Schwanenflugel (1991) [19], highlighting a strong association between contextual knowledge and abstract words. Moreover, based on Harris et al. (2003) [20], people tended to show affective reactions when they read inappropriate words, especially if the words are their first language. Based on the results of these studies, the representation of concept is tied with relevant situational context. Specifically, emotional states contain either internal or experiential components in which people might develop a specific feeling or experience an appearance change when they are in these states [21]. For instance, fear can make people feel cold inside their body, with some uncontrollable rhythmic movements such as trembling being expressed. Based on the finding that emotions are related with action, many studies were conducted to investigate the role of context in approach and avoid behavior. In other words, what determines people’ s automatic reaction when stimuli are given. Empirical evidence showed that specific adaptive actions were triggered by affective stimuli spontaneously.

Besides the fact that grounded cognition has supported the various facts of the embodied cognition, but still this theory is not without much criticism. Firstly, it has raised very few issues and there is no scientific evidence for the neuroimaging research that shows that modality specific activations have more importance than simple activation. Secondly, the grounded concept has been criticized for being the typical and will only be embodied to those concepts

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which have already been experienced. Finally, they are being criticized for lacking in computational research.

Based on the analysis of existing research, it is undoubted that adding emotional meanings on an abstract concept ensures the representation of the concept. Future studies should focus more on the other aspect of abstract concept, in the hope that the similar results would be obtained.

1.3. Situating Abstract Concepts

The final possible solution of the challenge is that Barsalou & Wiemer-Hastings(2005) [5] suggests that abstract concepts are grounded in events and situations and therefore are more temporally spread out than their concrete counterparts [2, p20]. Therefore, in any actual situation, all of this content—concrete and abstract—is perceived at the time of processing. In principle, there is no reason why they cannot be re-enacted later [5]. The remaining problem is that, does the content of perception individuals perceive differently in concrete and abstract concepts?

It is always tricky when individuals try to consider a specific situation of an abstract concept occurring. Without situation availability, concrete words do a better job in lexical access [22], word comprehension [23] and memory [24]. In contrast, once relevant situations are present, abstract concepts can be processed and remembered as well as concrete ones. That is because abstract concepts are used in a much broader range compared to the use of concrete concepts, such as truth. We can tell from the experiment that, first, the meaning of the concept is not a construction with a stand-alone set of descriptive characteristics. Situations provide much vital information in understanding of words, for example, the setting of the place in which it is found, the activities of which it is used, etc. Thus, the perception of the situation often becomes central to the representation of concepts [5]. Second, due to the more various use of abstract concepts, retrieving situations for abstract concepts may be more challenging than concrete concepts. Also, once individuals are processing abstract concepts, a relevant case may already be in place usually rather than there are situational vacuums. However, when processing abstract words in isolation, individuals may not precisely draw a blank. Krauth-Gruber et al.(2004) [25] suggest that, when there is any situational information, individuals tend to perceive a concrete word with representing its imaginary image, while an abstract concept is perceived by the associated terms initially. There is no situation that could come to mind immediately, and an abstract concept may activate associated information when being processed. Highly associated words with only surface-level phonological information often are triggered, then associated words could trigger a minimal level of conceptual information [26, 27].

Once we are aware of how crucial situational information for abstract concepts is, we can see how different types of concepts interact with situation information in Barsalou & Wiemer-Hastings (2005) [5]. First, as we have known that the perception of the situation often becomes central to the representation of concepts. For representing both concrete and abstract concepts, individuals need to recognise the related agents, settings, introspective states (e.g. affects, drives, cognitive operation), physical events, etc. Thus experiment indicates that shared situational content (including entities, settings, introspection, events) is created across both concrete and abstract concepts. Second, Concrete and abstract concepts tend to have different foci on and emphasise various aspects of situational content (also see [28]). The focus for concrete concepts is on the object/action itself and its properties, even though introspective and situational information also exists in the representation. Reversely, the focus of abstract concepts is distributed across introspective and situational information. In addition, the experiment suggests that as concepts being more abstract, the structure describing them involved with more complexity.

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Now we can have the conclusion that: concrete and abstract concepts share situational content with different situational foci. Getting back to our remaining problem, does the content of perception individuals perceive differently in concrete and abstract concepts? Individuals perceive the immediate space around them at any moment, even while they are paying attention to a specific entity or event in the situation, the perception of the background situation never disappears. On the bases of perceptual experience takes the form of a situation, at the same time a conceptual representation simulates perceptual experience; thus, the form of a conceptual representation should take the form of a perceived situation [5, p157]. Then abstract words may activate particular concrete situations that are examples of the concept or that provide a context for the concept. Once individuals establish a simulation to represent a specific category, no matter concrete or abstract concepts, they may tend to consider the variety in associated perceptual situations rather than in isolation.

There are only a few researches that can indeed validate situating abstract concepts. Pecher (2017) [29] suggests comprehensive critics of situating abstract concepts in embodied cognition. One argument may be that many details of specific situations are irrelevant for abstract concepts which elicit simulation (e.g. the environment of the park is not very vital to the concept of friendship when talking to a friend). Also, when processing abstract concepts, individuals tend to rely on irrelevant superficial characteristics of earlier problems (e.g. if the probability problem about cars was attributed to mechanics). Furthermore, the ideas that abstract concepts are rooted in way of the manifestation of concrete concepts which comprise situational information bases on the hypothesis that concrete concepts are necessarily grounded in the sensory-motor system. However, the necessity remains doubtful. On account of sensory-motor systems being essential for cognition, cognition is expected to undergo impairment if those sensory-motor systems are engaged in a secondary task. Results from dual-task paradigms research are mixed (e.g. [30-34]), thus doubt has casted on the necessity of sensory-motor systems for both types of concepts.

2. Conclusion

In conclusion, currently Metaphor Theory as the mainstream explanation of understanding abstract concepts through Embodied Cognition, suggests that it uses concrete words to describe abstract ideas. We have several supportive pieces of evidence throughout the experiment. However, these metaphors taken together do not provide a consistent definition for the concept of an idea. Meanwhile, other two theories are introduced in this review paper to interpret abstract concepts in Embodied Cognition. As Kousta et al. (2011) showed in Emotion Theory that, once a large number of factors are controlled, abstract words are processed faster than concrete words because of their greater affective associations. But there is no scientific evidence to encourage this theory. The embodied responses do not always appear to be necessary to perceive or understand affective information. The last theory - Situating Abstract Concepts indicates that individuals perceive abstract concepts through the simulation of the situation or events. However, the supportive evidence is also lacking. The critics are widely distributed. A noteworthy point is that it is doubtful whether the sensory-motor system is essential for concepts. This makes the idea of using Situating Abstract Concepts to understand abstract concepts through Embodied Cognition unavailable. All of these theories provide the ground of abstract concepts and indeed address the challenges somehow, but the lack of further research and validation are needed. Thus it is hard to say which one is the true answer, but the answer may exist in all three perspectives at the same time. Further research can make an effort on how these three views contribute to understanding abstract concepts through Embodied Cognition together.

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