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Solutions to the Problem of Abstraction: Review and Criticism

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ABSTRACT
Under the structure of embodied cognition, this theory suggests that in human conceptualization, modality-specific areas such as the visual cortex are involved in understanding concepts. This indicates the role of bodily experience in conceptual processing, hence supporting the view that human cognition is embodied. However, abstract concepts posted a challenge for embodied cognition: as people cannot physically act upon abstract concepts such as love and grief, how can people conceptualize those concepts? Consequently, in this paper several possible approaches to this question are discussed: metaphor approach, action approach and situated simulation approach. Review of these approaches would be accompanied by evaluation of current researches, and further experimental suggestions would be given to better assess the validity of these proposals in establishing the embodiment of abstract concepts.

Keywords*: Abstract Concepts, Embodied Simulation, Conceptual Metaphor, Action Approach, Situated Simulation*

1. INTRODUCTION

Embodied cognition has proposed that bodily simulation plays an essential role in conceptual processing. It is suggested that human conception is, at least partially, based on modality-specific brain areas responsible for physical actions, and thinking is characterized by simulating bodily states. For example, when people think of the concept "kicking", they might simulate the actual action of kicking a ball using their motor cortex to assist their understanding. Therefore, the theory of embodied cognition suggests that embodied simulations are fundamental for creating meanings.

However, unlike concrete concepts such as "kicking" which people can physically act upon, there are also abstract concepts that are not physically practicable. For example, the emotion "grief" is an abstract concept that people cannot create bodily experience with, as people cannot physically interact with grief. Therefore, as the essence in conceptualization is embodied simulation, abstract concepts become a challenge to the embodied view of cognition. As a result, this review paper would be focusing on the potential solutions of the problem of abstraction from three perspectives: metaphor approach, action approach and situated simulation approach. Definition and experimental evidence of these approaches would be discussed, and evaluation would be conducted on every approach. Furthermore, future suggestions on possible improvement would be proposed as supplementary references.

2. REVIEW & FURTHER SUGGESTIONS

2.1. Metaphor Approach

The proposal of metaphor theory in conception is mainly discussed and supported by George Lakoff and Mark Johnson. It is suggested that "abstract concepts are defined metaphorically in terms of concepts that are more concrete and more clearly structured on their own terms." [12] Metaphor theory suggested that when interpreting abstract concepts, a correlation is created between bodily experience and cognitive interpretation. A cognitive mapping is created directing from the source domain to the target domain to understand abstract concepts. For example, in Lakoff & Johnson study, they've categorized metaphorical concepts into orientational metaphors (more is up, etc.), ontological metaphors (the mind is a container, etc.) and structural metaphors (understanding is seeing, etc.). [12]

Therefore, it is concluded that conceptual metaphors are used to understand abstract concepts.

2.1.1. Evidence for Metaphor Approach.

The Conceptual Metaphor Theory (CMT) proposed by Lakoff and Johnson has gained much attention and support in cognitive science. There are numerous studies supporting the view and based on this theory, more advanced viewpoints are proposed. For example, in the study "Time in the mind: Using space to think about time" conducted by Daniel Casasanto & Lera Boroditsky in 2008, the asymmetry between mental representation of space and time was proven by psychophysical experiments that participants were asked to reproduce duration or spatial displacement after viewing lines or dots. The asymmetrical relationship was revealed that the distance estimation affected the temporal estimation more. Therefore, the metaphorical relationship between space and time was established beyond linguistic level in this study. [5] Additionally, behavioural studies were also conducted to investigate the metaphorical relationship between physical experience and conceptual processing based on CMT. The study conducted by Michael L. Slepian & Nalini Ambady tried to illustrate the effect of novel metaphors on conceptual processing. By implanting the recognition that "the past is heavy" or "the present is heavy" in the participants, the study indicated that the metaphor between time and weight would influence participants' estimation of objects' ages and physical weight. Therefore, the bidirectionality of sensorimotor processing and conceptual processing was also supported in this case. [15] Conclusively, there exist many studies trying to establish the important role of metaphorical thoughts in processing abstract concepts. However, these studies might have limitations in testing the embodiment of metaphors, and this would be further discussed in the next section.

2.1.2. Challenge for Current Evidence.

In this paper, the proposed major limitation for current studies on CMT is that there is limited evidence in the "embodiment" part of metaphorical thoughts. The concept of embodiment, according to Lawrence Baraslou in his paper "Perceptions of Perceptual Symbols", refers to the fact that thinking involves constructing simulation of bodily states. [1] These bodily states are instantiated in heteromodal areas in the brain, and representation of concepts would be accomplished with the activation of these areas in embodied simulation. To be specific with the metaphor theory, the bodily experience as a source domain when interpreting metaphorical thoughts should be measured and reconciled with the abstract concepts as the target domain. However, many studies failed to assess this relationship, such as the behavioural study mentioned above. It is not saying that behavioural studies are completely irrelevant to the establishment of metaphor theory, the way that people think metaphorically is actually well illustrated in results of behavioural studies. However, in order to measure embodiment, assessment of modality-specific areas must be included and correlated with the experiment to see if metaphorical thoughts do evoke sensorimotor simulations in human brains.

2.1.3. Further Suggestions for Metaphor Approach.

Referring back to the proposed limitations of many behavioural studies failing to assess embodiment, "it is only by testing for activity in modality-specific brain areas that embodied and amodal theories can be clearly distinguished; only modality-specific brain areas are useful for testing the embodied simulation hypothesis." [6] Therefore, to actually assess modality-specific areas activity to prove embodiment in metaphor approach, measurements of brain activation are required. As a result, brain-scanning machines such as Functional Magnetic Resonance Imaging (fMRI) might be involved in laboratory experiments. For example, when trying to assess the metaphorical thought "understanding is seeing", the visual cortex should be activated if there is an embodied metaphor in people's conceptualization of the abstract concept "understanding". In this sense, new experiments should be modified in the way that when participants make metaphorical expressions such as "I see what you mean", activation of the visual cortex should be detected to prove that there is actually embodiment in the structural metaphor "understanding is seeing". This goal could be possibly accomplished by using functional imaging techniques of the brain such as fMRI or EEG when assessing the mapping of concrete source domain to abstract domain in people's conceptualization of abstract concepts.

2.2. Situated Simulation Approach

The second approach trying to interpret the problem is the situated simulation theory [1]. According to Barsalou, simulation is the re-enactment of perceptual, motor and introspective states acquired during experience with the world,body and mind [2]. There are two phases of the re-enactment process: (i) storage in long term memory of multi-modal states that arise across the brain's system for perception,action and introspection. (ii) partial re-enactment of these multi-modal states for later representational use, including prediction. As described by him, the theory argued that concepts are not typically processed in isolation but are typically situated in background settings,events and introspections, that is to say, situated simulations.

2.2.1. Evidence for Situated Simulation Approach.

Empirical evidence of this approach is provided by feature generation experiments. In the study [4], participants were asked to freely produce properties of three abstract concepts, three concrete concepts,and three concepts intermediate in abstractness. Two core findings were reported : (i) conceptual content of abstract concepts is drawn from events and introspections, and that this content can be simulated in relevant modality-specific systems. (ii)when generating properties for abstract and concrete concepts, people produce situated content for both, but abstract concepts contain more content about people, social interactions, complex relations and introspections.

2.2.2. Evaluation for Situated Simulation Approach.

Based on the research, the first issue to be discussed is the problem of core knowledge. As mentioned by the author, core-knowledge view believes that a concept is like a dictionary or encyclopedia entry that attempts to define a category with a centralized summary representation. Thus, it argues that the properties produced in the task are relatively peripheral to the so-called 'core content' of the concept. In response, authors cited some empirical findings suggesting that the exact definition of concepts are almost difficult.[17] As for the paper's view, people use a multitude of situated representations to process a concept, and because they differ in goals, values and relevant experiences, these situations not only exhibit universal content including entity, setting, event, but also personalized content like beliefs, opinions and episodic memories. From this, we infer that the combination of situated representations of a specific concept differs from individuals, and for a certain individual, the content would probably change as his beliefs, opinions or episodic memories change by time. Then we can conclude that the combination of situated simulations are personalized and dynamic. According to Barsalou, a concept's core definition might be established when people repeatedly sample from situations in memory. However, since it is impossible to define a concept by telling the specific number of situated simulations, then to what extent can we say that a concept is defined? Is there a boundary for a concept's meaning? How can we find it out? These questions suggest a different direction for further research. In later experiments, it might be useful to have participants produce content based on a given specific situation, or ask them to describe different situations as much as possible.

Another element needs to be noticed is the introspective information. As described, “introspection” refers to internal states that include affect, motivation, intentions, meta-cognition, etc. In this study, researchers simply assumed that the presence of introspective content in conceptual representations does not constitute evidence against embodied theories of knowledge because there was no evidence that introspective content could not be simulated as part of a conceptual representation. However, as the research observed, abstract concepts contained more content involving introspections, which means that this kind of information plays an important role in our understanding of abstract concepts. From a historical view of Psychology, many scientists have suggested that this information cannot be used naively. It is relatively difficult to detect and clarify the true internal states of individuals. Even when people give confident descriptions of their mental processes, they are probably still being totally “unaware of their unawareness”. Further researches should also focus on deeper investigations about introspections.

Finally, as described above, this experiment is a behavioral study and the properties produced by participants are products of conscious mental process. However, to prove the embodiment, further research should focus more on unconscious processes, and provide neuroimaging evidence of the situated simulation theory.

2.3. Action Approach

Another approach states that the comprehension of abstract events is based on actions. The indexical hypothesis (IH) is one essential theory in this approach, asserts that sentences are understood by creating a simulation of the actions that underlie them [7]. The term was first proposed by Glenberg & Robertson, 1999, suggested that reference to a physical situation, not a description, is needed to understand some language. In IH, there’re in total three processes to understand an event sentence, that are recognizing perceptual symbols, mentally generating their affordances, and then mesh the affordances under the guidance of syntactic constructions [8] to see whether the event in the sentence can be true. Action approach contains the term of “action schema”, in which different events, including concrete and abstract ones, can be understood by simply modify the key verb, direction and the object [7].

2.3.1. Evidence for Action Approach.

Glenberg (2002) did an experiment aiming to provide empirical evidence for IH. In the experiment, participants were asked to judge the sensibilities of sentences by pressing buttons. There’re three buttons, near, middle, and far to the participant. A sentence will be presented after participant press the middle button, and participant should press another button (near or far, depend on the experimental condition), if they believe it make sense. Glenberg (2002) found that when the implied direction

of the sentence (toward self or away self) is consistent with the acting direction of pressing buttons (from middle to near or from middle to far), the reaction time is less than when it's inconsistent. The result apply to both concrete and abstract event sentences. Glenberg (2002) concludes this result support the IH and report this phenomenon the action–sentence compatibility effect (ACE).

Glenberg (2008) demonstrates later in his paper the concept of action schema. It was expected to further develop the action approach and explain the bullet point of why the implied direction of abstract events such as "I told Liz the story" can be reflected by concrete event direction of moving hands and pressing buttons. In the action schema theory, the linguistic material is grounded in motor processes, but not necessarily by direct simulation [7]. For example, in the process of learning the concept of transfer, children learn the linguistic encoding of transfer actions almost exclusively with the verb "to give" [10][16]. To be specific, the event of transfer was encoded as the action of get the object, force of transferring (passing, throwing, handing, etc.), and direction or target of the transfer. The schema is a structure that can fit to any concrete or abstract event by simply change the key word.

2.3.2.External Evaluation for Action Approach.

Although the researchers put so much effort to support the theory and it may seem to make sense at the first glance, action approach triggers much less attention and discussion now than metaphor theory and the situated simulation theory of abstract concept, because it has some apparent weaknesses.

To begin with, the ACE they found was only demonstrated for three sentences types: imperative sentences, sentences describing the transfer of concrete objects, and sentences describing the transfer of abstract entities [8]. This means the scope of the evidence is limited in particular range of language, and the researcher haven't published new evidence to extend the scope. Even if IH does work, it only works for a few types of sentences.

More importantly, the action approach is considering to be similar, or even belong to metaphor theory, as in its evidence and analysis, concrete action can be triggered to represent abstract event as in the experiment. Such doubt is fatal to the theory of action approach.

2.3.3.Further Suggestion to Action Approach.

According to the author, action approach may still work for part of the language, and can be distinguished with metaphor theory. The point is in the action schema, abstract event cannot be directly represented by concrete event, but through a common used core concept, which is the foundation of both the events. Let's again take and "telling the story" as and example. The two events share a core concept of transfer. When seeing a sentence of "I told the story to Liz", a person rapidly response to the words and understand the core concept of "transfer from me to another" implied by the sentence. As the event of handing things to others is also included in the core concept of transfer, which involves the action of moving hand away from the body, participants in Glenberg's study perform to move their hand to press the far button quickly when seeing the sentence of "I told the story to Liz."

How was the core concept established? We believed that people cannot understand these core concepts that are multifunctional for support different concrete and abstract events in the infancy. Instead, they learned the concepts by experiences of actions relate to it. For example, when a boy passing a toy to his friend, or delivering food to his pet, these actions continuously reinforce his understanding of the core concept of "transfer from me to another", thus the core concept is gradually established. After that, people can relate different events of "from me to others" together based on the same core concept.

However, such idea lacks of empirical evidence, so further experiment should be developed. Moreover, more questions are revealed with this idea: should this still be called the action approach because the establishment of core concepts based on actions? More importantly, in the metaphor theory, does abstract and concrete things directly relate to each other without present of core concepts? Further discussion will be needed.

3. PHILOSOPHISCAL DISCUSSION

The philosophical origin of embodied cognition seems to be Schopenhauer. According to him, the body is the bridge that connects the Wille and the Vorstellung. Based on his idea, can we boldly imagine that once we find experimental evidence that abstract concepts are embodied in future research, we will be able to confidently declare that we have made an empirical interpretation of Schopenhauer's theory in the view of cognitive psychology? People's cognition of the world is embodied. Does this mean that the body constricts the domain of human cognition? Is human cognition bounded? For example, the body in three-dimensional space determines that we can never understand four-dimensional space, even if it exists and is around us. Is our will free? Is it possible for us to break through the limitations of the body and recognize the world?

4. CONCLUSION

In this paper, we reviewed previous literature about the abstract concept challenge to embodiment and possible solutions to that challenge. We specifically

discussed about the metaphor theory. We then reviewed and evaluated two alternatives to it: action approach and situated simulation approach. In addition to revise researchers' idea, we also suggested own opinions to the theories. To conclude, every theory have own weaknesses and further research is required to answer the questions and solve the puzzle.

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