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Embodied Metaphor Processing in Second Language Acquisition: Proficiency-Driven Mechanisms

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Abstract: This research investigates how second language (L2) learners engage in embodied processing during metaphor comprehension, and the modulating role of language proficiency, within the theoretical framework of embodied cognition. Embodied cognition theory claims that conceptual understanding, particularly of abstract concepts, is grounded in sensory-motor interactions with the physical world. The study involves 30 L2 English learners from Beijing International Studies University, stratified into high and low proficiency groups based on CET-4 performance. Participants evaluate 16 metaphorical sentences with embodied semantics. Statistical analysis via independent sample t-test reveals a significant proficiency effect. Qualitative interview data corroborates these findings, underscoring proficiency as a pivotal factor of embodied processing. These results affirm the applicability of embodied cognition to L2 metaphor comprehension, advocating for pedagogical strategies that leverage sensory-motor activities for learners.

Keywords: embodied cognition, language proficiency, metaphor

Introduction

Metaphor provides linguistic mechanism to construct the framework for concreting the abstract idea by the source domain and rendering it into the tangible one^[1]. Typically, the association between the target domain and source domain is not arbitrary, instead, it is built by the sharing ground like sensory experience. For instance, in "grasping the ball", grasping is an action of holding objects with fingers physically. However, in "grasping the idea", obviously, the same verb undergoes a shift, now signifying the act of comprehending a concept clearly. In physical grasping, exerting force to bring an object under control corresponds to using cognitive effort to bring a concept into a state of understanding in cognitive comprehension, transforming the abstract cognitive process into a perceivable framework based on bodily experience. The theory of embodied cognition posits that perception holds significance in conceptual learning by highlighting that knowledge arises from real and dynamic interactions between the body and the physical environment^[2]. The source domain concretizes the target domain in a sensory-motor form. A great deal of research primarily focuses on the investigation of embodied metaphors in native languages. The graded salience hypothesis claims that the processing of metaphors is influenced by lexical exposure and conventionality^[3]. The more familiar the semantics, the less pronounced the embodied experience becomes. However, regarding the processing of embodied metaphors in a second language, few theories definitively describe whether learners directly access semantics or rely on sensory experiences. The present study addresses this gap by investigating whether L2 learners exhibit embodied processing when comprehending metaphors in their second language, with a focus on sentence-level metaphorical expressions. Its findings inspire evidence-based L2

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This work is licensed under the Creative Commons Attribution International License (CC BY 4.0). http://creativecommons.org/licenses/by/4.0/ teaching practices and pave the way for future research into the interplay of embodied cognition and language acquisition in multilingual contexts

1. Literature Review

1.1 Metaphor from an Embodied Perspective

Lakoff and Johnson proposed that conceptual metaphors are based on the similarities between the source domain and the target domain, enabling abstract concepts to be described in a way that is understandable to people^[4]. Usually, abstract concepts do not have a specific referent in life, which makes it impossible for us to physically touch or perceive them. The amodal theory emphasizes that people transform perceptual information into abstract linguistic symbols and store them in memory. These symbols are not limited to the same area of the brain; instead, they involve cross-modal processing. For example, when we see an incomplete apple shape, we will rely on the occipital lobe, which is responsible for visual processing, to conceive the complete shape of the apple. At the same time, the hippocampus, which is related to memory, may also be involved in this process as we think about what the complete apple we have seen in the past should look like. Also, the Dual Coding Theory mentions that the process of human cognitive information includes visual imagery and associated texts^[5]. When the human brain retrieves information about a certain concept, it will comprehensively retrieve visual information as well as linguistic information. However, according to Barsalou's viewpoint, abstract concepts bear unique neural representations^[6], that is to say, there is a direct correlation between abstract concepts and sensory-motor experiences. Existing empirical studies have used concrete, sensory concepts such as space, taste and temperature to construct abstract concepts like emotions and power^[7]. For example, when positive emotional words are presented at the top of a screen and negative emotional words at the bottom, participants' reaction times are shorter compared to other conditions. Additionally, some studies have asked participants to make association ratings between "happiness" and "sweet," or "sadness" and "bitter." The results show that the association rating task supports a direct relationship between taste and emotion.

1.2 Access to Metaphor in Second Language

For second language learners, the acquisition through embodied experiences and interactions with the objective world does not occur as naturally as it does for the native. Instead, they mainly acquire the second language through linguistic symbols in the classroom. Therefore, there is also controversy regarding how second language learners process abstract concepts. Relevant research has been carried out starting from spatial words. For example, the reaction times of participants with German as their L1 and L2 were observed through the Stroop paradigm. The results showed that the processing of the L2 also relies on embodied experiences, rather than just semantic extraction. However, the reaction times of L2 learners were not as fast as those of native German speakers. In Bai and He's research, participants were required to make judgments based on the physical properties of words^[8]. No significant discrepancies were detected, indicating that L2 lexical decision tasks failed to trigger spatially oriented motor responses among low-proficiency L2 learners. Both of them need to activate the semantic representation system during the process of metaphor processing and achieve the decoding and understanding of metaphorical meanings by activating the relevant nodes in the semantic network. L2 learners will be influenced by multiple factors such as language proficiency and cultural background. However, there is still no unified conclusion regarding the degree of connection between metaphor processing and sensory experience. Therefore, the following questions are included in this research:

(1) Do L2 learners exhibit embodied processing when understanding metaphors?

(2) How does language proficiency affect the processing of embodied metaphors by L2 learners?

2. Method

2.1 Participants

A total of 30 students from Beijing International Studies University were selected. According to the experimental level requirements, 15 (5 males, 10 females) participants who had passed CET-4 with scores above 550 were grouped as high proficiency. Another 15 (3 males, 12 females) participants with scores ranging between 425-512 were less skilled. Written consent was obtained and everyone was given a gift as a reward after finishing the experiment.

2.2 Design and Material

About experiment material in the questionnaire, firstly, 25 sentences that contained embodied metaphor were created (for example, SHE PUSHED HER FEARS ASIDE AND SPOKE CONFIDENTLY). Second, these sentences were rated by 10 subjects who didn't participate in the experiment with 7-point Likert scale. 5 sentences were removed as the subjects report a weak embodiment for these sentences. At last, 4 subjects who didn't participate in the experiment were required to reason in detail about the embodied metaphor in these sentences. 16 sentences with embodied metaphor were kept and we added 8 filler sentences just with literal meaning (for example, HE SET HIS BOOK ASIDE AND JOINED THE GAME) for the experiment.

2.3 Procedure

This research contained two parts. Participants wer required to finish the questionnaire in Wenjuanxing. Then, 3 participants from the low proficiency group and 3 from the advanced were asked to finish post-hoc interview.

2.4 Data Analysis

Conduct an independent sample t-test based on the scores given by participants of different levels for the sentences in the questionnaire. All analyses were performed by SPSS22.0. The interview sessions were audio-recorded. Subsequently, the researcher transcribed the recordings and conducted a thematic analysis, which was accomplished using NVivo.

2. Results

3.1 Scores of Sentence

The outcomes are displayed in the following figure. There is a significant effect between the high and low proficiency group (t = 3.260, p < 0.001).



3.2 Interview Findings

The interviews were mainly conducted from three aspects:

1. Whether the participants could understand the sentences;

2. Whether the participants gave priority to their native language or Chinese when processing the sentences;

3. Whether the participants had embodied experiences, that is, whether they could construct mental images based on the sentences or words, and even associate specific actions. The interview results are as follows:

I can understand these sentences. During the reading process, I will translate what they are about for the first time because this is my reading habit. Then, when I read them for the second time, I will think about why "doubts" can still be "kicked", but I can't associate it with scenes of kicking something away. (Student1 from Low Group)

I can understand. First, I would think about how actions like "kick" are performed. Then, by looking at the following collocations, I would think that "kick the doubts away" is like kicking an object, such as a ball. After that, I don't need to reread this sentence. (Student2 from Low Group)

I can understand. I tend to translate it into Chinese first. Then, in Chinese, I can directly think of actions like "throw". If I don't translate it into Chinese, I might not understand why "worries" can be "thrown". In fact, it should be concrete objects that can be thrown away. (Student3 from Low Group)

I can understand what the sentence is mainly about after reading each word, and there is no need to translate it into Chinese. However, I don't visualize a scene. I think I can simply infer from the literal meaning. But I find it interesting to be able to associate emotional words with actions. (Student1 from High Group)

At first, when reading sentences, I would associate these action words with specific behaviors in life and then match them with the following words. It's as if there is a vivid picture in my mind. In this way, I can understand the meaning without translating the sentences into Chinese. (Student2 from High Group)

I don't translate them into Chinese because when I see the nouns at the end, I'll automatically associate them with relevant scenes related to those words. For example, if it's related to fear, and then combined with the verb in the front, I can generally figure out what it means. (Student3 from High Group)

4. Discussion

This study demonstrates that L2 learners exhibit embodied processing when comprehending metaphors, though the extent of this processing varies due to individual differences. Through ratings of sentences containing embodied metaphors by high- and low-proficiency participants, significant differences were observed between the two groups, suggesting that high-proficiency learners incorporate greater perceptual and sensory experiences during metaphor processing. For instance, high-proficiency participants could directly associate action verbs (e.g. "kick" or "push") with mental imagery related to physical movements, without relying on semantic transformation or L1 translation. This finding supports Barsalou's embodied cognition theory, which proposes that the comprehension of abstract concepts is grounded in sensory-motor experiences^[6]. Interview results further corroborate that high-proficiency learners automatically construct vivid action-related mental scenes when reading metaphorical sentences, highlighting the pivotal role of embodied processing in L2 metaphor comprehension. Conversely, low-proficiency learners exhibit weaker embodied processing, relying predominantly on L1 translation for semantic decoding, with limited integration of perceptual experiences. Thus, while L2 learners' metaphor comprehension involves embodied processing, its prominence is closely tied to language proficiency.

Language proficiency significantly influences the degree of embodied processing in L2 metaphor comprehension. The study found that high-proficiency participants outperformed their low-proficiency counterparts in rating embodied metaphorical sentences, indicating a stronger ability to directly activate sensory-motor experiences without semantic mediation. Interview data revealed that high-proficiency learners (e.g., Student 2 from the high-proficiency group) could rapidly evoke action imagery, such as kicking a ball, when processing expressions like "kick the doubts away," comprehending the metaphor without translating it into L1. In contrast, low-proficiency learners (e.g. Student 1 from the low-proficiency group) tended to translate sentences into their L1 to construct cognitive pathways, relying on their native language as a mediator. Overall, higher language proficiency leads to greater dependence on L1-mediated semantic transformation, resulting in diminished embodied processing.

5. Limitations and Implications

The study investigates the presence of embodied processing in L2 metaphor comprehension; however, it has the following limitations. First, the sample is limited, consisting of students from a single university, which lacks generalizability. Second, the study relies on a rating format; it should have employed real-time measures, such as eye-tracking experiments, to monitor the information processing process. Finally, the number of sentences used as materials should be increased.

This study confirms the presence of embodied processing in L2 learners' metaphor comprehension, offering significant implications for embodied cognition theory and L2 pedagogy. For teaching, it is recommended to design embodied activities, such as gesture exercises or role-playing, for high-proficiency learners to enhance metaphor comprehension. For low-proficiency learners, bilingual explanations and visual materials can reduce L1 dependence,

gradually fostering embodied processing. Textbook design should incorporate comparisons of Chinese and English metaphors to enhance cultural sensitivity. These strategies not only improve L2 metaphor instruction but also provide a foundation for developing embodied language resources and cross-cultural communication training.

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