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Embodied Cognition, Metaphors and Child's Language Development

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1. Introduction

Language has traditionally been considered as a purely symbolic and abstract system. However, the theory of embodied cognition has contributed to the emergence of hypotheses based on the idea that cognitive processes, including language, are grounded in bodily interactions with the physical world. Abstract concepts are often understood through metaphors such as "up" for happiness and "down" for sadness which we understand in an immediate way because they directly derived from our spatial experience (Lakoff and Johnson 1980).

According to Lakoff and Johnson (1999), our bodies and their morphological features shape our ability to conceptualize. Furthermore, language abilities – when referring to actions – involve the same neural areas involved in movement (Gallese, 2008; Glenberg and Gallese, 2011).
Metaphors, widely used in everyday language, are therefore naturally recruited by our sensorimotor system for abstract uses.

These metaphors are not arbitrary: they are rooted in human physical experiences, which suggests that our cognitive system is shaped by the way we interact with the world. This might explain why many idiomatic expressions and phrases stem from physical actions and perceptions, supporting the idea that language is not a disembodied symbol system but it is connected to sensory and motor functions.

Developmental psychology also provides evidence for the embodied nature of language. Studies of language acquisition reveal that motor development and physical interactions play a crucial role in this process; children learn words and their meanings through experiences such as object manipulation and movement in space (Vigliocco *et al.,* 2019).

Embodied theories consider these interactions crucial to language and higher-order cognitive functions development. Early embodied experiences would allow children to learn language and represent concepts based on previous sensorimotor interactions (Thelen, 2008). In addition, children with greater motor activity in infancy and greater sensorimotor interactions with objects and their environment appear to develop a semantic understanding of objects and their features (Scofield *et al.,* 2009).

Experimental evidence further supports this hypothesis by showing that brain areas involved in motor control and sensory processing are activated during some language tasks (Pulvermüller, 2005). This neural evidence suggests that language comprehension involves the simulation of associated physical actions, further supporting the view that language processing is embodied.

The aim of this article is to examine the nature of language by addressing two key areas. First, it discusses linguistic metaphors and their significance in shaping how we understand language. Second, it explores research findings that demonstrate how early sensorimotor experiences are essential for language development and future cognitive growth. Through this analysis, the article aims to provide a brief understanding of the relationship between language, cognition, and the formative experiences of early childhood.

2. The Role of Metaphors in Embodied Cognition

The relationship between embodied cognition and language has been studied by Lakoff and Johnson (2008) through their theories on the role of metaphors, later extended by authors such as Gibbs (1994, 2003).

Lakoff and Johnson's theory argues that metaphors are not mere linguistic devices, but represent the way our mind is structured. In this perspective, metaphors would demonstrate that our physical perceptions and interactions with the concrete world are necessary as a basis for understanding abstract concepts. In structural metaphors, for example, one abstract concept is metaphorically structured in terms of another. A classic example is the metaphor "argument is war" where the dynamics of every disagreement are verbalized as if they were a battle, emphasizing the agonistic rather than the cooperative aspects of the confrontation (Lakoff and Johnson, 2008). This mode of metaphorical thinking simplifies complex concepts, allowing for a more immediate understanding, but it can also limit the perception of some aspects of reality. At the same time, our embodied mind is deeply constrained by the metaphors we use to simplify abstract concepts. Orientational metaphors are particularly important for embodied theory because they link groups of concepts to spatial positions or movements, thus following the rules of our physical world. Again, what we concretely learn in early childhood about the physical world becomes analogous to abstract concepts. An example provided by Lakoff and Johnson is "happy is up, sad is down" which has a physical foundation. In fact, when we are depressed, our posture reflects; when we are happy, we stand upright. Through ontological metaphors, we speak of abstract concepts as if they were objects. Essentially, according to Lakoff and Johnson (2008), metaphors are an indispensable element of human language and evidence of the embodied nature of our minds.

Gibbs (1994) has empirically proved how these metaphors arise in bodily experience. One of his primary interests has been exploring how people understand metaphorical expressions and how this understanding is influenced by their bodily experiences. In one of his most famous experiments, participants were asked to read metaphorical phrases and then to perform physical tasks consistent with the metaphors they had read. For example, reading the phrase "take a decision" and then grasping an object made participants faster and more accurate in interpreting the metaphor, suggesting that the understanding of metaphors is influenced by bodily experiences and mental simulations associated with such actions (Gibbs, 1994).

However, the theory of conceptual metaphors is not without its critics. Zipoli Caiani (2011) raised doubts about the ability of the topological structures described by Lakoff and Johnson to adequately explain the involvement of the sensorimotor system in understanding abstract concepts. He suggested that while metaphors may act as a bridge between the concrete domain of actions and the abstract domain of thoughts, the mere description of topological relationships between referents is insufficient to explain how motor intentionality is extended to abstract contexts. This challenges the idea that embodied metaphors can explain all forms of abstract cognition.

Additionally, while behavioral studies seem to confirm the embodied nature of language, neuroimaging studies have produced conflicting results regarding motor activation during the comprehension of metaphorical phrases containing action words. While Boulenger *et al.* (2009) found evidence of motor and premotor cortex activation, other studies, such as Aziz-Zadeh *et al.* (2006), did not report such activations, suggesting that the connection between metaphors and embodied cognition may not be universal or applicable to all abstract concepts (Bechtold *et al.,* 2023).

On the other hand, understanding abstract concepts may depend not only on their metaphorical relationships with concrete concepts but also on the situational properties and social interactions that accompany them. As highlighted by Borghi *et al.* (2016), abstract words tend to be acquired through linguistic and social interactions rather than direct sensorimotor experiences.

This implies that understanding abstract words may require integrating situational information, making the role of embodied metaphors only part of the broader complexity of human cognition.

3. The Embodied Nature of Language

Piaget (1952), in his theory of cognitive development, has emphasized the role of sensorimotor experiences as essential to the learning process.

Children, in fact, use this kind of information to acquire knowledge about the world through the development of a representational system that is the result of perceptual and motor interactions with their environment (Meltzoff, 1990).

The process of language development occurs in several stages, each characterized by specific progress. A prelinguistic stage (0-12 months) in which infants begin to develop nonverbal communication skills such as crying, smiling and gestures. Later, they begin to produce sounds that can be defined as precursors to words. A second stage is from 12 to 24 months in which children begin to produce their first words. This period is characterized by increased vocabulary and understanding of simple sentences. Between the ages of two and three years old, children begin to combine two or more words to form simple sentences, developing their first syntactic rules. Greater vocabulary expansion is also observed at this stage.

The acquisition of motor skills provides children with opportunities to practice action scenarios that influence children's experiences with objects, others, and their own bodies in ways that are relevant to both general communicative development and language acquisition (Iverson, 2010).

When children observe or participate in everyday activities, such as play or object manipulation, they associate words with the actions and objects involved, building a vocabulary based on their direct experiences.

Gestures can become especially relevant when they allow the child to create and build increasingly salient sensorimotor associations with specific objects over time. The caregiver's grasp of an object, along with specific actions related to its real-world use, could influence language acquisition and processing, highlighting the role of sensorimotor information in language learning (Macedonia *et al.,* 2020).

Situated learning theory, proposed by Lave and Wenger (1991) argues that learning is intrinsically linked to the context in which it occurs. Furthermore, research by Tomasello (2003) has shown that children learn new words more easily when they are required to use them during in meaningful activities rather than through passive exposure. A study by Oudeyer and Smith (2016) suggests that children's innate tendency to explore the environment through movement and interaction with objects is a key driver of language learning. This study highlights how motor curiosity drives children to actively interact with their environment, thus creating opportunities to associate words with direct sensorimotor experiences. Exploratory actions, such as grasping, touching and manipulating objects, provide an experiential basis that facilitates word learning and vocabulary building.

Evidence concerning the experimental side, instead, has shown that the processing of action-related words activates areas such as the premotor and motor cortex (Pulvermüller *et al.,* 2009) whereas words referring to actions performed with specific effectors activate the motor system in a somatotopic way (Hauk *et al.,* 2004).

There is also experimental evidence from longitudinal studies showing that infants who exhibit more exploratory behaviors and active interaction with their environment tend to have more pronounced intellectual and academic abilities in adolescence (Wellsby & Pexman, 2014).

Recent studies have shown that manipulating the environment remains the best method for learning, even in older children. For example, a study by Lozada and Carro (2016) investigated the effectiveness of active learning in 6- to 7-year-old children. Half of the children in the experiment faced the Piagetian conservation task with the opportunity to manipulate pieces of clay, glasses of water, and other materials. The remaining children could only observe these same operations performed by the experimenter. At the end of the experiment, the children in the first group demonstrated a significantly better understanding of the conservation concept than the second one, highlighting the importance of active and embodied learning.

In this regard, several studies have indicated that activities involving the body are optimal for learning scientific subjects at all ages. An experiment reported by Kontra and colleagues (2012) shows that targeted motor training aimed at teaching physics concepts such as torque and angular momentum significantly improves the understanding of these concepts in university students. These scientific findings suggest the possibility of introducing and/or increasing sensorimotor activities aimed at learning in educational and school contexts. Furthermore, this would also benefit the socio-emotional development of children and adolescents. In fact, as early as 1967, Vygotsky had emphasized the importance of pretend and role-play as a cognitive and social exercises. According to the psychologist, through play, children learn emotional self-regulation and respect for rules, understand the emotional states of others, manage conflicts, and construct their social identity.

This perspective has found support through various scientific findings. The study by Pellegrini and Smith (1998), for example, highlights how physical play enhances children's theory of mind, enabling them to more accurately distinguish real aggression from harmless, play-related aggression. This type of play also positively affects emotional self-regulation by exercising self-control over impulses, especially aggressive ones, and increases children's ability to recognize social hierarchies.

In a review, Diamond and Lee (2011) reported scientific evidence supporting the hypothesis that physical activities combining movement, sensory perception, and awareness, such as dance and martial arts, not only improve executive functions but also concentration, stress management, and emotional regulation. The authors emphasize that physical exercise can significantly improve cognitive abilities and self-regulated behavior in children.

Yu and Smith (2012) demonstrated that when children are given the opportunity to play by manipulating toys in the presence of a parent, they show higher levels of selective attention and are better able to learn the names of the toys. Other studies have shown that children better understand stories and sentences when they can perform the actions described. This suggests that physical and motor involvement not only facilitates the learning of new words but also enhances the comprehension of more complex language (Glenberg *et al.,* 2004).

Neuroscience studies have shown that hearing action-related words activates the motor areas of the brain involved in those movements, suggesting a close connection between language and the motor system (Barsalou, 2008).

Research conducted by Pulvermüller (2005) has shown that cortical systems for language and actions are not independent but reciprocally connected with each other. In some cases the activation of these areas is not limited to action words but also extends to abstract concepts, demonstrating how sensorimotor experience can influence understanding of a wide range of linguistic meanings.

Embodied cognition also explains how language is processed in real-time interactions. According to Glenberg and Gallese (2012), during conversations people often use gestures that align with their verbal expressions, reinforcing the idea that language is not just a cognitive function but a multimodal activity involving the whole body. Thus, it is clear that sensorimotor experiences shape language and conceptual processing (Willems and Francken, 2012). Despite this evidence, it is beyond important that research on embodied effects in children's conceptual and linguistic processing converge with insights from developmental psychologists.

4. Conclusion

According to the theory of embodied cognition, our cognitive processes are not something that happens only in our minds. Rather, cognition is strongly related to the way we interact with the world through our bodies.

One of the most characteristic aspects of human cognition is language, which is a complex communication system that develops gradually from infancy. From an early age, children explore their surroundings using their senses, and these early experiences play a crucial role in forming the basis for language development.

Embodied cognition suggests that these early sensory and motor experiences help children build the mental structures needed to understand and use language. For example, when a child repeatedly handles an object, these interactions help him to understand and use words related to that object. Moreover, these theories argue that the meaning of words is closely related to our bodily experiences. When we understand a word, it is not just an abstract process. Instead, we mentally simulate the physical actions or sensory experiences related to that word.

Early sensorimotor experiences, thus, play a crucial role in language development but also in later cognitive growth. From the moment children enter the world, their experiences with the environment begin to shape cognitive and language abilities. These early interactions are not simply passive observations, but rather active engagements that profoundly influence the construction of language and thought. As children repeatedly reach for and manipulate objects, they not only learn their physical properties but also begin to form associations. These associations are critical in helping them understand the meaning of words, making them easier to remember and use in the future. Repeated associations of sensory experiences with verbal labels allow children to build a rich vocabulary, which is critical for language and cognitive development. Finally, studies using brain imaging techniques also provide support for embodied theories of action-perception circuits in language.

References

Aziz-Zadeh, L., Wilson, S. M., Rizzolatti, G., Iacoboni, M. (2006). Congruent embodied representations for visually presented actions and linguistic phrases describing actions. *Current Biology*, 16(18), 1818-1823.

Barsalou LW. (2008). Grounded cognition. *Annu. Rev. Psychol.* 59:617-645.

Bechtold, L., Cosper, S. H., Malyshevskaya, A., Montefinese, M., Morucci, P., Niccolai, V., Shtyrov, Y. (2023). Brain signatures of embodied semantics and language: A consensus paper. *Journal of Cognition*, 6(1).

Boulenger, V., Hauk, O.,Pulvermüller, F. (2009). Grasping ideas with the motor system: Semantic somatotopy in idiom comprehension. *Cerebral Cortex,* 19(8), 1905-1914.

Borghi, A. M., Zarcone, E. (2016). Grounding abstractness: Abstract concepts and the activation of the mouth. *Frontiers in Psychology,* 7, 1498.

Diamond, A., Lee, K. (2011). Interventions shown to aid executive function development in children 4 to 12 years old. *Science*, 333(6045), 959-964.

Glenberg AM, Gallese V. (2012). Action-based language: a theory of language acquisition, comprehension, and production. *Cortex.* Jul;48(7):905-22.

Gallese V. Mirror neurons and the social nature of language: the neural exploitation hypothesis. Soc Neurosci. 2008;3(3-4):317-33.

Gibbs, R. W. (1994). The Poetics of Mind: Figurative Thought, Language, and Understanding. Cambridge University Press.

Gibbs Jr, R. W. (2003). Embodied experience and linguistic meaning. *Brain and language*, 84(1), 1-15.

Gibbs Jr, R. W. (2006). Metaphor interpretation as embodied simulation. *Mind & Language,* 21(3), 434-458.

Glenberg, A. M., Gutierrez, T., Levin, J. R., Japuntich, S. J., Kaschak, M. P. (2004). Activity and imagined activity can enhance young children's reading comprehension. *Journal of Educational Psychology*, 96(3), 424.

Hauk, O., Johnsrude, I., Pulvermüller, F. (2004). Somatotopic representation of action words in human motor and premotor cortex. *Neuron*, 41(2), 301–307.

Iverson, J. M. (2010). Developing language in a developing body: the relationship between motor development and language development. *Journal of Child Language, 37(2), 229-261.*

Lakoff, G., Johnson, M. (1999). Philosophy in the Flesh: The Embodied Mind and Its Challenge to Western Thought. New York: Basic Books.

Lakoff, G., Johnson, M. (1980). The metaphorical structure of the human conceptual system. *Cognitive science*, 4(2), 195-208.

Lakoff, G., Johnson, M. (2008). Metaphors we live by. University of Chicago Press.

Lave, J., Wenger, E. (1991). Situated Learning: Legitimate Peripheral Participation. Cambridge University Press.

Lozada, M., Carro, N. (2016). Embodied action improves cognition in children: Evidence from a study based on Piagetian conservation tasks. *Frontiers in Psychology,* 7, 393.

Macedonia M, Lehner AE, Repetto C. (2020). Positive effects of grasping virtual objects on memory for novel words in a second language. *Sci Rep*. Jul 1;10(1):10760.

Meltzoff AN. (1990). Towards a developmental cognitive science. The implications of cross-modal matching and imitation for the development of representation and memory in infancy. *Ann N Y Acad Sci.;608*:1-31; discussion 31-7.

Oudeyer PY, Smith LB. (2016). How Evolution May Work Through Curiosity-Driven Developmental Process. Top Cogn Sci. Apr;8(2):492-502.

Paivio, A. (1990). Mental representations: A dual coding approach. (pp. 583-605) Oxford University Press.

Friedemann, Pulvermüller., Yury, Shtyrov., Olaf, Hauk. (2009). Understanding in an instant: Neurophysiological evidence for mechanistic language circuits in the brain, B*rain and Language,* Volume 110, Issue 2, 81-94.

Pulvermüller F. (2005). Brain mechanisms linking language and action. *Nat Rev Neurosci.* Jul;6(7):576-82.

Pulvermüller, Friedemann & Shtyrov, Yury & Hauk, Olaf. (2009). Understanding in an instant: Neurophysiological evidence for mechanistic language circuits in the brain. *Brain and language.* 110. 81-94. 10.1016/j.bandl.2008.12.001.

Schwanenflugel, P. J., Shoben, E. J. (1983). Differential context effects in the comprehension of abstract and concrete verbal materials. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, 9(1), 82.

Zipoli Caiani, S. (2011). The Embodied Theory of Language: Evidence and Constraints. *Logic & Philosophy of Science*, 9.

Kontra, C., Goldin-Meadow, S., Beilock, S. L. (2012). Embodied learning across the life span. *Topics in cognitive science,* 4(4), 731-739.

Pellegrini, A. D., Smith, P. K. (1998). Physical activity play: The nature and function of a neglected aspect of play. *Child Development,* 69(3), 577-598.

Piaget, J. (1952). The Origins of Intelligence in Children. International Universities Press.

Pulvermüller, F. (2005). Brain mechanisms linking language and action. *Nature Reviews Neuroscience,* 6(7), 576-582.

Scofield, J., Fernandez, L., Schmitt, M. (2009). Semantic learning and embodied cognition: Evidence from early language acquisition. *Developmental Science*, 12(2), 296-304.

Sommerville, J. A., Woodward, A. L., Needham, A. (2005). Action experience alters 3-month-old infants' perception of others' actions. *Cognition*, 96(1).

Thelen, E. (2008). Grounded in the world: Developmental origins of the embodied mind. *Infant Behavior and Development*, 31(1), 1-9.

Tomasello, M. (2003). Constructing a language: A usage-based theory of language acquisition. Harvard University Press.

Vigliocco, G., Motamedi, Y., Murgiano, M., Wonnacott, E., Marshall, C. R., Milan Maillo, I., & Perniss, P. (2019). Onomatopoeias, gestures, actions and words in the input to children: How do caregivers use multimodal cues in their communication to children? *Proceedings of the 41st Annual Conference of the Cognitive Science Society.pp.* pp. 1171-1177. Cognitive Science Society: Montreal, Canada.

Vygotsky, L. S. (1967). Play and its role in the mental development of the child. S*oviet Psychology*, 5(3), 6-18.

Wellsby, M., Pexman, P. M. (2014). Developing embodied cognition: Insights from children's concepts and language processing. *Frontiers in Psychology,* 5, 506.

Willems, R. M., Francken, J. C. (2012). Embodied cognition: Taking the next step. *Frontiers in Psychology, 3,* Article 582.

Yu, C., Smith, L. B. (2012). Embodied attention and word learning by toddlers.*Cognition,* 125(2), 244-262.