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English Vocabulary Teaching Based on Psycholinguistics and Brain Science

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Abstract: ***This paper explores a new theoretical framework for college English vocabulary teaching from the perspectives of psycholinguistics and brain science. It first introduces cognitive linguistics theories, such as prototype category theory, conceptual metaphor theory, and schema theory, which provide important guidance for vocabulary teaching and emphasize the importance of understanding and memorizing vocabulary through cognitive processes like analogy and induction. Subsequently, the paper discusses findings from mental lexicon research, highlighting the necessity of deepening vocabulary learning in context and the importance of establishing semantic networks through association and reorganization. Furthermore, the paper applies insights from memory psychology, examining the roles of different types of memory and their impact on language learning. It further analyzes the pattern recognition mechanisms the brain relies on when processing linguistic information, as well as the influence of neural activity mechanisms on vocabulary memory capacity. Research indicates that the brain achieves deep understanding and memory of vocabulary through the coordinated work of specific brain regions. The activation of brain regions involved in semantic memory, working memory, and semantic association is closely related to human language ability. Finally, the paper emphasizes that in the era of artificial intelligence, education needs to pay more attention to the implications of brain science, understanding the cognitive forms of brain memory and the neural mechanisms of language memory. This will not only enhance teaching efficiency but also stimulate students' interest in learning, promoting deeper understanding and long-term memory in language acquisition. By integrating cognitive linguistics theories with brain science research, teachers can design more effective teaching strategies, thereby improving the efficiency and effectiveness of students' vocabulary learning.***

Keywords: Psycholinguistics, Cognitive linguistics theory, Vocabulary memory capacity, Neural activity mechanism**.**

1. Introduction

When exploring new approaches to college English vocabulary teaching, the perspectives of psycholinguistics and brain science provide a novel framework for understanding and practice. The integration of psycholinguistics and brain science offers opportunities to deeply understand the cognitive mechanisms involved in language acquisition, which is crucial for designing more effective vocabulary teaching strategies.

Cognitive linguistics theories, such as prototype category theory, conceptual metaphor theory, and conceptual integration theory, provide important guidance for college English vocabulary teaching. These theories emphasize how vocabulary learners understand and memorize words through cognitive processes like analogy and induction, which resonates with findings from brain science on how the human brain processes linguistic information. For instance, prototype category theory in cognitive linguistics explains how people learn and remember polysemous words by identifying "typical" examples of a category, consistent with the brain's reliance on pattern recognition mechanisms when processing linguistic information.

Research findings on the mental lexicon, such as the organization, retrieval, representation, and development of vocabulary, provide a scientific basis for developing vocabulary teaching strategies. This research emphasizes the need to deepen vocabulary learning in context and to establish semantic networks through association and reorganization. This aligns with brain science findings on memory formation and language processing—specifically how information is encoded, stored, and retrieved in the brain.

Moreover, the application of memory psychology, including the connections among sensory memory, short-term memory, and long-term memory, is significant for improving the effectiveness of college English vocabulary teaching and acquisition. This is consistent with brain science findings on different types of memory functions and their impact on language learning.

The new theory of college English vocabulary teaching based on psycholinguistics and brain science emphasizes the importance of using cognitive linguistics theory and mental lexicon theory to guide teaching practice. By understanding how learners' brains process linguistic information and how they learn and remember vocabulary through cognitive processes, teachers can design more effective teaching strategies, thereby improving the efficiency and outcomes of students' vocabulary learning. This requires teachers not only to master traditional language teaching methods but also to understand the latest research in psycholinguistics and brain science in order to apply these research findings in practical teaching.

2. Psychological Guidance of Cognitive Linguistics Theory

To apply the basic categories of cognitive linguistics theory in college English vocabulary teaching, one must first understand the core concepts and principles of cognitive linguistics. Cognitive linguistics focuses on language users' cognitive processes and how these processes affect language learning and application. It provides a range of theoretical frameworks, such as prototype category theory, conceptual metaphor theory, and schema theory, which are significant for understanding and teaching polysemous words, vocabulary input, and vocabulary use in reading.

To effectively apply prototype category theory in college English vocabulary teaching, it is necessary to understand its basic concepts and characteristics. First, basic category words are those that are representative or typical; they evoke the most direct and strongest cognitive responses in specific contexts. In teaching, teachers can help students better understand and remember English vocabulary by emphasizing the typical meanings of these words. For example, teachers can design activities that allow students to explore and discuss the use of these basic category words in different contexts, thereby deepening their understanding of polysemy. Second, prototype category theory posits that words in a language do not exist in isolation but are organized into a hierarchical, structured semantic network through cognitive mechanisms such as metaphor and metonymy. This theory emphasizes the importance of basic category words and the intrinsic connections among polysemous words. In terms of teaching strategies, teachers should first place basic category words at the core of instruction, as these words form the foundation for constructing the meanings of other words. By teaching students these basic words, teachers can help them build an initial understanding of English vocabulary structure. Second, in teaching, teachers should not only teach the basic meaning of a word but also explore its different meanings and the relationships among them. This not only helps students understand the richness of words but also promotes their awareness of linguistic flexibility. Metaphor and metonymy are important cognitive mechanisms that connect different concepts. Introducing these elements into teaching can help students understand abstract concepts and encourage them to use language creatively. By creating specific contexts for students to use newly learned vocabulary in real communication, teachers can deepen students' understanding and memory of word meanings. This method enables students to better grasp the usage conditions and environments of vocabulary. Teachers can also use methods such as semantic aggregation and segmentation, and semantic association, to help students establish connections between different cognitive categories, thereby better mastering and using English vocabulary. Prototype theory suggests that people tend to associate "typical" members of a category with that category. In vocabulary teaching, teachers can use this theory to help students quickly master and distinguish word meanings by presenting the "typical" meaning of each word. In addition, teachers can guide students to discover and analyze similarities and differences among words, thereby promoting deeper language understanding and memory.

Conceptual metaphor theory reveals the universal phenomenon of metaphor in human thinking, i.e., we often understand one seemingly unrelated thing through the characteristics of another. In vocabulary teaching, teachers can help students understand the deeper meanings and cultural backgrounds of words by analyzing and discussing common metaphorical expressions in English, thus improving their language application skills. Through conceptual metaphors, teachers can help students better understand and remember new vocabulary. For example, by linking abstract concepts to things students already know, learning abstract vocabulary becomes more intuitive and easier to remember. This method not only reduces students' memory burden but also increases their interest in vocabulary and their ability to use it. Introducing conceptual metaphors in teaching can promote students' cognitive development and help them build richer and more flexible language expression abilities. This is particularly important for non-English majors, as it helps them develop a more comprehensive and deeper understanding in language learning. According to recent research, conceptual metaphor also involves the issue of cultural transfer, i.e., how to express a concept from one culture in the manner of another culture. In vocabulary teaching, this approach can help students understand language use in different cultural contexts, thereby better adapting to multicultural communication environments. In specific teaching practice, teachers can design relevant activities, such as role-playing and storytelling, to allow students to use these words in authentic contexts, thus deepening their understanding and memory of word meanings. For example, teachers can describe a scene and ask students to choose appropriate words to express that scene.

Schema theory plays an important role in helping college students construct and expand their knowledge schemas of English vocabulary. First, schema theory emphasizes that people rely on existing knowledge structures, i.e., "schemata," when processing information. This is the process by which human cognitive structures process input information, and it is crucial for understanding the role of background knowledge stored in the brain in language comprehension. By applying schema theory, teachers can help students build a cognitive framework of schemas for vocabulary, thereby promoting the transformation of short-term memory into long-term memory. In vocabulary teaching, teachers can use this theory to provide rich contextual backgrounds and relevant associations, helping students construct and expand their knowledge schemas, thus learning and remembering new vocabulary more effectively. Specific strategies for applying schema theory include establishing phonological schemas, word-formation schemas, and using contextual schemas. These strategies help students understand and remember English vocabulary from multiple dimensions, not simply memorizing words and their meanings but deeply understanding vocabulary through the network relationships between words and other related words. This approach can effectively increase students' English vocabulary size and improve their comprehensive English application ability. Furthermore, schema theory has been used to guide students in acquiring vocabulary in specific contexts. This means that learners need not only to memorize words themselves but also to understand the usage and meaning of these words in authentic contexts, thereby better mastering practical language application skills. Schema theory, by providing a learning framework based on cognitive psychology, helps college students construct and expand their knowledge system of English vocabulary within a dynamic schema structure of sound, form, meaning, and background knowledge. This not only helps increase students' vocabulary size but also enhances their vocabulary awareness and vocabulary acquisition ability.

In summary, applying the basic category vocabulary of cognitive linguistics theory to college English vocabulary teaching requires teachers to deeply understand these theories and innovate teaching methods to promote students' deep understanding and long-term memory of English vocabulary. This will not only improve teaching efficiency but also

stimulate students' interest in learning, allowing them to gain more new insights in the learning process. Of course, this is only a basic application, which includes many psychologically guided learning models. However, in the contemporary era of rapid AI development, more attention should be paid to the impact of brain science on human memory ability. Understanding the cognitive forms of brain memory and the neural mechanisms of language memory is the most important research direction today. As long as artificial intelligence cannot yet replace the human brain in work, education needs to pay more interdisciplinary attention to brain science, which also provides some feasible research materials for AI control centers in the age of artificial intelligence.

3. Pattern Recognition Mechanisms the Brain Relies on When Processing Linguistic Information

The impact of the brain's reliance on pattern recognition mechanisms when processing linguistic information on vocabulary memory can be analyzed from multiple perspectives. First, according to the dual-process model, recognition memory can be based either on recollection of details of a previous event or on assessment of stimulus familiarity. This model emphasizes that when processing linguistic information, the brain does not simply recognize known words but enhances memory effects through pattern recognition.

In terms of neuroanatomy, lexical and semantic processing involve activity in different brain regions. For example, phonological processing is mainly associated with the left superior temporal gyrus (Wernicke's area), while semantic processing involves more brain regions, including the left middle temporal gyrus, left inferior temporal gyrus, left medial parietal lobe region, and left prefrontal region. This indicates that when processing linguistic information, the brain achieves deep understanding and memory of vocabulary through the coordinated work of these regions. Furthermore, deep semantic processing can enhance memory encoding, and this effect is associated with activity in the left inferior prefrontal cortex (LIPC) and left hippocampus. This shows that when processing words with rich semantic content, the brain can enhance memory effects through specific neural mechanisms. In addition, prediction mechanisms also affect vocabulary memory. When people use context to predict upcoming information during reading, such prediction not only immediately facilitates current processing and understanding but may also lead to false memory for predictable information. This indicates that when processing linguistic information, the brain can influence vocabulary memory and recall through pattern recognition and prediction mechanisms. However, different types of sensorimotor experience do not consistently affect vocabulary memory. For example, body-related experience may reduce rather than improve vocabulary memory performance. This suggests that when processing linguistic information, the brain needs to consider the specific effects of different types of sensorimotor experience on memory.

The pattern recognition mechanisms the brain relies on when processing linguistic information affect vocabulary memory through different neural mechanisms and regional activities. These mechanisms include, but are not limited to, recollection and familiarity assessment in the dual-process model, deep semantic processing, prediction mechanisms, and the effects of different types of sensorimotor experience. These findings reveal how the brain achieves efficient processing and long-term memory of linguistic information through complex neural networks and regional collaboration.

4. The Influence of Neural Activity Mechanism Research on the Brain's Processing of Linguistic Information

The influence of neural activity on vocabulary memory ability when the brain processes linguistic information can be analyzed from multiple perspectives. First, semantic memory refers to knowledge of people, objects, actions, relationships, self, and culture acquired through experience. The storage and retrieval of this knowledge involve multiple brain regions, including the posterior lateral parietal lobe, middle temporal gyrus, fusiform cortex and parahippocampal gyrus, dorsomedial prefrontal cortex, inferior frontal cortex, ventromedial prefrontal cortex, and posterior cingulate gyrus. Activation of these regions is closely related to human language abilities, including planning, problem-solving, and creating cultural and technological products.

Another important component of the memory system is the medial temporal lobe memory system, which consists of the hippocampus and adjacent cortex and is crucial for memory of facts and events. Over time, memories stored in the neocortex gradually become independent of medial temporal lobe structures. During language learning, different brain regions participate in the cognitive mechanisms of extracting words from speech, discovering their embedded grammatical structures, and inferring meaning from speech context. For example, better cross-modal task performance (e.g., judging whether auditory words are spelled the same or whether visual words rhyme) is associated with greater activation in posterior heteromodal regions. In addition, word recognition and memory are influenced by semantic association relationships among words. Words with multiple semantic associations lead to increased P200 amplitude and decreased N400 amplitude, indicating that the brain regions mainly involved in semantic association processing are the superior frontal gyrus and the left medial temporal lobe region. Changes in working memory load also affect brain activation patterns, supporting a working memory model that includes storage and executive processes, which recruit a network involving multiple brain regions. Age also affects the neural correlates of phonological word retrieval. Older adults show increased activation in the right triangular cortex during task performance, which may be related to compensatory processing.

In summary, neural activity affects vocabulary memory ability when the brain processes linguistic information by influencing activation patterns in specific brain regions. These regions include, but are not limited to, the medial temporal lobe, posterior lateral parietal lobe, middle temporal gyrus, fusiform cortex, dorsomedial prefrontal cortex, inferior frontal cortex, ventromedial prefrontal cortex, and posterior cingulate gyrus. Activation of these brain regions is closely

related to factors such as semantic memory, working memory, semantic association, and age-related cognitive changes.

5. Conclusion

This paper has deeply explored the application of psycholinguistics and brain science in college English vocabulary teaching, emphasizing the importance of cognitive linguistics theories for improving vocabulary teaching effectiveness. Through theoretical frameworks such as prototype category theory, conceptual metaphor theory, and schema theory, the paper points out that teachers can design more effective teaching strategies to promote students' deep understanding and long-term memory of English vocabulary. At the same time, the paper analyzes the pattern recognition mechanisms the brain relies on when processing linguistic information and the influence of neural activity mechanisms on vocabulary memory, revealing how the brain achieves efficient processing and long-term memory of linguistic information through complex neural networks and regional collaboration. Finally, the paper notes that in the contemporary era of rapid AI development, the education field needs to pay more attention to the implications of brain science, understanding the cognitive forms of brain memory and the neural mechanisms of language memory. This will not only help improve teaching efficiency but also stimulate students' interest in learning, allowing them to gain more new insights in the learning process.

References

[1] Hu, P. (2011). Application of Cognitive Linguistics Theory in College English Vocabulary Teaching. Science & Technology Information, (08), 149. doi:CNKI:SUN:KJXX.0.2011-08-117.

[2] Chang, Y. H., Li, B., & Lu, J. (2021). English Vocabulary Teaching from a Cognitive Perspective. OAlib, 08(09), 1-8. https://doi.org/10.4236/oalib.1107777

[3] Zhu, H. (2009). College English Vocabulary Teaching from the Perspective of Cognitive Linguistics. Educational Research and Experiment, (S1), 109-111. doi:CNKI:SUN:YJSY.0.2009-S1-034.

[4] Xu, H., & Su, Z. (2014). Mental Lexicon and Vocabulary Teaching. Modern Linguistics, 2(1), 7.

[5] Jiang, L. (2014). Application of Memory Psychology in College English Vocabulary Teaching. Science & Technology Innovation Herald, (01), 146. doi:10.16660/j.cnki.1674-098x.2014.01.130.

[6] Wu, J. (2021). Implications of Prototype Theory and Category Theory in Cognitive Linguistics for College English Vocabulary Teaching. Modern English, (11), 95-98. doi:CNKI:SUN:XDYM.0.2021-11-032.

[7] Mo, L. (2021). A Study on College English Vocabulary Teaching from the Perspective of Cognitive Linguistics. Journal of Higher Education, (27), 84-86+91. doi:10.19980/j.cn23-1593/g4.2021.27.019.

[8] Liu, S. (2006). Category View of Cognitive Linguistics and English Vocabulary Learning. Journal of Guangxi University for Nationalities (Philosophy and Social Science Edition), (S2), 78-80. doi:CNKI:SUN:GXZS.0.2006-S2-029.

[9] Wang, L., & Li, H. (2008). Implications of the Category View of Cognitive Linguistics for College English Vocabulary Teaching. Journal of Liaoning University of Technology (Social Science Edition), (05), 111-114. doi:CNKI:SUN:LLGX.0.2008-05-035.

[10] Wang, J. (2020). College English Vocabulary Teaching Based on Prototype Category Theory. Overseas English, (22), 25-26+35. doi:CNKI:SUN:HWYY.0.2020-22-011.

[11] Zhang, L., & Wang, X. (2010). A Brief Discussion on Prototype Category Theory and College English Vocabulary Teaching. Science & Technology Information, (02), 173. doi:CNKI:SUN:KJXX.0.2010-02-136.

[12] Yu, Z. (2013). Exploration of English Vocabulary Teaching from the Perspective of Prototype Category Theory. Education Teaching Forum, (04), 81-82. doi:CNKI:SUN:JYJU.0.2013-04-053.

[13] Cheng, Y. (2015). Application of Prototype Category Theory in College English Vocabulary Teaching. Overseas English, (01), 62-63+67. doi:CNKI:SUN:HWYY.0.2015-01-028.

[14] Zhang, H. (2017). A Study on Implication of Prototype Theory in English Vocabulary Teaching. Journal of Language Teaching and Research, 8(1), 133-133. https://doi.org/10.17507/jltr.0801.16

[15] Zhang, B. (2007). Vocabulary Teaching from the Perspective of Prototype Category Theory. Journal of Mudanjiang Normal University (Philosophy and Social Sciences Edition), (01), 77-78. doi:10.13815/j.cnki.jmtc(pss).2007.01.028.

[16] Liao, Y. (2007). Application of Categorization Theory in English Vocabulary Teaching. Science and Education Writer (Late Issue), (30), 113. doi:CNKI:SUN:KJXH.0.2007-10-092.

[17] Rao, J., & Wang, X. (2015). Analysis of Cognitive Linguistics Theory and English Vocabulary Teaching. Contemporary Educational Practice and Teaching Research, (06), 106-107. doi:10.16534/j.cnki.cn13-9000/g.2015.0947.

[18] Tang, S., & Ma, R. (2009). Guiding Significance of Cognitive Linguistics Theory for College English Vocabulary Teaching. China Electric Power Education, (05), 233-235. doi:10.19429/j.cnki.cn11-3776/g4.2009.05.113.

[19] Zhang, J. (2019). Application of Metaphor in English Vocabulary Teaching. The Guide of Science & Education (Early Issue), (28), 128-129. doi:10.16400/j.cnki.kjdks.2019.10.061.

[20] Peng, J. (2015). Application of Conceptual Metaphor in Vocabulary Teaching for Non-English Majors. English Square, (08), 84-86. doi:10.16723/j.cnki.yygc.2015.08.045.

[21] Li, Y., & Huang, F. (2022). Application of Conceptual Metaphor in College English Vocabulary Teaching. English Square, (05), 52-54. doi:10.16723/j.cnki.yygc.2022.05.014.

[22] Long, Y., & Gulimila Abulaiti. (2020). A Study on the Application of Conceptual Metaphor Theory in English Vocabulary Teaching. Science & Technology Vision, (14), 64-65. doi:10.19694/j.cnki.issn2095-2457.2020.14.25.

[23] Luo, M. (2017). An Experimental Research of Schemata Theory-based College English Vocabulary Teaching. Journal of Changchun University, (02), 102-106. doi:CNKI:SUN:CDXB.0.2017-02-023.

[24] Wang, R. (2012). College English Vocabulary Teaching Model Guided by Cognitive Linguistics Theory. Science & Technology Information, (20), 3-4. doi:CNKI:SUN:KJXX.0.2012-20-002.

[25] Wu, X. (2015). On the Application of Schema Theory in College English Vocabulary Teaching. Journal of Educational Institute of Jilin Province (Late Issue), (01), 78-80. doi:10.16083/j.cnki.22-1296/g4.2015.01.035.

[26] Zhang, A., & Liu, Y. (2006). Schema Theory and English Vocabulary Teaching. Journal of Anhui Agricultural University (Social Science Edition), (04), 132-134. doi:10.19747/j.cnki.1009-2463.2006.04.038.

[27] Shao, X. (2006). Using Schema Theory to Guide Students in Acquiring Vocabulary in Context. Social Sciences Review, (05), 165-166. doi:10.16745/j.cnki.cn62-1110/c.2006.05.086.

[28] Jiang, C., & Tang, J. (2019). English Vocabulary Learning Strategies Based on Schema Theory. Education Modernization, (88), 154-156+175. doi:10.16541/j.cnki.2095-8420.2019.88.061.

[29] Zhu, L. (2010). Application of Cognitive Linguistics in College English Vocabulary Teaching. Journal of Inner Mongolia Agricultural University (Social Science Edition), (04), 169-171. doi:CNKI:SUN:NMLX.0.2010-04-064.

[30] Yonelinas, A. P. (2002). The Nature of Recollection and Familiarity: A Review of 30 Years of Research. Journal of Memory and Language, 46(3), 441-517. https://doi.org/10.1006/jmla.2002.2864

[31] Démonet, J.-F., Chollet, F., Ramsay, S. C., Cardebat, D., Nespoulous, J.-L., Wise, R. J. S., Rascol, A., & Frackowiak, R. S. J. (1992). The Anatomy of Phonological and Semantic Processing in Normal Subjects. Brain, 115(6), 1753-1768. https://doi.org/10.1093/brain/115.6.1753

[32] Fließbach, K., Buerger, C., Trautner, P., Elger, C. E., & Weber, B. (2010). Differential effects of semantic processing on memory encoding. Human Brain Mapping, 31(11), 1653-1664. https://doi.org/10.1002/hbm.20969

[33] Hubbard, R., Rommers, J., Jacobs, C. L., & Federmeier, K. D. (2019). Downstream Behavioral and Electrophysiological Consequences of Word Prediction on Recognition Memory. Frontiers in Human Neuroscience, 13, 291. https://doi.org/10.3389/fnhum.2019.00291

[34] Dymarska, A., Connell, L., & Banks, B. (2023). More is not necessarily better: How different aspects of sensorimotor experience affect recognition memory for words. Journal of Experimental Psychology: Learning, Memory, and Cognition, 49(10), 1572-1587. https://doi.org/10.1037/xlm0001265

[35] Binder, J. R., Desai, R. H., Graves, W. W., & Conant, L. L. (2009). Where Is the Semantic System? A Critical Review and Meta-Analysis of 120 Functional Neuroimaging Studies. Cerebral Cortex, 19(12), 2767-2796. https://doi.org/10.1093/cercor/bhp055

[36] Squire, L. R., & Zola-Morgan, S. (1991). The Medial Temporal Lobe Memory System. Science, 253(5026), 1380-1386. https://doi.org/10.1126/science.1896849

[37] Rodríguez-Fornells, A., Cunillera, T., Mestres-Missé, A., & de Diego-Balaguer, R. (2009). Neurophysiological mechanisms involved in language learning in adults. Philosophical Transactions of the Royal Society B, 364(1536), 3711-3735. https://doi.org/10.1098/rstb.2009.0130

[38] Booth, J. R., Burman, D. D., Meyer, J. R., Gitelman, D. R., Parrish, T. B., & Mesulam, M. M. (2003). Relation between brain activation and lexical performance. Human Brain Mapping, 19, 155-169. https://doi.org/10.1002/hbm.10111

[39] Li, Y., & Sui, X. (2021). Semantic association effect and its neural mechanism from the perspective of lexical co-occurrence frequency. Advances in Psychological Science, (01), 112-122.

[40] Jonides, J., Schumacher, E. H., Smith, E. E., Lauber, E. J., Awh, E., Minoshima, S., & Koeppe, R. A. (1997). Verbal Working Memory Load Affects Regional Brain Activation as Measured by PET. Journal of Cognitive Neuroscience, 9(4), 462-475. https://doi.org/10.1162/jocn.1997.9.4.462

[41] Geva, S., Jones, P. S., Crinion, J., Price, C. J., Baron, J.-C., & Warburton, E. A. (2012). The Effect of Aging on the Neural Correlates of Phonological Word Retrieval. Journal of Cognitive Neuroscience, 24(11), 2135-2146. https://doi.org/10.1162/jocn_a_00278