

# *The Interaction Between Word Frequency and Concreteness Effects in Anomic Aphasia*

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**Abstract.** The core impairment of Anomic Aphasia lies in difficulty of retrieving words. Through a systematic review, this article analyzes the roles of two key variables, word frequency and concreteness, in the cognitive processing of patients. The study found that the word frequency effect mainly manifests as an advantage for high-frequency words, serving as a sensitive indicator of phonetic access difficulty. The concreteness effect is manifested as specific words outperforming abstract words, and its effect size is regulated by the completeness of the semantic system. The interaction between the two variables is significant; in particular, low-frequency abstract words pose the greatest retrieval challenge. This study further indicates that the word frequency effect and the concreteness effect respectively act on the early stage of word selection and the late stage of phonetic encoding. This review provides a theoretical basis for understanding the cognitive mechanism of Anomic Aphasia and offers guiding significance for clinical assessment and rehabilitation training.

**Keywords:** Anomic Aphasia, Frequency Effect, Concreteness Effect, Vocabulary Retrieval, Cognitive Mechanism

## **1. Introduction**

Anomic Aphasia, one of the most common types of aphasia, exerts a profound impact on patients' daily communication. The core manifestation is difficulty in extracting words, which means although patients understand the meaning of the words, they are unable to effectively retrieve the phonetic form of the target words. However, the underlying cognitive mechanism of this symptom remains debated. The word frequency effect and concreteness effect are regarded as key breakthroughs in revealing the semantic and phonetic processing stages. Existing scholars have conducted multi-angle discussions but reached inconsistent conclusions. Some studies indicate that the discourse cohesion ability of patients with Anomic Aphasia is lower than that of normal participants, with differences in the use of discourse cohesion strategies between the two groups [1]. Another study suggests that impairments in the phonological output buffer [2]. However, research gaps persist regarding how the interaction of these effects jointly influences naming performance and its neural mechanism.

This paper aims to systematically explore the manifestation patterns of the word frequency and concreteness effects in Anomic Aphasia and the underlying neural mechanisms through literature

review. By exploring the interaction between the two effects, it deepens the understanding of language cognitive mechanism and clarifies bottlenecks at different stages of lexical retrieval. This provides a solid theoretical basis for developing more targeted clinical assessment tools and rehabilitation training programs based on the interaction of word frequency and concreteness.

## **2. Theoretical foundation and core concepts**

### **2.1. Anomic Aphasia**

#### **2.1.1. Concept of Anomic Aphasia**

Anomic Aphasia is one of the most common types of aphasia. Its most core and prominent feature is the difficulty in retrieving words, especially for nouns and verbs. When the patient is conscious and has complete conceptual knowledge, they are unable to actively and accurately produce the phonetic form of target words, a phenomenon known as the Tip-of-the-Tongue (TOT) Phenomenon. In clinical evaluations and spontaneous speech, patients typically exhibit circumlocutory speech and naming failure. Circumlocutory speech refers to the situation where patient cannot retrieve target words, substitute them with extensive descriptive language. Naming failure is particularly evident in picture-naming task, manifested as prolonged pauses and an effortful searching state.

#### **2.1.2. Lesion localization and cognitive model**

The lesion associated with Anomic Aphasia is not localized to a single, specific "naming center", but involves a distributed network responsible for semantic integration and phonetic extraction. Neuroimaging and clinical pathological studies consistently show that the most common lesion sites are located in the posterior region of the temporal lobe of the left cerebral hemisphere, particularly the posterior part of the middle temporal gyrus and the posterior part of the inferior temporal gyrus, as well as the angular gyrus located in the inferior parietal lobule. These regions act as key hubs connecting the anterior part of the temporal pole responsible for conceptual processing, the superior temporal gyrus (Wernicke's area) responsible for auditory lexical forms, and the inferior frontal gyrus (Broca's area) responsible for phonetic programming. To explain this neural basis, some scholars have proposed the dual-stream model. They believe that the angular gyrus and other hubs are the core of semantic information integration. Damage to these hubs impairs the effective convergence of rich sensory features of objects, preventing the triggering of corresponding phonological codes [3].

### **2.2. The Tip-of-the-Tongue (TOT) phenomenon and the bottleneck of vocabulary retrieval**

The TOT phenomenon is a typical state of partial failure in lexical retrieval. It is particularly common among patients with Anomic Aphasia. Patients can clearly perceive the concept of the target word and may even extract partial phonetic information (e.g., the initial letter or syllable count), but they are unable to produce the complete phonological form of the word phonetics.

This phenomenon precisely reveals the bottleneck of lexical retrieval. The word frequency and concreteness effects provide key clues for locating this bottleneck. The research indicates that if the TOT state occurs more frequently on low-frequency words, it suggests impaired ability to activate weakly connected lexical entries. If abstract words are more likely to trigger TOT more often than concrete words, it may relate to insufficient semantic feature integration, resulting in weakened activation drive for lexical nodes [4]. Analyzing the modulatory effects of word frequency and

concreteness on TOT constitutes a core approach to understanding the cognitive mechanisms underlying Anomic Aphasia.

### **2.3. Concreteness and word frequency effects**

#### **2.3.1. Concreteness effect**

The Concreteness effect refers to the phenomenon where individuals process specific words more efficiently than abstract words in cognitive tasks. This is typically manifested as faster response times and higher accuracy rates for specific words. The existing explanatory mechanisms primarily include the dual encoding theory, which suggests that specific words can simultaneously activate both the language system and the imagery system in the brain, thereby enhancing the advantages of dual encoding for memory and retrieval [5]. The second is the background validity model, which claims that the concreteness effect stems from specific words possessing richer contextual association information in the semantic network, rather than relying on the imagery system. These two viewpoints explain the cognitive mechanism of the concreteness effect from distinct angles.

#### **2.3.2. Frequency effect**

The frequency effect refers to the phenomenon where high-frequency words are processed faster and have lower error rates than low-frequency words in tasks such as vocabulary recognition, naming, and memory. The frequency of words is usually objectively evaluated based on occurrence rates in large corpora. The theoretical explanations for this effect mainly include the lexical access model and the cognitive resource allocation hypothesis. The lexical access model suggests that the activation threshold of lexical units in the mental lexicon varies: high-frequency words have a lower threshold due to their common usage and are easier to recognize; low-frequency words have a higher threshold and require more cognitive resources and time. The cognitive resource allocation hypothesis states that high-frequency words form stronger neural representations and automatic processing paths through repeated exposure, enabling more efficient processing under limited resources. These theoretical accounts provide a framework for investigating how the frequency effect is manifested and potentially altered in the pathological condition of Anomic Aphasia.

### **3. Converging evidence for the word frequency effect in Anomic Aphasia**

#### **3.1. Behavioral manifestations**

In tasks such as image naming and word judgment, patients with Anomic Aphasia generally exhibit a retrieval advantage for high-frequency words. This advantage is reflected in higher naming accuracy and shorter reaction times. This effect shows significant robustness, meaning it can be consistently observed in patients with different causes (e.g., stroke, neurodegenerative diseases) and different severity levels.

However, the word frequency effect does not act in isolation. The experiments of Peach et al. demonstrated that the interaction among word frequency, acquisition age, and life span has a much greater impact on naming speed than any single variable; specifically, early-acquired high-frequency nouns are named the fastest, and nouns are faster than verbs [6]. Therefore, the interaction between word frequency and other variables must be considered and compared.

### 3.2. Neurophysiological insights

The robust behavioral frequency effect observed in Anomic Aphasia is underpinned by distinct neurocognitive processes. Event-related potential (ERP) studies provide highly accurate evidence for the temporal dynamics of the frequency effect. The N200 and N400 are negative-going ERP components that appear approximately 200 milliseconds or 400 milliseconds after the stimulus presentation. They are associated with cognitive conflicts or selection difficulty during the vocabulary selection stage.

A team from Nanjing University of Science and Technology conducted a translation recognition task, asking different levels of English learners to judge whether Chinese words were correct translations of English words [7]. The results proved that in the time window around 400 milliseconds after the presentation of the target word, for high-level English learners, the amplitude of the event-related potential waves induced by high-frequency words was smaller than that of low-frequency words, showing a significant translation frequency effect. In contrast, low-level English learners did not show a negative wave in the 400-millisecond time window but instead presented a positive wave in the 200-millisecond time window. This finding provides strong evidence that the frequency effect operates in the early stage of vocabulary retrieval.

## 4. The concreteness effect in Anomic Aphasia

### 4.1. The concrete word advantage

In most cases, patients with Anomic Aphasia, like healthy individuals, exhibit a processing advantage for specific words. This advantage is manifested in tasks such as picture naming, vocabulary judgment, and word repetition. The underlying core mechanism is generally believed to stem from processing differences at the semantic level.

The dual-coding theory provides a powerful explanation for this phenomenon: specific words, such as "apple", can simultaneously activate both the language encoding system and the non-linguistic representational encoding system. This system incorporates multi-sensory information such as visual images, tactile sensations, and taste perceptions, thereby providing support for multiple representations. While abstract words, such as "freedom", mainly rely on semantic relationships within the language system. To explain this phenomenon, neuropsychological research provides evidence. For example, studies on patients with aphasia have found that their specific word advantage is associated with enhanced activation of brain regions representing sensory features in object perception [8]. ERP technology indicates that specific words induce larger N400 and LPC amplitudes, suggesting greater resource investment in semantic integration and memory encoding. Additionally, specific nouns (e.g., "cat") trigger a stronger N170 component in the early perception stage, related to visual representation processing; when the representational and contextual validity of the words are controlled, the specific word advantage diminishes, further demonstrating the crucial role of sensory features in the processing of specific words.

### 4.2. The moderating role of semantic integrity

The concreteness effect is not a fixed attribute but is dynamically regulated by the integrity of the patient's semantic system. When the patient's semantic system is only mildly to moderately impaired, the specific word advantage is typically obvious. However, as the semantic damage intensifies, the specific word advantage may diminish or even vanish. This is because, although

specific words have the support of representational encoding, the extraction of their semantic features also relies on a functionally intact semantic system. Severe semantic system damage weakens the connection between the representational encoding of concrete words and the linguistic system, eroding their processing advantage. Therefore, the existence and magnitude of the concreteness effect can serve as a sensitive indicator of the residual functions of the semantic system.

## **5. Interaction of frequency effect and concreteness effect in Anomic Aphasia**

### **5.1. The behavioral evidence of interaction**

The most significant behavioral finding regarding the interaction effect is that low-frequency abstract words pose the greatest naming challenge for patients. Numerous studies have shown that the correct naming rate of patients drops to the lowest point in the combination of low-frequency - abstract words. Du Chen conducted an eye-tracking experiment using a two-factor interaction design of concreteness and word frequency. The results showed that when Chinese disyllabic nouns were presented in isolation, a concreteness effect emerged in the lexical judgment task, and was only observed in low-frequency words. Thus, it proved the view that low-frequency abstract words are the most difficult to process [9].

The key to the interaction effect lies in the asymmetry of the word frequency effect in the processing of abstract words and concrete words. This asymmetry is supported by findings that the word frequency effect is more pronounced for abstract words [10]. This study found that the main effect of word frequency was significant, and the interaction effect between words and word type was marginally significant. This further validates the interaction between the two effects.. The multiple representations of concrete words provide a compensatory pathway, partially reducing their reliance on word frequency. Therefore, concreteness can partially modulate or buffer the negative impact of the word frequency effect. The extraction of abstract words almost entirely depends on the semantic-phonetic pathway within the language system. When this pathway is already inefficient due to the low frequency of the words, the weak semantic representation of the abstract words cannot provide effective additional support, resulting in a huge fluctuation in the extraction success rate due to a small change in word frequency.

### **5.2. Theoretical explanatory model of interaction**

The word frequency effect and concreteness effect are not independent. They align with the semantic-phonetic interaction model. This model posits that concreteness affects the processing intensity and stability of the early semantic level during vocabulary extraction, while word frequency mainly influences the accessibility efficiency at the vocabulary-phonetic level. In Anomic Aphasia, a bottleneck exists in the conversion pathway from semantic representation to phonetic form. For concrete words, their strong and stable semantic representation can generate sufficient activation and transmit it to the downstream phonetic nodes, thereby partially overcoming the problem of high activation threshold of phonetic nodes caused by low frequency. However, the weak representation of abstract words makes the extraction process completely limited by the efficiency of the phonetic pathway regulated by word frequency, resulting in the extreme vulnerability of low-frequency abstract words.

## 6. Discussion

### 6.1. Summary

Word frequency and concreteness both independently and interactively influence word extraction. The word frequency effect is robust and serves as a sensitive indicator of the difficulty of speech accessibility. The concreteness effect is complex, and its strength highly depends on the completeness of the patient's semantic system. Neurophysiological evidence has successfully distinguished these two effects in the temporal process, indicating that they respectively affect different processing stages such as word selection and speech encoding. The semantic-phonological interaction model, combined with behavioral evidence collectively reveals that low-frequency abstract words are the most difficult lexical type to extract, as they lack the dual advantages of both word frequency and concreteness.

### 6.2. Limitations and future directions

This field still confronts significant challenges and research gaps. Currently, there is a systematic lack in cross-language research, especially in languages with distinct characteristics such as Chinese. The patterns of word frequency and concreteness effects need to be explored. Meanwhile, the dynamic time course of vocabulary extraction and the regulatory effects of individual differences (such as etiology, disease course, and precise localization of lesions) still need to be addressed.

Based on the above content, future research should focus on combining high spatiotemporal resolution neuroimaging techniques to capture the dynamic process of vocabulary extraction in real time. It should also develop precise rehabilitation plans based on individual injury patterns, such as designing training materials specifically to address the challenges of low-frequency abstract words. Additionally, the research should expand from isolated vocabulary naming to more complex linguistic units such as sentences and texts.

## 7. Conclusion

This study, through a literature review method, systematically explored the manifestations, neural mechanisms, and interactions of word frequency and concreteness effects in the lexical retrieval of Anomic Aphasia patients. The findings indicate that these two effects are key variables in revealing the core aspects of patients' cognitive impairments. Their interaction, particularly the extreme difficulty in extracting low-frequency abstract words, highlights that lexical retrieval is a complex process involving multiple stages and factors.

However, this study also has certain limitations. It is based on the synthesis of existing literature and lacks original data collection and empirical analysis. Due to its focus on word frequency and concreteness, other factors were overlooked. Additionally, the discussion of concreteness effects in the Chinese context remains insufficient. Future research should place more attention on cross-language comparisons and integrate advanced technologies such as neuroimaging. This will help transform theoretical understanding into individualized rehabilitation practices that can effectively improve patients' communication abilities.

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