

Bilingual Lexicon: English & Spanish Vocabulary

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Introduction to the Bilingual Lexicon

The study of the **bilingual lexicon** stands as a cornerstone within psycholinguistics and cognitive psychology, addressing the fundamental question of how two or more language systems are organized, stored, and accessed in the human mind. Unlike monolingual speakers who manage a single, integrated vocabulary, bilingual individuals possess a complex mental architecture responsible for managing overlapping yet distinct linguistic units, including words, morphemes, and concepts. This mental dictionary, or lexicon, is not merely a doubled inventory; rather, it represents a dynamic and highly interactive system where representations from Language 1 (L1) and Language 2 (L2) constantly compete and collaborate during comprehension and production. Understanding the bilingual lexicon requires moving beyond simple word-to-word translation and delving into the underlying semantic and phonological networks that facilitate rapid, context-appropriate language switching and retrieval, often without conscious effort. The efficiency of this system is remarkable, allowing proficient bilinguals to navigate linguistic tasks with minimal interference, though the mechanisms governing this remarkable feat remain the subject of intense research and theoretical debate, particularly concerning the degree of integration between the two systems.

A central challenge in modeling the bilingual lexicon involves characterizing the nature of the connections between lexical entries and their corresponding conceptual representations. For instance, does the word "dog" in English and "chien" in French map onto a single, shared conceptual node representing the animal, or do they possess separate, language-specific conceptual links? Early models often posited a strict separation, suggesting that L1 and L2 operated in parallel, independent modules, but empirical evidence overwhelmingly supports a more integrated view, especially among highly proficient bilinguals. This integration is evident in phenomena such as cross-language activation, where hearing or reading a word in one language automatically activates its translation equivalent and related semantic neighbors in the other language, even when the task demands focus solely on one language. Furthermore, the **frequency of use** and the age of acquisition significantly modulate the strength and speed of these lexical connections, meaning that the structure of the lexicon is not static but continuously shaped by linguistic experience and environmental demands. The complexity inherent in this dual system necessitates sophisticated theoretical frameworks that can account for both the distinctiveness required for accurate production and the interconnectedness necessary for efficient processing.

The term "lexicon" itself encompasses more than just the surface form of words; it includes detailed information about phonology (how the word sounds), orthography (how the word is spelled), syntax (how the word functions grammatically), and semantics (the meaning of the word). In the bilingual context, these layers of information must be managed simultaneously for both languages. For example, a Spanish-English bilingual must manage the phonological rules of

Spanish (e.g., rolled 'r') alongside those of English, sometimes leading to subtle interference or blending, particularly in low-proficiency speakers or when speaking under cognitive load. Crucially, the bilingual lexicon is also heavily influenced by the specific context of acquisition, including the modality (e.g., simultaneous vs. sequential acquisition) and the social environment (e.g., compound vs. coordinate bilingualism). Therefore, any comprehensive model must address how different types of linguistic information are tagged or marked to prevent the constant, debilitating intrusion of one language system into the other, a mechanism often referred to as **language selection** or inhibition, which is crucial for maintaining fluency and accuracy in the target language.

Models of Lexical Organization

Historically, research into the bilingual lexicon has been dominated by efforts to visualize and explain the relationship between the two language systems, leading to the development of several influential theoretical models. The earliest significant attempts, often categorized as **separate-store models**, suggested that L1 and L2 were maintained in entirely distinct mental compartments, operating independently of each other. These models struggled, however, to account for the frequent and rapid cross-language interference and activation observed in experimental settings, particularly semantic priming effects that bridge the two languages. A major turning point came with the introduction of the Revised Hierarchical Model (RHM) proposed by Kroll and Stewart, which posited a more nuanced, asymmetric relationship between the two lexicons. According to the RHM, L2 lexical items are strongly linked to L1 lexical items, while L1 lexical items are more directly and strongly linked to the shared conceptual store. This asymmetry explains why translating from L2 to L1 (backward translation) is often faster and more efficient than translating from L1 to L2 (forward translation), especially in non-dominant or less proficient bilinguals, where L2 access often relies on L1 mediation.

The RHM laid the groundwork for subsequent, more complex integrated models, such as the Word Association Model and the Concept Mediation Model. The **Concept Mediation Model** proposed that both L1 and L2 lexical entries connect independently to a single conceptual store, meaning that once proficiency is high, the semantic meaning can be accessed directly from either language without relying on the translation equivalent in the other language. This model better explains the performance of highly fluent, compound bilinguals who often report thinking directly in their non-native language. In contrast, the Word Association Model suggests that L2 entries are primarily linked to L1 entries, which then connect to the conceptual store, aligning more closely with the experience of beginner or coordinate bilinguals who rely heavily on translation. Contemporary models, such as the Bilingual Interactive Activation (BIA) model and its successor, BIA+, move beyond simple hierarchical structures to emphasize the interactive and parallel nature of lexical access. These models propose that all activated words from both languages simultaneously compete for selection based on input features (orthographic or phonological) and contextual constraints, providing a dynamic explanation for how bilinguals manage to suppress the non-target

language while processing the target language.

The BIA+ model, in particular, is highly influential because it formalizes the idea of competition and inhibition. It suggests that when a bilingual hears or reads a word, the system activates not only the relevant lexical entry in the target language but also all phonologically or orthographically similar words in the non-target language. For example, an English-Spanish bilingual reading the English word "coin" might simultaneously activate the Spanish word "coche" (car) due to overlapping initial sounds or letters. The selection process, therefore, requires a mechanism of inhibition to suppress the activated competitors from the irrelevant language. This constant, low-level competition and subsequent inhibition are thought to be key characteristics of the bilingual cognitive system, potentially leading to cognitive advantages, such as enhanced executive function. Furthermore, these models highlight the importance of the **language tag**--a hypothetical feature attached to each lexical item that identifies its language membership--which helps the system regulate activation and ensure that only the appropriate language output is selected in a given communicative context. The effectiveness of this tagging and inhibitory control varies significantly depending on factors like proficiency, context, and recent language use.

The Concept of Separate vs. Shared Storage

One of the most enduring debates regarding the bilingual lexicon centers on the degree to which the two language systems utilize separate or shared storage mechanisms for various levels of linguistic representation. While early theoretical approaches favored strict separation, modern neuroscientific and behavioral evidence strongly supports a highly integrated system, particularly concerning conceptual and semantic knowledge. The prevailing view suggests that **conceptual representations**--the underlying meanings and knowledge structures--are largely shared between the two languages. This means that a bilingual does not maintain two separate mental concepts for "tree" and "árbol," but rather accesses a single, unified concept node through two different lexical routes. Evidence for this sharing comes from cross-language semantic priming studies, where presentation of a word in L1 speeds up the recognition of a semantically related word in L2, demonstrating the interconnectedness at the meaning level.

However, the integration is less complete at the lexical level, particularly concerning phonology and orthography. While some highly frequent or cognate words (words sharing similar form and meaning, like "hospital" in English and Spanish) may share underlying phonological features, the majority of words maintain language-specific representations for their sound and spelling. For instance, the phonological rules governing syllable structure or stress placement are stored distinctly for each language, allowing the bilingual speaker to maintain native-like pronunciation in both L1 and L2 without constant blending. This partial separation at the form level, coupled with integration at the conceptual level, allows for efficiency: the bilingual avoids the cognitive burden of learning two separate conceptual systems while still maintaining the necessary distinctiveness for

accurate linguistic production. The boundary between separation and sharing is often blurred and dynamic, heavily influenced by the bilingual's cumulative experience and the degree of exposure to each language.

The organization of grammatical features, or morphosyntax, presents another complex area concerning shared versus separate storage. While some research suggests that grammatical rules are largely language-specific, allowing for distinct parsing and production structures in L1 and L2, there is evidence that the processing of certain abstract grammatical categories, such as gender or number, might interact across languages, especially when the languages share similar features. For example, interference in grammatical gender assignment has been observed in speakers of languages where gender is a prominent feature. Therefore, the architecture of the bilingual lexicon is best described as a partially overlapping system: the conceptual level is highly shared; the lexical form (phonology/orthography) level maintains substantial separation; and the grammatical level exhibits variable degrees of interaction depending on the specific features of the languages involved. Crucially, the functional separation needed for successful language use is often achieved not through structural segregation, but through **inhibitory control mechanisms** that selectively suppress the currently irrelevant system, even when both systems are structurally intertwined and activated in parallel.

Access and Retrieval Mechanisms

The process of accessing and retrieving specific words from the bilingual lexicon is a complex, multi-stage mechanism that operates under intense time constraints. When a bilingual intends to speak, the system must first activate the intended concept, then select the appropriate lexical entry (phonological form) corresponding to that concept, and finally ensure that the selection belongs to the target language while suppressing activated competitors from the non-target language. A key finding in psycholinguistics is that lexical access in bilinguals is generally **non-selective**, meaning that when a concept is activated, potential lexical candidates from both languages are simultaneously retrieved and compete for selection. This simultaneous activation is highly efficient but necessitates robust control mechanisms to manage the resulting competition, which is the root cause of many observed bilingual processing differences.

The mechanism of language selection is crucial for maintaining fluency. Several theories propose that this selection is achieved through a domain-general mechanism of cognitive control, often linked to the prefrontal cortex, which monitors the linguistic environment and applies inhibition to the non-target language. For example, if an English-Spanish bilingual is speaking English, the Spanish system must be actively inhibited to prevent Spanish words from intruding into the speech stream. Research using the language-switching paradigm demonstrates the cost of this inhibition: bilinguals are consistently slower and less accurate when switching languages compared to staying within a single language context. This **switching cost** reflects the time and effort required

to deactivate the currently dominant language set and activate the previously suppressed language set, providing strong behavioral evidence for the active management of the dual lexicon. The ability to efficiently manage this selection and inhibition is often correlated with measures of executive function.

Retrieval efficiency is also profoundly affected by factors such as word frequency and lexical distinctiveness. High-frequency words, which are accessed often, have stronger and faster connections within the lexicon, making them less susceptible to interference. Conversely, low-frequency words may take longer to retrieve, especially if they have phonological neighbors or translation equivalents that are also activated. Furthermore, the retrieval process is often subject to the phenomenon of **tip-of-the-tongue (TOT) states**, which bilinguals experience more frequently than monolinguals, particularly when attempting to retrieve proper nouns or low-frequency words. This increased frequency of TOT states is hypothesized to stem from the constant competition between the two language systems, where the activation of the target word is sufficient to retrieve its semantic information but insufficient to fully activate the correct phonological form before a competitor interferes. Therefore, successful access and retrieval require not only robust lexical links but also highly effective cognitive control mechanisms to arbitrate the continuous competition inherent in the bilingual mind.

Factors Influencing Lexical Processing

The way a bilingual processes and retrieves words is highly susceptible to a variety of internal and external factors that modulate the efficiency and structure of the lexicon. One of the most critical internal factors is **age of acquisition (AoA)**. Individuals who acquire both languages simultaneously from birth (simultaneous bilinguals) often exhibit highly integrated lexicons and processing patterns that differ significantly from those who acquire their second language later in life (sequential bilinguals). Earlier AoA is often associated with more native-like fluency and phonological processing in L2, likely because the language learning mechanisms were more plastic during early childhood development. However, while AoA affects the ultimate processing speed and accent, high proficiency achieved later in life can often mitigate many of the structural differences observed between early and late bilinguals.

Another crucial factor is **proficiency and dominance**. The strength of the lexical representations in each language is directly correlated with the speaker's skill level and the frequency of use. In unbalanced bilinguals, where one language is significantly stronger (the dominant language), the dominant language exerts greater influence and is more resistant to interference. Processing in the non-dominant language often requires greater inhibitory effort. This dominance is not static; it can shift over time based on the linguistic environment. For instance, a Spanish speaker who moves to an English-speaking country might experience a shift in dominance toward English, leading to attrition in their native Spanish lexicon. This dynamic nature underscores the lexicon as a flexible

system constantly adapting to environmental input, demonstrating that lexical strength is maintained through continuous activation.

External factors, such as the linguistic context and the task demands, also significantly influence lexical processing. Contextual cues, such as the language of the interlocutor or the physical setting, help the language selection mechanism predict and prioritize the target language, thereby reducing the need for extensive inhibition. Furthermore, the specific task being performed--such as reading, speaking, or translation--engages different components of the lexicon and control system. For instance, translation tasks inherently require maximum activation and interaction between the two lexicons, whereas monolingual speech production requires maximal suppression of the non-target language. The degree of **cognate status** (words that look and mean the same, e.g., "taxi") also affects processing speed; cognates are typically processed faster than non-cognates because they receive simultaneous activation from both languages, enhancing their overall activation level. Conversely, interlingual homographs (words that look the same but have different meanings, e.g., "gift" in English and "poison" in German) cause interference and slow down processing, requiring greater inhibitory control to select the correct meaning based on the target language.

Developmental Aspects of the Bilingual Lexicon

The development of the bilingual lexicon in children, particularly in simultaneous bilinguals, provides unique insights into how the human cognitive system manages dual linguistic input from the earliest stages of life. Initially, infants exposed to two languages often appear to integrate their vocabulary, sometimes mixing words from both languages in the same utterance, a phenomenon known as **code-mixing**. However, research indicates that, even in the babbling stage, infants are sensitive to the phonological distinctions between their two input languages. By the age of two, most bilingual children demonstrate the ability to differentiate their lexicons, showing language-specific use of vocabulary depending on the interlocutor, suggesting that the development of two distinct yet interacting lexicons occurs rapidly.

A key developmental question concerns whether bilingual children experience a temporary delay in vocabulary acquisition compared to monolingual peers. When vocabulary is measured solely in one language, bilingual children often score lower than monolinguals in that specific language. However, when their **conceptual vocabulary** (the total number of unique concepts for which they have a word in either language) is measured, bilingual children generally match or exceed their monolingual counterparts. This suggests that the conceptual development is robust, but the lexical load is distributed across two systems, leading to lower frequency and strength for individual words in each language compared to a monolingual child's single, highly reinforced lexicon. This distributed storage is a hallmark of the developing bilingual lexicon.

The development of control mechanisms is also central to bilingual language acquisition. Young

bilingual children must learn not only the words but also the contextual cues necessary to select the correct language. This constant need to monitor and select languages is hypothesized to contribute to the observed advantages in executive function often reported in bilingual populations, such as enhanced inhibitory control and cognitive flexibility. Furthermore, the input balance plays a critical role; children receiving highly balanced input from both parents tend to develop more balanced lexicons, while children exposed predominantly to one language may develop dominance and experience cross-linguistic influence more strongly in their weaker language. The trajectory of the bilingual lexicon is therefore highly dependent on the quality and quantity of linguistic exposure, shaping the eventual architecture of the mental dictionary and the efficiency of the underlying access and retrieval mechanisms throughout life.

Neural Correlates and Future Directions

Neuroimaging techniques, such as functional Magnetic Resonance Imaging (fMRI) and Electroencephalography (EEG), have provided invaluable evidence regarding the neural substrates underlying the bilingual lexicon, largely confirming the behavioral findings of integration and competition. Research consistently shows that both L1 and L2 rely on a largely overlapping set of cortical regions, primarily involving the classical language areas like the **Broca's area** (associated with speech production and syntax) and **Wernicke's area** (associated with comprehension and semantic processing). The degree of separation or overlap observed in these regions often correlates with the age of acquisition and proficiency. Early, highly proficient bilinguals tend to show greater overlap and co-activation of L1 and L2 in these cortical areas, suggesting high integration, whereas late bilinguals sometimes show slightly more distinct or extended activation patterns, particularly in L2 processing.

Crucially, the management of the bilingual lexicon--the processes of selection, inhibition, and switching--is strongly linked to the **prefrontal cortex (PFC)** and the anterior cingulate cortex (ACC), areas known to be central to executive function and cognitive control. When bilinguals perform tasks requiring language switching or inhibition of the non-target language, these control regions show heightened activation. This neurobiological evidence supports the hypothesis that bilingualism relies on domain-general cognitive resources to manage the constant competition between the two language systems. Studies have shown that the structural integrity and functional connectivity within these control networks are often enhanced in bilingual individuals, providing a neural explanation for the reported cognitive advantages.

Future research in the bilingual lexicon is focusing intensely on several key areas. First, there is a growing need to understand how the lexicon changes across the lifespan, particularly in aging bilinguals and those experiencing language attrition. Second, the role of **individual differences**--such as working memory capacity, personality traits, and motivation--in shaping lexical organization requires further exploration. Third, computational modeling continues to advance,

providing increasingly sophisticated tools (like deep learning networks) to simulate the dynamic processes of lexical activation, competition, and learning, allowing researchers to test complex theoretical predictions about the architecture of the mental lexicon. Finally, research is expanding beyond balanced, highly proficient bilinguals to include populations such as heritage speakers, individuals with language disorders (e.g., aphasia), and multilinguals (speakers of three or more languages), to build a more comprehensive and nuanced understanding of how the human brain manages linguistic diversity.

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