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# ORTHOGRAPHIC ACCENTS AND THEIR INFLUENCE ON LEXICAL STRESS PERCEPTION IN L2 WORD RECOGNITION

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## Abstract

This study investigates how L1 background, stress perception, and orthographic cues, such as orthographic accents, influence L2 Spanish word recognition, with a focus on native speakers of English and Korean. Using a cross-modal word identification task, participants were presented with Spanish word fragments in stressed and unstressed conditions, with or without orthographic accents. The results confirmed the significant role of lexical stress in improving word recognition accuracy for both native and L2 learners. Surprisingly, L1 Korean learners outperformed native Spanish speakers in unstressed conditions, challenging the expected "stress deafness" pattern often associated with learners from non-stress languages. These findings suggest that Korean learners may rely on other cues to compensate for their difficulty processing stress. In contrast, English learners did not benefit from orthographic accents, likely due to their reliance on vowel reduction and other stress-related cues in their L1. The study concludes that L2 learners' processing of suprasegmental features, like stress, is shaped by their L1 characteristics and the specific task demands. Implications for teaching stress perception in L2 are discussed, with an emphasis on integrating both visual and auditory cues to enhance word recognition accuracy.

**Keywords:** Lexical stress; Suprasegmental processing; Orthographic accents; L2 Spanish; Word recognition

## Els accents ortogràfics i la seva influència en la percepció de l'accent lèxic en el reconeixement de paraules en L2

**Resum**: Aquest estudi investiga com la llengua materna (L1), la percepció de l'accent lèxic i les pistes ortogràfiques, com els accents, influeixen en el reconeixement de paraules en espanyol com a segona llengua (L2) en parlants nadius d'anglès i de coreà. Mitjançant una tasca d'identificació de paraules en modalitat creuada, els participants van escoltar fragments de paraules en espanyol en condicions accentuades i no accentuades, amb i sense accent ortogràfic. Els resultats van confirmar el paper significatiu de la identificació de l'accent lèxic per millorar la precisió en el reconeixement de paraules tant en parlants nadius com en aprenents de L2. Sorprenentment, els parlants de L1 coreà van superar els parlants nadius d'espanyol en condicions no accentuades desafiant el patró esperat de "sordesa a l'accent" associat normalment amb aprenents de llengües sense accent lèxic. Aquests resultats suggereixen que els aprenents coreans podrien dependre més d'altres pistes acústiques per compensar la seva dificultat a l'hora de processar l'accent. En canvi, els aprenents d'anglès no es van beneficiar dels accents ortogràfics, probablement a causa de la seva dependència en la reducció vocàlica i d'altres pistes relacionades amb l'accent en la seva L1. L'estudi conclou que el processament de trets suprasegmentals, com l'accent, en els aprenents de L2 està determinat per les característiques de la seva L1 i les exigències específiques de la tasca. Es discuteixen implicacions pedagògiques i es destaca la importància d'integrar pistes visuals i auditives per millorar la precisió en el reconeixement de paraules.

**Paraules clau:** Accent lèxic; Processament suprasegmental; Accent ortogràfic; Espanyol L2; Reconeixement de paraules

## Los acentos ortográficos y su influencia en la percepción del acento léxico en el reconocimiento de palabras en L2

**Resumen:** Este estudio investiga cómo la lengua materna (L1), la percepción del acento léxico y las señales ortográficas, como los acentos, influyen en el reconocimiento de palabras en español como segunda lengua (L2), con especial enfoque en hablantes nativos de inglés y coreano. Utilizando una tarea de identificación de palabras en modalidad cruzada, los participantes escucharon fragmentos de palabras españolas en condiciones acentuadas y no acentuadas, con o sin acentos ortográficos. Los resultados confirmaron el papel significativo de la identificación del acento léxico para mejorar la precisión en el reconocimiento de palabras tanto en hablantes nativos como en aprendientes de L2. Sorprendentemente, los hablantes de L1 coreano superaron a los hablantes nativos de español en condiciones no acentuadas desafiando el patrón esperado de "sordera al acento" que suele asociarse con aprendientes de lenguas sin acento léxico. Estos hallazgos sugieren que los aprendientes coreanos podrían depender más de otro tipo de pistas acústicas para compensar su dificultad en procesar el acento. En contraste, los aprendientes de inglés no se beneficiaron de los acentos ortográficos, probablemente debido a su dependencia de la reducción vocálica y otras pistas relacionadas con el acento en su L1. El estudio concluye que el procesamiento de las características suprasegmentales, como el acento, por parte de los aprendientes de L2, está determinado por las características de su L1 y las demandas específicas de la tarea. Se discuten implicaciones pedagógicas y se destaca la importancia de integrar pistas visuales y auditivas para mejorar la precisión en el reconocimiento de palabras.

**Palabras clave:** Acento léxico; Procesamiento suprasegmental; Acento ortográfico; Español L2; Reconocimiento de palabras

# 1. Introduction

## 1.1. Lexical Stress in L2 Word Recognition

Speakers of different languages vary in their reliance on suprasegmental cues during real-time word recognition. For instance, in Spanish, where lexical stress is integral and vowel reduction is absent, suprasegmental features can differentiate between competing lexical candidates. This is true not only for minimal pairs like *PApa* (potato) versus *paPÁ* (dad) but also for words that temporarily overlap, such as *peLOta* (ball) and *peloTÓN* (platoon) (Soto-Faraco, Sebastián-Gallés, & Cutler, 2001)[1].

A significant body of research links challenges in identifying stress in a second language (L2) to the influence of an individual's first language (L1). Generally, those whose native languages use stress to distinguish meaning (e.g., Spanish, English, German) demonstrate better stress perception than those whose languages do not (e.g., French, Finnish, Korean) (Dupoux et al., 97), a phenomenon referred to as "stress deafness" (Dupoux et al., 1997; Dupoux et al., 2008; Peperkamp & Dupoux, 2002). For example, French speakers have been shown to be less accurate than Spanish speakers in perceiving lexical stress in Dutch (Dupoux et al., 1997) and also struggle with stress in L2 Spanish (Dupoux et al., 2008). However, these findings may also be influenced by individual differences (Schwab & Dellwo, 2019; 2022) and the specifics of the tasks used in the studies (Tremblay, 2008; 2009).

Word recognition in spoken language is shaped not only by segmental information, such as consonants and vowels but also by suprasegmental cues related to lexical stress, including pitch (F0), duration, and intensity. Lexical stress has been demonstrated to be crucial in distinguishing between words and influencing lexical access across various languages, such as Dutch (van Donselaar, Koster, & Cutler, 2005), Spanish (Soto-Faraco, Sebastián-Gallés, & Cutler, 2001), Italian (Sulpizio & McQueen, 2012; Tagliapietra & Tabossi, 2005), Greek (Protopapas, Panagaki, Andrikopoulou, Gutierrez Palma, & Arvaniti, 2016), and English (Cooper, Cutler, & Wales, 2002). These studies indicate that suprasegmental information is processed concurrently with segmental cues, immediately influencing the activation and competition of lexical items (Cho, McQueen, & Cox, 2007).

For instance, cross-modal priming research in languages like Spanish, Italian, Dutch, and English has consistently shown the importance of lexical stress in the activation and modulation of lexical items during word recognition (Andrikopoulou, Protopapas, & Arvaniti, 2021; Cooper et al., 2002; Soto-Faraco et al., 2001; Tagliapietra & Tabossi, 2005; van Donselaar, Koster, & Cutler, 2005). In these studies, auditory primes that matched the following visual targets in both segmental and lexical stress (e.g., *PRINci-* for *PRINcipe* (prince)) facilitated faster responses, compared to a neutral condition. On the other hand, primes that were segmentally identical but differed in stress position (e.g., *prinCI-* from *prinCIpio* (beginning), for the target "PRINcipe") either slowed down or had no effect on response times (Soto-Faraco et al., 2001). These results suggest that native Spanish speakers rely on suprasegmental cues when recognizing words. When such cues are absent or misleading, word recognition becomes more difficult, a pattern that has also been observed in English speakers learning Spanish as an L2 (Soto-Faraco et al., 2001).

[1] Capitalization represents the stressed syllable in all the examples provided.

Recognizing words in an L2 is inherently challenging, as it involves not only lexical confusion but also potential perception errors, among other factors. Lexical stress serves as a critical cue in L2 word recognition, though its effectiveness varies depending on the listener's language background. Research often associates difficulties in perceiving L2 stress to the influence of individuals' L1 properties. Speakers whose native language uses stress to convey meaning (e.g., Spanish, English, German) typically perform better in perceiving stress than those from languages without this feature (e.g., French, Finnish, Korean) (Dupoux, Pallier, Sebastián-Gallés, & Mehler, 1997), a condition known as "stress deafness" (Dupoux et al., 1997; Dupoux, Sebastián-Gallés, Navarrete, & Peperkamp, 2008; Peperkamp & Dupoux, 2002).

In the context of Spanish, where lexical stress patterns are prominent and vowel reduction is absent, suprasegmental cues (F0, duration, and intensity) are crucial in distinguishing between competing words (Harris, 1967) with both minimal pairs and words with overlapping temporal sequences (e.g., Soto-Faraco et al., 2001; Cooper et al., 2002). This pattern has been examined in detail with native speakers of Metropolitan French, a language without lexical stress, at different levels of proficiency in L2 Spanish (from naïve to advance). For example, a study by Dupoux, Sebastián-Gallés, Navarrete, and Peperkamp (2008) found that French speakers struggled with encoding Spanish nonwords that differed only in stress placement (e.g., *NUmi* vs. *nuMI*). These speakers also had difficulty rejecting Spanish words with incorrect stress, such as **SAlud* (incorrectly stressed version of 'health').

This stress insensitivity persisted even among proficient Spanish speakers, mirroring results found with French Canadian learners of English (Tremblay, 2008). Dupoux and colleagues concluded that French listeners are "deaf" to lexical stress due to their inability to establish the stress parameter necessary for encoding stress (e.g., Dupoux, Peperkamp, & Sebastián-Gallés, 2001; Dupoux et al., 2008; Peperkamp & Dupoux, 2002), which could directly impact their use of this cue for word recognition. While much of the research on lexical stress perception has focused on isolated words, Llisterri et al. (2016) examined stress perception in words embedded within sentences. Their findings suggest that sentence prosody interacts with lexical stress perception, sometimes enhancing and sometimes masking stress cues depending on the context. This highlights the need to consider both word-level and phrase-level prosody when investigating stress perception in L2 learners.

However, it is important to point out that research on how speakers of languages without lexical stress perceive and use this cue in their L2 has produced mixed results, highlighting the complexity of stress processing in L2 acquisition. Some studies suggest that these speakers are "deaf" to stress in their L2 (e.g., Dupoux et al., 1997; Dupoux et al., 2008; Tremblay, 2008), indicating difficulties in perceiving stress patterns and, consequently, in using stress for word recognition. This aligns with findings that native speakers of languages with word-level stress, like Spanish, Dutch, and English, rely heavily on stress cues during lexical access (e.g., Cooper, Cutler, & Wales, 2002; Soto-Faraco et al., 2001). As a spoken word is heard, potential lexical candidates that match the input segmentally are partially activated and compete with the target word for activation (Luce & Pisoni, 1998; Luce, 1986; Marslen-Wilson & Warren, 1994). In languages with word-level stress, words that match both segmentally and suprasegmentally show greater activation (Cooper et al., 2002; Soto-Faraco et al., 2001).

However, other studies suggest variability among learners, with some individuals being able to use lexical stress effectively in L2 word recognition (e.g., Martínez García & Schwab, 2023; Martínez García, Amber, Schwab, 2024; Lee, 2015). This discrepancy may be influenced by individual differences (Schwab & Dellwo, 2019; Tremblay, 2008) and task-specific factors (Connell et al., 2018), as well as the level of immersion in an L2-speaking environment (Tremblay, 2008). The mixed findings underscore the need for further research to determine the factors that influence an individual's ability to perceive and utilize stress cues during L2 word recognition.

While research on the perception and use of lexical stress in L2 Spanish has primarily focused on English- and French-speaking learners, other language pairings remain largely unexplored. This study aims to fill this gap by investigating how native speakers of English and Korean process lexical stress in L2 Spanish and the role orthographic marks play in either supporting or complicating this recognition process. These languages were chosen due to the contrasting stress systems they present compared to Spanish. By analyzing how learners' L1 characteristics, orthographic accents, and stress perception intersect in word recognition, this study will shed light on critical factors that influence L2 Spanish proficiency and the effectiveness of lexical stress as a cue in real-time word identification.

## 1.2. Lexical Stress in Spanish, English, and Korean

In Spanish, stress is signaled using three key acoustic features: fundamental frequency (F0), duration, and intensity, much like in several other languages. All of these features contribute to both the production and perception of stress in Spanish. Among these, F0 is often regarded as the primary indicator of stress, with duration and intensity playing complementary roles (Llisterri, Machuca, de la Mota, Riera, & Ríos, 2002a, 2002b, 2003). However, research on the relative importance of duration has yielded mixed findings. While some studies support the idea that duration servesprimarily as a secondary cue (e.g., Llisterri et al., 2002a, 2002b, 2003), others suggest that it plays a more prominent role in stress perception, potentially functioning as a primary cue under certain conditions (Delattre, 1969; Hualde, 2015; Navarro Tomás, 1916, 1918; Ortega-Llebaria & Prieto, 2011). Specifically, duration has been found to be a particularly strong predictor of stress in cases where F0 and intensity cues are neutralized or less reliable.

Additionally, duration tends to be a stronger secondary cue compared to intensity, except in the final syllable, where intensity takes precedence. This is because duration becomes less reliable due to final-syllable lengthening, a common phonetic phenomenon in Spanish (Enríquez, Casado, & Santos, 1989). Furthermore, Spanish dialects typically do not exhibit vowel reduction, making stress primarily dependent on suprasegmental cues. The placement of stress in Spanish can often be predicted through abstract rules. For instance, in nouns, stress tends to fall on the final syllable if the word ends with a consonant other than [n] or [s], and on the penultimate syllable otherwise (Harris, 1969). Whenever a word does not follow the aforementioned rule, Spanish marks irregular stress placement with the use of orthographic accents (e.g., *camisón* 'nightshirt' which should have penultimate stress placement according to the Spanish stress rule, yet the orthographic mark signals the correct stress placement).

In English, stress is cued by the same three acoustic parameters: fundamental frequency (F0), duration, and intensity. However, the relative weight of these cues differs slightly from their roles in Spanish. F0 is also considered the primary cue for stress in English, with duration and intensity serving as secondary cues (Beckman, 1986). The importance of duration varies depending on syllable position, similar to Spanish, though English lacks the strict word-final lengthening seen in Spanish. A key difference between the two languages is the use of vowel reduction in English, which serves as a crucial cue for distinguishing stressed from unstressed syllables. In unstressed syllables, vowels frequently reduce to a schwa [ə] or other centralized vowels like [ɪ], particularly in function words or non-content-bearing parts of speech (Roach, 2009). This reduction provides a clear acoustic contrast between stressed and unstressed syllables, adding an extra layer of differentiation that is absent in Spanish, where vowels generally maintain their quality regardless of stress. Moreover, spectral tilt, which refers to the relative distribution of energy across frequencies, has been identified as another relevant cue in English stress perception, as stressed vowels tend to exhibit greater energy in higher frequencies compared to unstressed vowels.

English stress placement is less predictable than in Spanish, owing to the language's irregular morphology and diverse word origins (e.g., Latin, French, Germanic). Nevertheless, lexical stress patterns are essential for distinguishing meaning, as in the contrast between nouns and verbs like record (noun) vs. record (verb). Unlike Spanish, English stress rules are typically less abstract and

are often influenced by morphological structure and syllable weight, with stress more likely to fall on syllables containing long vowels or ending in consonants. Importantly, English lacks external markers (such as orthographic accents) to indicate where stress should fall within a word, leaving stress assignment more flexible and context-dependent.

Korean does not exhibit word-level stress like English or Spanish. Instead, prominence is marked primarily by intonation and pitch accents, with fundamental frequency (F0) playing the dominant role, particularly in accentual phrases where the initial syllable has a rise in pitch followed by a gradual lowering (Jun, 1993, 1998, 2000). This tonal pattern, rather than lexical stress, serves to highlight important syllables. Duration also contributes, especially through phrase-final lengthening, but its function is to mark prosodic boundaries rather than word-level stress. Intensity is a secondary cue and plays a lesser role compared to F0. Unlike English, Korean does not use vowel reduction, so prominence is primarily conveyed through pitch and phrasing. Stress-like effects in Korean occur mainly at the phrase level, where focus and emphasis are signaled by pitch peaks. For example, a rise in F0 at the start of an intonational phrase indicates the importance or focus of the following material. Intonation patterns also help differentiate meaning in interrogative and declarative sentences. Like English, Korean lacks orthographic marks to signal which part of a sentence carries prominence.

## 1.3. Orthographic Accents as Visual Cues

Orthographic accents, which modify the pronunciation and meaning of words through orthographic marks, are a critical aspect of phonological and semantic processing in languages that use them. Although much research has focused on orthographic accents in visual word recognition, their influence on auditory word recognition is equally significant. In languages such as Spanish and French, orthographic accents often signal differences in pronunciation that are crucial for recognizing and distinguishing words in spoken language. For example, in Spanish, the acute accent (e.g., *canto* 'I sing' vs. *cantó* 'he/she sang') alters both the meaning and the stress pattern of the word, giving an extra visual cue that signals where the stress would fall within the word. Sebastián-Gallés et al. (2006) found that native speakers of Spanish rely on these auditory cues provided by orthographic marks to recognize words quickly and accurately, using stress as a phonological signal to disambiguate homophones or other similar-sounding words. This reliance on orthographic cues helps native speakers resolve lexical ambiguity during real-time auditory processing.

However, this effect is only found in languages such as Spanish or French. In Hebrew and Arabic, orthographic marks, particularly those placed on vowel marks, are integral to auditory word recognition. These languages are written in *abjads*, where vowel sounds are often not represented orthographically in unpointed texts. However, in spoken form, orthographic marks become critical cues for identifying the correct pronunciation and meaning of words. Frost (1998) demonstrated that native Hebrew speakers can accurately recognize spoken words with or without vowel diacritics, but in cases of phonological ambiguity, the presence of orthographic cues help disambiguate meaning in auditory stimuli, improving word recognition speed and accuracy. Similarly, in Arabic, where vowel (*harakat*) are not usually written in everyday texts, they play a crucial role in auditory word recognition, especially in ambiguous or unfamiliar contexts. Perea et al. (2016) found that when vowel orthographic information is provided together with acoustic information, native speakers can disambiguate words faster and with greater precision. This suggests that even though orthographic marks are often omitted in writing, they remain fundamental in spoken language for accurate word recognition.

For L2 learners, the role of orthographic marks in auditory processing is more complex. Many learners whose first language (L1) does not use these marks or relies less on them may struggle to perceive and interpret these markers correctly in spoken language. Sebastián-Gallés. Echeverría, and Bosch (2006) found that L2 learners of Spanish often fail to recognize orthographic accents as distinct phonological cues in auditory stimuli, leading to slower and less

accurate word recognition compared to native speakers. This lack of sensitivity to orthographic information in auditory input can result in confusion, particularly when minimal pairs are distinguished only by stress or other subtle phonetic differences. In languages like Hebrew and Arabic, where vowel orthographic forms are not commonly used in written texts but remain vital in spoken forms, L2 learners similarly benefit from the explicit inclusion of them during the learning process. Frost (1998) showed that L2 learners of Hebrew, for example, heavily rely on vowel orthographic information to accurately recognize spoken words. When these cues are absent, learners often struggle to discern word meaning based solely on consonantal patterns, underscoring the importance of orthographic information as auditory aids in L2 acquisition.

Orthographic accents influence auditory word recognition by providing critical phonological information that aids in distinguishing between otherwise similar-sounding words. For native speakers, these markers serve as auditory cues that streamline word recognition and disambiguate meaning, particularly in languages with homographs or phonological ambiguity. For L2 learners, orthographic marks are essential tools that facilitate comprehension in spoken language, though their effectiveness varies depending on the learner's familiarity with the phonological rules of the target language.

## 1.4. Rationale for the Study

Understanding lexical stress in L2 word recognition has revealed how language background influences stress perception. Research shows that L1 stress patterns shape how listeners approach stress in an L2, often leading to "stress deafness" among learners whose L1 lacks lexical stress, as in Korean and French. However, mixed findings on the role of stress among L2 learners suggest that variables such as individual differences, task specifics, and language immersion also play substantial roles in learners' sensitivity to stress cues. Despite these insights, most studies on L2 stress perception focus primarily on English- and French-speaking learners of Spanish, overlooking learners from languages like Korean, where stress is absent. Investigating Korean learners offers an opportunity to expand our understanding of stress deafness across languages with diverse prosodic structures.

In addition, examining English-speaking learners provides a comparative perspective, as English has word-level stress but differs from Spanish in terms of vowel reduction and other stress-related phonological rules. Furthermore, orthographic marks in Spanish add another layer of complexity. While these orthographic cues aid native speakers in marking stress patterns, L2 learners may either benefit from or be challenged by them. For languages without them, such as English, or with distinct alphabets, such as Korean, understanding how learners process these markers could reveal valuable insights into their role in supporting or hindering auditory word recognition. This study seeks to address these gaps by analyzing how native speakers of English and Korean approach lexical stress and orthogrpahic accents in L2 Spanish. By examining these factors, this study aims to clarify the combined influence of L1 stress properties and orthographic cues on learners' L2 word recognition, potentially guiding more effective teaching strategies for stress perception and pronunciation in Spanish.

# 2. Methodology

## 2.1. Participants

A total of 96 participants completed the study, divided into three groups. The first group comprised 32 Spanish speakers (control group), recruited from the University of Alicante in Spain who were either monolingual or bilingual Spanish-Valencian (mean age: 25 years, sd: 4.29). While the inclusion of Spanish-Valencian bilinguals introduces an additional linguistic background, we do not expect it to significantly influence the results, as both Spanish and

Valencian share similar stress patterns and phonological structures. However, it is worth considering that bilingualism can sometimes lead to cross-linguistic activation, particularly in tasks involving phonetic and lexical processing. The second group consisted of 32 English speakers tested at the University of Kansas in the USA (mean age: 25 years, sd: 9). The third gorup comprised 32 Korean listeners recruited from the University of Utah Asia Campus and Hankuk University of Foreign Studies in South Korea (mean age: 23.8 years, sd: 2.8).

At the time of the study, all non-native participants exhibited an intermediate-to-advanced level of proficiency in Spanish, assessed through the Dialang listening proficiency test (Weber, 2007). None of the participants started learning Spanish before the age of 9 years, and they shared similar backgrounds in Spanish language acquisition. On average, the English-speaking group had studied Spanish for 7.2 years (sd: 5.1) and had an average of 8.3 months of immersion in Spanish-speaking countries (sd: 14.1), and the Korean-speaking group for an average of 5 years (sd: 2.8) of study and 6.41 months (sd: 9.9) of L2 immersion.

## 2.2. Procedure and Stimuli

Participants completed two tasks, following the order presented in this study. First, participants completed a cross-modal word-identification task (adapted from Cooper, Cutler, & Wales, 2002; Soto-Faraco et al., 2001; Tremblay, 2008). This first experiment was administered using Paradigm (Tagliaferri, 2005). Participants heard semantically ambiguous auditory sentences that ended with two-syllable word fragments (e.g., *Elena dijo caSE…* 'Elena said caSE…'). Participants were asked to choose the word corresponding to the fragment they heard by clicking on one of the two options that appeared on the screen (e.g., "*casero*" vs. "*caserón*"). The word pairs used in the task were carefully selected and matched for lexical frequency to ensure that differences in recognition accuracy were not driven by word frequency effects.

Stimuli were presented in four possible conditions: With or without orthographic marks and with or without stress. In the NoOrthography condition, the fragments could either be Stressed or Unstressed. In the Stressed-NoOrthography condition, the fragments were stressed on the penultimate syllable and there were no orthographic marks presents (e.g., *liTE-*, from the word *liTEra* 'bunk bed'); in the Unstressed-NoOrthography condition, the fragments were unstressed (e.g., *lite-*, from the word *liteRAL* 'literal). Similarly, in the Orthography condition, the fragments could either be Stressed or Unstressed, but the unstressed condition always exhibited an orthographicmark that would give extra information on the position of the stress. In the Stressed-Orthography condition, the fragments were stressed on the penultimate syllable (e.g., *caSE-*, from the word *caSEro* 'landlord'); in the Unstressed-NoOrthography condition, the fragments were unstressed (e.g., *case-*, from the word *caseRÓN* 'barn'). An illustration of the four conditions is provided in Table 1.

| **ORTHOGRAPHY CONDITION** | | | **NO ORTHOGRAPHY CONDITION** | | |
|---|---|---|---|---|---|
| **Audio** | **Word Choice** | | **Audio** | **Word Choice** | |
| Stressed Fragment | | | Stressed Fragment | | |
| caSE- | Casero | Caserón | liTE- | Litera | Literal |
| Unstressed Fragment | | | Unstressed Fragment | | |
| case- | Casero | Caserón | lite- | Litera | Literal |

**Table 1**. Example of an experimental trial in the four conditions (underlined is the correct response).

Twenty experimental stimuli were created and divided into four counterbalanced lists. Each experimental item consisted of trisyllabic words with 'regular' stress placement, as outlined in the introduction, following the stress patterns described by Harris (1967). Words with penultimate stress (Stressed fragments) and final stress (Unstressed fragments) were matched in terms of

lexical frequency. All fragments were derived from words exhibiting regular stress patterns in Spanish, and no visual cues regarding stress placement were provided other than the standard orthographic marks. The experimental task comprised 36 filler items, wherein the contrast between the two candidate target words was segmental rather than suprasegmental, for instance, *balido* meaning 'bleat' versus *batido* meaning 'shake'. Both the experimental trials and the filler items were randomized throughout the experiment.

Next, participants were also asked to complete the Dialang proficiency test (Weber, 2007) to make sure groups were matched in as many individual differences variables as possible. Moreover, a t-test comparison of the Dialang scores revealed no significant difference between the two groups of learners ($t = -1.69$, $df = 61$, $p = 0.096$).

## 2.3. Data Analysis

The accuracy of participants was examined using a logistic regression model, following the approach outlined by Baayen (2008). This analysis was conducted with the *glm* package (Hothorn & Everitt, 2014) in *R* (R Development Core Team, 2009). Three categorical predictors were included in the analysis. The first predictor was L1, with three levels (Spanish, English, and Korean), using Spanish as the baseline. The second predictor was the type of condition (e.g., with diacritics or without diacritics), with the diacritic condition as the baseline. Lastly, presence or absence of stress (stressed vs. unstressed fragment) was examined, with "Unstressed" as the baseline.

Two sets of models were run for this analysis. The first set used L1 as a predictor and considered accuracy rates across all participants. The second set focused specifically on L2 learners, examining their accuracy rates in relation to their proficiency. However, proficiency was ultimately excluded from the final model, as the model without it provided the best fit. Both sets of models included participant and item as random effects in the analysis.

# 3. Results

Figure 1 shows the mean accuracy of the three groups, with the results divided by condition (e.g., with orthographic information or without orthographic information) and fragment type (stressed vs. unstressed fragment), while Table 2 provides the results of the logistic regression analysis for participants' overall accuracy.

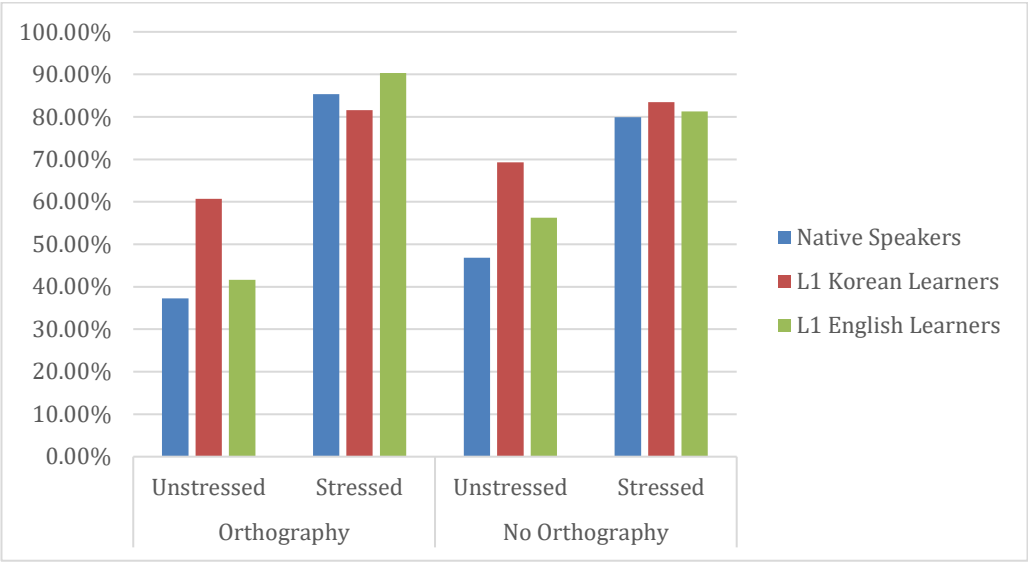


**Figure 1.** Accuracy results for the three groups in the cross-modal word identification task.

| Variable | Estimate (SE) | *z* | *P* |
|---|---|---|---|
| (Intercept) | -0.54 (.2) | -2.7 | <.01 |
| L1: English L2 Learners | 0.2 (.28) | 0.72 | >.05 |
| L1: Korean L2 Learners | 1.01 (.28) | 3.57 | <.001 |
| Condition: Orthography | 0.37 (.25) | 1.52 | >.05 |
| Fragment type: Stress | 2.38 (.3) | 7.92 | <.001 |
| Condition: Orthography x L1: English L2 | 0.19 (.35) | .55 | >.05 |
| Condition: Orthography x L1: Korean L2 | -0.01 (.35) | -.02 | >.05 |
| Fragment type: Stress x L1: English L2 | 0.31 (.45) | .68 | >.05 |
| Fragment type: Stress x L1: Korean L2 | -1.27 (.41) | -3.11 | <.01 |
| Condition: Orthography x Fragment type: Stress | -0.73 (.4) | -1.83 | =.07 |
| L1: English L2 x Condition x Fragment type | -0.55 (.59) | -.93 | >.05 |
| L1: Korean L2 x Condition x Fragment type | 0.54 (.57) | .95 | >.05 |

*Note*: *df = 1843*; α = .05

**Table 2.** Logit regression model on all participants' accuracy results.

A generalized linear mixed-effects model was fit using a binomial family to examine the effects of L1 group, the presence or absence of stress, and orthography (the presence of orthographic information) on participants' accuracy. The model accounted for random intercepts for both subjects and trials, and interactions between Group, Stress, and Orthography were included in the fixed effects. While proficiency was originally included in the model, that model failed to reach significance, indicating that proficiency was not an important factor to explain the results obtained (this is the reason why no proficiency effects are reported in this study).

The analysis revealed a significant main effect of L1 group, with Korean L2 learners showing higher accuracy than the reference group (native speakers of Spanish), while no significant effect was found for English L2 learners. Stress was a significant predictor, with stress-marked fragments leading to higher accuracy. However, orthography (specifically, the presence or absence of orthographic information) did not have a statistically significant main effect; that is, the orthography manipulation did not have any main effect on the results obtained. In terms of interactions, the Stress × Group interaction was significant for Korean L2 learners, indicating that stress had a differential impact on their accuracy compared to the reference group (this group showed higher accuracies whenever the fragment was stressed than when it was unstressed). However, no significant interaction was found for English L2 learners in relation to stress. Similarly, the interaction between orthography and group was non-significant for both English and Korean L2 learners, suggesting that the presence of orthographic accents did not influence their performance differentially across L1 backgrounds. The three-way interaction among Group, Stress, and Orthography did not reach statistical significance, indicating that the combined effect of these variables did not significantly alter performance patterns.

# 4. General Discussion

This study examined how L1 background, lexical stress, and orthographic cues influence L2 Spanish word recognition, with particular focus on native speakers of Korean and English given the properties of their native languages. The results confirmed the expected role of lexical stress as a crucial cue in both speech perception and word recognition, but they also revealed surprising performance patterns, especially among L1 Korean learners. Contrary to expectations, Korean learners outperformed native Spanish speakers in certain conditions, particularly with unstressed items when orthographic accents were present or absent. This unexpected result highlights the complex interaction between suprasegmental processing, orthographic cues, and task-specific effects, prompting a reconsideration of how L2 learners from non-stress languages process stress in the target language.

Additionally, the performance of the native Spanish group may have been influenced by their bilingualism status, as some participants were Spanish-Valencian bilinguals rather than strictly monolingual Spanish speakers. While Spanish and Valencian share many phonological features, bilingual individuals often exhibit greater phonetic flexibility and cross-linguistic activation, which could have modulated their reliance on stress cues. Prior research suggests that bilinguals sometimes demonstrate different processing strategies compared to monolinguals, particularly in tasks requiring rapid lexical access and phonetic discrimination. In this study, it is possible that the bilingual participants had a more distributed activation across both phonological systems, which might have influenced their response patterns. However, given that Spanish and Valencian have similar stress systems, any potential influence from bilingualism is unlikely to have substantially altered overall stress perception patterns. Future research should further explore how bilingual status interacts with lexical stress processing, particularly in populations with varying degrees of proficiency and language dominance.

Lexical stress has long been recognized as a key suprasegmental feature that facilitates both speech perception and word recognition, especially in languages like Spanish where vowel reduction is absent and stress plays a prominent role in distinguishing words (Soto-Faraco, Sebastián-Gallés, & Cutler, 2001). In this study, stressed fragments led to improved performance across all groups, confirming that suprasegmental features like F0, duration, and intensity are essential cues for real-time lexical access for native speakers (Soto-Faraco, Sebastián-Gallés, & Cutler, 2001), Italian (Sulpizio & McQueen, 2012; Tagliapietra & Tabossi, 2005), Greek (Protopapas, Panagaki, Andrikopoulou, Gutierrez Palma, & Arvaniti, 2016), and English (Cooper, Cutler, & Wales, 2002), but that L2 learners are also able to use it, independently of whether their L1 has this feature (Soto-Faraco et al., 2001; Cooper et al., 2002) or does not (e.g., Martínez García & Schwab, 2023; Martínez García, Amber, Schwab, 2024; Lee, 2015).

For L2 learners, processing suprasegmental cues in word recognition involves a complex interplay of their L1 background and the characteristics of the target language. English learners, who are accustomed to word-level stress and vowel reduction in their L1 (Roach, 2009), performed better in stressed conditions compared to unstressed ones. However, the absence of vowel reduction in Spanish may have posed a challenge for English learners, who typically rely on reduced vowels to identify unstressed syllables in English (Beckman, 1986; Lee, 2015). This could explain why their performance in unstressed conditions was not as strong as expected, highlighting the importance of understanding cross-linguistic differences in suprasegmental processing. Contrary to some prior studies (Tremblay, 2008), the results indicated no significant effect of proficiency on stress perception or word recognition accuracy. This finding suggests that proficiency alone is not a sufficient predictor of L2 learners' ability to process suprasegmental features like stress. However, future studies should consider evaluating other proficiency scores more targeted towards the perception of spoken language.

The most unexpected finding, however, was the strong performance of the Korean learners, particularly in the "unstressed" conditions, where they outperformed native Spanish speakers. This result contradicts previous research on "stress deafness" (Dupoux et al., 1997; 2008;

Peperkamp & Dupoux, 2002), which posits that learners from non-stress languages should struggle with lexical stress perception in their L2. Further supporting the notion of stress deafness, Schwab and Llisterri (2010) found that French speakers had difficulty perceiving lexical stress contrasts in Spanish, particularly in tasks requiring stress identification. Similarly, Alfano et al. (2009) compared French and Italian speakers, showing that while Italian speakers had some advantage in perceiving Spanish stress patterns, their reliance on native-language stress cues sometimes led to misperceptions.

These findings highlight the role of L1 phonological structure in shaping L2 stress perception. However, it is important to realize that, while (Seoul) Korean has been claimed not to have lexical stress (although this topic is debatable in the literature (see, Martínez García & Schwab, 2023), other studies have reported that Korean speakers may rely on phrase-boundary cues for segmentation in both familiar and unfamiliar contexts (Kim & Cho, 2009). Thus, it could be the same that, in this study, Korean were showing a transfer from accentual level stress into the perception of word-level stress, in line with Kim and Cho (2009)'s claims. Another potential explanation for this unexpected pattern of results is that Korean learners, lacking word-level stress in their L1, may have focused more on orthographic and segmental cues in the absence of stress. This aligns with the concept of "compensatory prosody," where learners from non-stress languages develop alternative strategies, such as paying closer attention to orthographic markers, to process L2 word recognition tasks (Kim, 2004). Why the current study seems to indicate that, at least, intermediate-to-advanced Korean-speaking L2 learners of Spanish are able to make use of lexical stress despite theories indicating that they should be "deaf" to this feature as it is inexistent in their L1 (Dupoux et al., 1997; 2008; Peperkamp & Dupoux, 2002) is ground for future research.

Importantly, for all three groups, the presence of stress highly constrains lexical access, but not its absence. This could be understood such that L2 learners show more evidence of learning for stressed fragments than for unstressed fragments. It is unclear, though, whether this effect is due to the greater saliency of stressed fragments, the lesser amount of lexical competition they generate, or both. However, the fact that this pattern of results is found in all three groups suggest that, whichever mechanism is used, native Spanish listeners and English- and Korean-speaking L2 learners of Spanish appear to use the same type of mechanism when recognizing Spanish words. Two possibilities could explain what processing mechanisms afford the use of suprasegmental information in word recognition. On the one hand, it could be the case that segmental and suprasegmental information are processed in parallel, in spirit with the Shortlist model as implemented in Norris, McQueen, & Cutler (1995). On the other hand, it could be the same that segmental and suprasegmental information are processed holistically, in spirit with the Episodic Trace model of Goldinberg (1996) and McClelland and Elman (1986). Future studies consider exploring which one of these two models better account for how native speakers and L2 learners process lexical stress online.

Moreover, task-specific effects could have played a significant role in the high accuracies achieved by the Korean group. In a controlled experimental setting where words were presented in isolation, the lack of contextual information might have led learners to rely more heavily on other cues to make lexical decisions. This strategic shift could explain why Korean learners outperformed native speakers in unstressed conditions. Previous research supports the idea that task design can influence L2 learners' reliance on visual and segmental cues over suprasegmental ones, especially when processing spoken words out of context (Tremblay, 2008). Another possibility could be related to other lexical properties partly controlled in the previous study. While all the conditions were matched in terms of lexical frequency, it is true that the words from which the stressed fragments were sliced were statistically more frequent than those in the unstressed conditions (no differences were found when comparing the Orthography vs. no-Orthography conditions).

While it was not explored in the current study, a possibility could be that the Korean learners happened to be particularly familiarized with the words used in the unstressed conditions which,

in turn, would explain why they were so accurate in identifying them. Moreover, fragments in unstressed conditions do have a larger set of competitor words (e.g., while *liTE-* must be elicited from *liTEra*, the fragment *lite-* could be fragmented from *liteRAL*, *literaliDAD*, lite*RAL*mente, etc.), creating more lexical confusion which could have impacted the lower accuracy rates among native speakers (more familiar with all the other potential lexical competitors).

Orthographic marks, which signal stress placement in Spanish, are traditionally thought to aid native speakers in word recognition (Sebastián-Gallés et al., 2006). However, the present study revealed that orthographic accents do not seem to have the same impact among L2 learners. For native speakers of English, this may be because stress patterns in their L1 are not marked orthographically, and these learners may be more accustomed to relying on auditory cues like vowel reduction rather than visual markers. On the other hand, Korean uses a completely different alphabet, in which orthographic marks such as orthographic accents are inexistent. As they are first acquitted with the Roman alphabet when learning English (which also lacks these marks), they are not as familiarized with their role and how influential these marks are at predicting and signaling the position of the stressed syllables (let us remember that orthographic marks are only used to mark irregular forms, which are less frequent than the regularly stressed trisyllabic words in Spanish).

These results are in line with previous studies that have found that L2 learners of Spanish often fail to recognize orthographic accents as distinct phonological cues in auditory stimuli, leading to slower and less accurate word recognition compared to native speakers (Sebastián-Gallés, Echeverría, and Bosch, 2006). This difference highlights the importance of considering L1 background when evaluating how L2 learners process orthographic information. While for certain learners (likely familiarized with orthographic marks), orthographic accents may serve as an essential compensatory tool in L2 auditory word recognition, for learners from stress languages, they may play a more peripheral role, independently of whether these learners' L1 has or does not have lexical stress.

These findings have significant implications for L2 instruction. Learners from non-stress languages, such as Korean, may benefit from explicit instruction that integrates both visual and auditory cues. Instructors could design exercises that explicitly teach the relationship between orthographic marks and stress patterns, helping learners develop greater sensitivity to both orthographic and auditory information. This multimodal approach has been shown to enhance word recognition accuracy in L2 learners (Frost, 1998; Perea et al., 2010), and could be particularly useful for learners from non-stress languages. For learners from stress languages like English, instruction should emphasize the differences between L1 and L2 stress systems, focusing on features like the absence of vowel reduction in Spanish and the role of predictable stress patterns. Developing exercises that target both auditory and orthographic cues can help learners fully exploit these features in real-time word recognition tasks.

Future research should explore how task-specific effects and individual differences influence L2 learners' reliance on orthographic versus auditory cues (including exploring the role of L2 proficiency with a more targeted proficiency test). Studies that manipulate the presence of orthographic information across a range of tasks—both in isolated word recognition and in connected speech—could provide deeper insights into how learners process these cues in natural language use. Additionally, expanding this research to include learners from other non-stress languages, such as Chinese or Japanese, would offer a more comprehensive understanding of suprasegmental processing in L2 acquisition, and including learners from languages such as French (familiarized with orthographic accents, yet without lexical stress in their L1) would have a direct impact in understanding how orthographic marks and suprasegmental cues interact in the use of lexical stress in online word recognition.

# 5. Conclusion

This study highlights the intricate interplay between L1 background, lexical stress, and orthographic cues in L2 Spanish word recognition. While lexical stress consistently facilitated word recognition across all groups, the findings challenge the assumption that native speakers invariably outperform L2 learners. Notably, L1 Korean learners—despite coming from a non-stress language background—outperformed native Spanish speakers in some unstressed conditions, suggesting that learners may develop compensatory strategies that rely more on orthographic and segmental cues. In contrast, L1 English learners showed stronger performance in stressed conditions, likely due to their familiarity with stress-based segmentation but also showed limitations in leveraging stress cues in the absence of vowel reduction, a feature absent in Spanish.

Native Spanish speakers, although expected to perform best overall, demonstrated lower accuracy in certain unstressed conditions, possibly due to increased lexical competition or influence from bilingualism (e.g., Spanish-Valencian speakers). Across all groups, the presence of orthographic accents did not uniformly enhance performance—while they offered visual support for some learners, especially Korean speakers, their impact was less pronounced for English speakers unfamiliar with such orthographic markings.

These findings underscore the importance of considering L1-specific processing strategies, task design, and the type of suprasegmental and orthographic information available. They call for pedagogical approaches that explicitly teach how stress and orthographic markers signal lexical distinctions in Spanish. Future research should explore how different L1 backgrounds interact with suprasegmental processing, especially under varying task demands and proficiency levels, and extend the scope to include other language groups and real-time processing tasks.

# Authorship Contribution Statement

María Teresa Martínez García: Conceptualization, Data curation, Formal analysis, Investigation, Methodology. Project administration, Supervision, Validation, Visualization, Writing (original draft), Writing (review and editing).

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# Appendix

## Stimuli used in the experimental task

Table 1 lists the Spanish word pairs used in the study to examine the interaction between lexical stress and orthographic cues in L2 word recognition. Each pair differs in stress position. Items in the "Orthography" condition included a written accent; items in the "No Orthography" condition did not.

| **Stress** | **No-Stress** | **Condition** |
|---|---|---|
| Botella | botellín | Orthography |
| Camisa | camisón | Orthography |
| Casero | caserón | Orthography |
| Chicharra | chicharrón | Orthography |
| Cuchara | cucharón | Orthography |
| Mejilla | mejillón | Orthography |
| Pelota | pelotón | Orthography |
| Peluca | peluquín | Orthography |
| Soltera | solterón | Orthography |
| Sucesión | sucesión | Orthography |
| Comedia | comedor | No Orthography |
| Dictado | dictador | No Orthography |
| invento | inventor | No Orthography |
| matado | matador | No Orthography |
| naranja | naranjal | No Orthography |
| pescado | pescador | No Orthography |
| portada | portador | No Orthography |
| producto | productor | No Orthography |
| secado | secador | No Orthography |

**Table 1.** Stimuli used in the experimental task. **Note**. Word pairs differ in stress position. Orthography = with written accent; No Orthography = without accent.