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Does omitting the accent mark in a word affect sentence reading? Evidence from Spanish

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Abstract

Lexical stress in multisyllabic words is consistent in some languages (e.g., first syllable in Finnish), but it is variable in others (e.g., Spanish, English). To help lexical processing in a transparent language like Spanish, scholars have proposed a set of rules specifying which words require an accent mark indicating lexical stress in writing. However, recent word recognition using that lexical decision showed that word identification times were not affected by the omission of a word's accent mark in Spanish. To examine this question in a paradigm with greater ecological validity, we tested whether omitting the accent mark in a Spanish word had a deleterious effect during silent sentence reading. A target word was embedded in a sentence with its accent mark or not. Results showed no reading cost of omitting the word's accent mark in first-pass eye fixation durations, but we found a cost in the total reading time spent on the target word (i.e., including re-reading). Thus, the omission of an accent mark delays late, but not early, lexical processing in Spanish. These findings help constrain the locus of accent mark information in models of visual word recognition and reading. Furthermore, these findings offer some clues on how to simplify the Spanish rules of accentuation.

Keywords

Word recognition; eye movements; orthography

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When we read, how do we assign lexical stress to multisyllabic words? In some languages, lexical stress is entirely consistent (e.g., Finnish: initial syllable; Polish: second-to-last syllable; French: final syllable). However, in most languages, the position of lexical stress is variable. To help lexical processing in a transparent language where lexical stress is variable such as in Spanish (i.e., the focus of the current study), scholars have since long proposed a series of rules of accentuation depending on the stressed syllable and the ending letters (from Nebrija, 1492, to the Real Academia Española, 2010). Of note, while 489 million people are native Spanish speakers, this figure increases to 585 million when considering the individuals with limited proficiency or who have learned Spanish as a foreign language (Instituto Cervantes, 2020).

Unlike other languages (e.g., French, German, Finnish, etc.), accent marks in Spanish do not affect the individual vowels' pronunciation. They only indicate which syllable is stressed (e.g., cámara [camera] is pronounced /ˈka.ma.ɾa/). As a result, it is generally assumed that both accented and non-accented letters in Spanish (e.g., a and á) activate the same orthographic representations in the letter/word identification systems (see Chetail & Boursain, 2019; Perea et al., 2020, for discussion).[1]

The main question we analyse in the present study is whether, for skilled readers, a word's accent mark helps lexical access during sentence reading in Spanish compared with a condition where the accent mark is omitted (e.g., cárcel [jail] vs. carcel). Before presenting the rationale of the experiment, we first review the rules of accentuation in Spanish, and then we review the prior literature related to this issue.

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Following the economy principle in language, the logic of the rules of accentuation in Spanish is that the number of words requiring an accent mark should be as low as possible (Real Academia Española, 2010). In Spanish, lexical stress typically falls on the second-to-last syllable (79.50%), being much less frequent on the last syllable (17.68%) and even less in the third-to-last syllable (2.76%) (Quilis, 1993). Thus, the rules of accentuation in Spanish with a prosodic function are the following:

1. Lexical stress falls on the last syllable: The accent mark is assigned when the word ends in a vowel (e.g., café) or the consonants n and s (e.g., corazón [heart], autobús [autobus]).
2. Lexical stress falls on the second-to-last syllable: An accent mark is required when the word does not end either in a vowel or in the consonants n or s (e.g., frágil [fragile]). This way, neither the word comida [food] nor its plural comidas [foods] require an accent mark.
3. Lexical stress falls on the third-to-last syllable, or earlier: An accent mark is mandatory in all cases (e.g., brújula [compass]).

Besides, as in other Romance languages, accent marks can also be used with a diacritical function in Spanish. First, accent marks are added to distinguish monosyllabic words that would be homographs otherwise (e.g., él [he] vs. el [the, as singular masculine], aún [still] vs. aun [even]). Second, accent marks are also added to interrogative words when used in a question (cuándo [when, as in "when are you visiting us?"] vs. cuando [when, as in "I don't eat when I feel sick"]).

Although the general rules of accentuation with a prosodic function are clear-cut, they suffer from numerous exceptions. For instance, reír [reˈir] (to laugh) is an exception to the first rule, bíceps [ˈbi.θeps] (biceps) is an exception to the second rule, and claramente [ˈkla.ɾa.men.te] (clearly) is an exception to the third rule.

Furthermore, we must bear in mind that the vast majority of Spanish words do not require an accent mark in writing. Only 12.4% of the 500 most frequent words require an accent mark (Davis & Perea, 2005). As a result, it is not straightforward to discern where lexical stress falls in most written words. Among other criteria, readers would need to quickly encode (1) the number of syllables; (2) whether the word ends in a vowel or the consonants n or s; (3) whether any syllable containing two adjacent vowels form a diphthong or a hiatus; (4) whether the final letters end in –mente; or (5) whether an exception to the general rule applies. To complicate matters, the rules of accentuation in Spanish evolve rapidly over time. For instance, the expression "Sólo fué a pié Sión sin guión y rió" [S/he only went to Zion walking without a script and laughed] was correct until 1999. However, after the norms of 2010, the sentence should be written as "Solo fue a pie a Sion sin guion y rio"—the reader may appreciate a simplification in the use of accent marks.

All and all, applying the rules of accent marks in Spanish is complicated not only for developing readers and L2 learners but also for skilled readers. Of note, the 2010 edition of the Orthography Norms by the Royal Spanish Academy devotes 45 pages (Section 3.4; Real Academia Española, 2020) to describe when to use (or not) accent marks in their prosodic and diacritical functions. Therefore, it is no surprise that many scholars have claimed that the rules of accentuation in Spanish should be dramatically simplified. For instance, the Nobel Prize winner in Literature Gabriel García-Márquez claimed in an influential interview:

> Let's put more sense into the accent marks. As they are today, with apologies to the purist gentlemen, they have no logic whatsoever. And the only thing that is being achieved with these martial laws is that the students hate the language. (Estefanía, 1997)

Indeed, other Romance languages like Italian or Romanian have a much more reduced usage (often with a diacritical function) of accent marks (e.g., Italian: àncora [anchor] vs. ancòra [again]; see Colombo & Sulpizio, 2021).

Given the complexity of accentuation rules in Spanish, one might wonder whether the presence of a word's accent mark help lexical access in skilled readers. Keep in mind that the vast majority of accented words in Spanish have an unambiguous spelling: omitting the accent mark in cárcel [jail] or fácil [easy] does not create another word. Furthermore, the same word may contain an accent mark in its singular form but not in its plural form (e.g., corazón-corazones [heart-hearts]). Thus, one might wonder why a word's orthographic representation would be affected by an accent mark in the visual input.

Recent empirical evidence using laboratory visual word recognition tasks has shown that omitting the accent mark in Spanish words with unambiguous spellings does not entail a processing cost for the readers. Using a lexical decision task ("does the letter string form a word?") with skilled adult readers, Schwab (2015) found remarkably similar response times for words regardless of presenting the normative accent mark (e.g., cárcel) or not (e.g., carcel). (Of note, participants were asked not to pay attention to whether the accent mark was present/omitted.) Schwab (2015) concluded that this finding "casts some doubts about the necessity to use in the Spanish spelling the accent mark in unambiguous words" (p. 13). In a similar vein, Perea et al. (2020) found that the identification time of an accented word like FÁCIL was similar when it was very briefly (50 ms) preceded by the masked prime facil (i.e., identical except for the omission of the accent mark) and

fácil—the masked prime fecil yielded slower response times. Thus, the omission of an accent mark in a Spanish word with unambiguous spelling does not delay the initial contact with the lexical entries.

However, one limitation of the above experiments is that they measured the response times to isolated words in a laboratory word identification task (lexical decision). Thus, one might argue whether these data may not reflect the same processes as normal sentence reading. A more ecologically valid paradigm is to have participants reading sentences while their eye movements are recorded. Keep in mind that, in sentence reading, readers would extract parafoveal information from the upcoming words (e.g., see Angele et al., 2013; Rayner et al., 2012, for reviews; see Chang et al., 2020, for evidence in Chinese; see Pagán et al., 2016, for evidence with developing readers). Furthermore, eye movement data may inform us on the time course of the effect (e.g., if the effect is already present in the duration of first-pass fixations on the target word or only later in lexical processing). Note, however, that all basic phenomena found initially in word identification experiments have also been extended to a reading situation (e.g., transposed-letter effect: Blythe et al., 2014; contextual diversity effect: Plummer et al., 2014; letter rotation effects: Blythe et al., 2019; letter similarity effects: Marcet & Perea, 2018).

Thus, the main aim of the present experiment was to examine whether omitting the accent mark in a Spanish word with unambiguous spelling had a deleterious effect on sentence reading. Participants read sentences for comprehension and an eye-tracking device registered the participant's eye movements. We created a set of sentences that contained a target word that required an accent mark (e.g., frágil). Each target word was presented either with its accent mark (e.g., frágil) or without it (e.g., fragil). All other words in the sentence were presented with their accent marks when required. An example is "Solo hicieron una única cárcel en el norte del país." [Only one prison was built in the North of the country.] All target words had an unambiguous spelling (e.g., fragil is not a word; words like sábana [sheet] vs. sabana [savanna] would not have been selected). We chose words where the accent mark fell on the last syllable (e.g., corazón), the second-to-last syllable (e.g., frágil), or the third-to-last syllable (e.g., brújula).

We can envision three potential outcomes concerning the effect of omitting a word's accent mark in Spanish when reading sentences: no effect, an early effect, or a late-only effect. The first scenario is that omitting a word's accent mark does not affect lexical access (as proposed by Schwab, 2015). In this case, the duration of fixations on the target word (e.g., cárcel or carcel) would be alike on first-pass fixations (e.g., first-fixation duration; gaze duration [sum of fixations before leaving the word]) and on the total time (i.e., the sum of first-pass fixations and those fixations where readers went back to the target word). This outcome would imply that accent marks in Spanish do not entail any advantage in lexical access during silent reading, hence having substantial implications on the future norms of accentuation in Spanish (see Marcet et al., 2021, for discussion).

The second scenario is that accent marks facilitate lexical processing during sentence reading. The rationale is that participants could process parafoveally a salient visual cue such as the accent mark of the upcoming word, thus helping to integrate the words' phonological codes. Complementary, or it may be that the target word is more familiar with its corresponding accent mark. In either case, words with an accent mark would provide higher familiarity values in the L1 criterion in a leading model of eye movements in reading like the E-Z Reader model (Reichle, 2015; Reichle et al., 1998). As a result, one would expect a deleterious effect of omitting a word's accent mark in first-pass measures on the target word (e.g., first-fixation durations and gaze durations). This outcome would require reinterpreting some of the conclusions put forward by Schwab (2015) and Perea et al. (2020). Finally, the third scenario is that accent marks play a facilitative role in sentence reading, but only at late stages of lexical processing (e.g., at a post-access processing stage; see Slattery & Rayner, 2010). In this case, one would expect an effect of omitting the accent mark, not on first-pass eye fixation measures (i.e., first-fixation duration, gaze duration) but rather in late measures (i.e., total reading times, presumably via more regressions to the target word). Thus, while this latter outcome would reveal a role of a word's accent marks during sentence reading, its role would be constrained to late stages of lexical processing.

Method

Participants

The sample was composed of 24 (17 female) psychology students at the Universitat de València, native Spanish speakers, and with normal vision. Participants signed a consent form before the experiment.

Materials

We selected 120 nouns in Spanish; all of them contained an accent mark. The mean Zipf frequency was 3.73 (range: 1.85–5.59), the mean number of letters was 6.4 (range: 5–10), and the mean OLD20 was 2.21 (range: 1.40–3.65) in the EsPal database (Duchon et al., 2013; see Van Heuven et al., 2014, for the advantages of using the Zipf scale as a measure of word frequency). The accent mark could fall on the last syllable (e.g., corazón), the second-to-last syllable (e.g., frágil), or the third-to-last syllable (e.g., brújula). Each word was embedded in one sentence (e.g., "Natalia compró una vieja brújula de más de cien años"

Table 1. Measures on the target word when the accent was present vs. omitted: percentage of first-pass fixations on the target word, first-fixation duration, gaze duration, go-past time, percentage of regressions, and total time.

	First-fixation duration	Gaze duration	Total time
Accent mark			
Present	234 (6.5)	277 (11.1)	307 (14.7)
Omitted	239 (6.5)	280 (11.2)	328 (16.8)

Note: The standard errors (computed by subjects) are given between brackets. For the interested reader, the probability of first-fixation durations was 0.9646 for the words with the accent mark present and 0.9639 for the words with the omitted accent mark.

[Natalia bought an old compass that is more than 100 years old.]), thus yielding 120 sentences. We checked, via a cloze task with 10 naïve individuals, that the target was not predictable from its previous context—this required adjusting six sentences and starting the process again with additional individuals that did not see the preliminary sentences. For the final set of 120 sentences, we asked 10 naïve individuals to evaluate whether the sentences were easily comprehensible on a 1–10 Likert-type scale. The average was 9.97. We created two versions of each sentence, one in which the target word was presented with its accent mark and another in which the accent mark was omitted from the target word. The full set of sentences is presented in the Supplemental Appendix.

Procedure

The experiment took place individually in a quiet, dimly lit room containing an Eyelink 1000 + video-based eye-tracker device (SR Research Ltd, Canada), a 144 Hz 24-inch LCD Asus VG248 monitor, and a Windows-based computer running the EyeTrack software from the University of Massachusetts (https://blogs.umass.edu/eyelab/software/). Participants were seated at 60 cm of the monitor. Each of the sentences was in 20-pt Courier New—this corresponds to approximately 2.5 letters per degree of visual angle. Although viewing was binocular, the system only registered eye movement data from the participant's right eye. Participants were first instructed that they were going to be presented with individual sentences. They had to read for comprehension as they would usually read, and that there would be yes/no comprehension questions after 20% of the sentences—they were not told that some words in the experiment did not have the required accent mark. They were also told that they should seat comfortably and still—we used a chinrest to reduce eye movements. To calibrate the system, we used a 3-point calibration where the participants had to look at three static dots (left, centre, right) on the screen—this process was repeated whenever necessary to ensure the quality of the data. Once the system was calibrated, the setup of each trial was as follows. Participants would look at a dot at the centre of the screen, thus allowing us to verify the calibration quality for each participant. If the quality was good, the participants were presented with a black square to the screen's left. Once they fixated the square, the sentence would come up—this location would be the sentence's initial letter. After finishing reading the sentence, participants had to press a button on a gamepad. After 20% of the trials, they were presented with a comprehension question—yes/no answers were also made on the gamepad (left for no; right for yes). The experiment took approximately 15–20 min to complete.

Results

All participants were highly accurate when answering the comprehension questions after the sentences ($M = 95\%$; range: 87%–100%). The screening of the eye movement data (e.g., fixation durations less than 80 ms or greater than 800 ms, track losses or blinks by the target word) was done automatically using robodoc software, which is a Python script developed in the Eyetracking lab of the University of Massachusetts (https://blogs.umass.edu/eyelab/software/). This process excluded 2% of the trials. To obtain the dependent variables in the critical region, we used Eyedry software, which is also part of the suite cited above. The critical region was composed of the target word and the blank space before it.

For the inferential analyses, we employed linear mixed-effects models in R (R Core Team, 2020) with the lmer package (Bates et al., 2015). The only fixed factor was Accent Mark of the Target Word (Present, Omitted), which was encoded as −0.5 and 0.5. The averages of each of dependent variable (first-fixation duration, gaze duration, and total time) in the two conditions are presented in Table 1. The models for each dependent variable included both subjects' and items' intercepts and slopes—the model was simplified when it did not converge or a singular convergence occurred. (The models are given in Supplemental Appendix B.) We conducted the analyses with a log transformation of the eye fixation measures, but the pattern was the same had we used untransformed data. Finally, as our hypothesis involved the null hypothesis, we obtained an estimate of the evidence in favour of (or against) the null hypothesis. Specifically, we computed Bayes Factors using the default priors in the BayesFactor package (Morey et al., 2015)—note that $BF_{10} = 15$ would mean that the alternative hypothesis is 15 times more likely than the null hypothesis with that set of observations.

First-fixation duration

The duration of the first-pass first-fixations on the target word was, on average, only 5 ms faster when the accent mark was present than when it was omitted and it was not significant

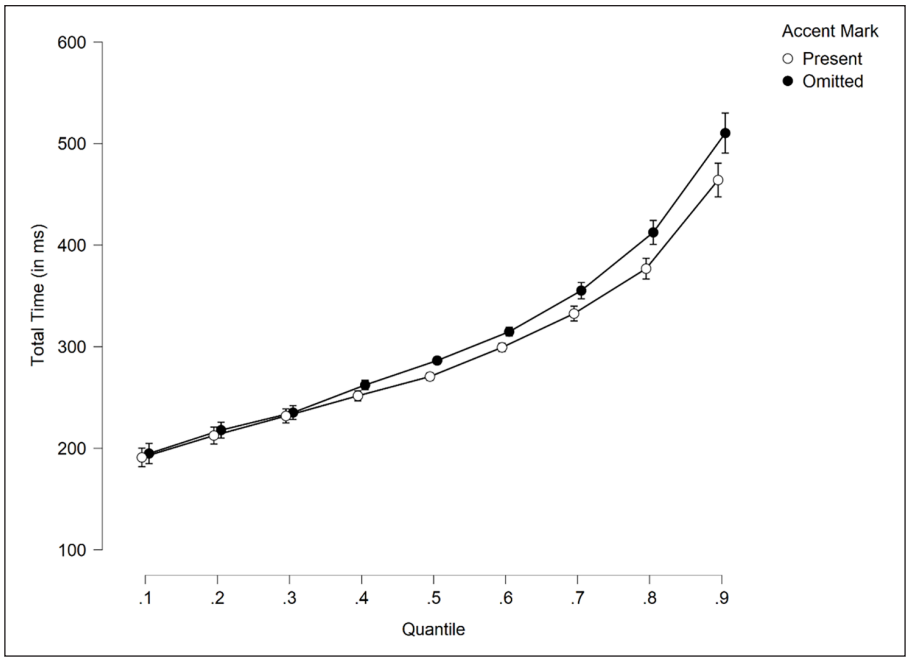

Figure 1. Vincentile plot on the total time on the target word. The bars represent the standard errors of the mean.

with an uncorrected alpha value, $b=0.0190$, $SE=0.0100$, $t=1.911$, $p=.0691$. Indeed, the corresponding Bayes Factor favoured the null hypothesis, $BF_{10}=0.279 \pm 2.57\%$. Thus, the 5 ms difference on first-fixation durations is best regarded as a null effect.

Gaze duration

First-pass gaze durations on the target word were, on average, only 3 ms faster when the accent mark was present than when it was omitted, $t<1$. Bayesian analyses showed strong evidence towards the null hypothesis, $BF_{10}=0.0641 \pm 0.72\%$.

Total time

The total time on the target word was, on average, 21 ms shorter when the accent mark was present than was it was omitted, $b=0.0494$, $SE=0.0149$, $t=3{,}398$, $p=.003$. This difference strongly favoured the hypothesis that there is a cost of omitting the word's accent mark when reading, $BF_{10}=43.68 \pm 1.03\%$.

For completeness, via robust indexes, we computed the Vincentile plot of the differences in the total time on the target word when the accent mark was omitted or present for the .1, .2, .3, .4, .5, .6, .7, .8, and .9 quantiles averaged per participant (see Staub et al., 2010, for the first application to distribution analyses to eye movement experiments during reading). As shown in Figure 1, there was a gradual increase in the reading cost due to the omission of the target mark—note that the short eye fixation times would probably reflect those trials in which there was no re-reading of the target word.

We conducted some post hoc analyses to shed some light on the potential sources of the reading cost due to omitting the accent mark on the total time. We examined two possibilities: (1) more regressions back to the target word; and (2) longer go-past durations (i.e., the sum of first-pass fixations from first fixating the target word [critical region] to leaving it on the right, including regressions earlier to the target word). First, participants effectively made more regressions to the target word when the accent mark was omitted than when it was present (9.3% vs. 7.7%, respectively; $b=0.402$, $SE=0.197$, $z=2.044$, $p=.041$). Second, go-past durations were longer when the accent mark was omitted than when it was present (298 ms vs. 287 ms; $b=0.030$, $SE=0.013$, $t=2.299$, $p=.023$).[2]

Finally, we conducted some exploratory analyses to test whether reading cost due to the omission of an accent mark in total times on the target word was modulated by the position of lexical stress (last, second-to-last, third-to-last). Results showed that the advantage of the baseline over omitted condition was somewhat greater when the accent mark fell on a non-canonical position (35 ms: third-to-last position [33 words]; 28 ms, last position [27 words]) than when the accent fell on the standard, second-to-last position (11 ms [60 words])—note, however, that one should be cautions of post hoc exploratory analyses.

Discussion

Recent lexical decision experiments in Spanish have revealed that omitting the accent mark in a word does not entail longer word identification times (e.g., cárcel=carcel; Schwab, 2015; fácil-FÁCIL=facil-FÁCIL; Perea

et al., 2020). These findings were interpreted in terms of accented and non-accented vowels activating the same abstract orthographic representations—note that accent marks in Spanish indicate lexical stress with no changes in vowel quality. Here we examined whether this pattern holds in a more ecologically valid scenario (i.e., silent sentence reading). To that end, a set of words with a normative accent mark (e.g., frágil) were embedded in meaningful sentences and silently read for comprehension. The accent mark was omitted in half of the trials. Results showed similar first-pass durations (first-fixation durations, gaze durations) on the target word regardless of whether the accent mark was present or omitted (cárcel = carcel). This null effect is fully consistent with the evidence of masked priming experiments in Spanish (fácil-FÁCIL = facil-FÁCIL; Perea et al., 2020). Therefore, the early stages of lexical access during sentence reading (e.g., as indexed by the L1 [familiarity stage] of the E-Z Reader model, Reichle et al., 1998) do not seem to be affected by the lack of the accent marks in a Spanish word. This finding, together with the results with word identification tasks (Perea et al., 2020; Schwab, 2015), suggests that the accent marks are not an inherent element of the orthographic representation of Spanish words.

In addition, we found a reading cost (around 21 ms) due to the omission of the accent marks in the total time spent on the target word (i.e., when taking into account re-reading and not just first-pass fixations). Thus, while omitting an accent mark does not affect the initial contact with the lexical entries, it affects later lexical processing. The existence of an effect in total times on the target word, but not in the first-pass measures (first-fixation duration, gaze duration), has been reported in earlier eye movement experiments (neighbourhood frequency effects: Perea & Pollatsek, 1998; effects of legibility of fonts: Rayner et al., 2006; Slattery & Rayner, 2010, effects of reading handwriting words: Perea et al., 2018). An explanation of this pattern, which was due to an aggregate effect of re-reading (longer go-past durations, more regressions) can be explained in terms of more difficulties at a post-access processing stage, as suggested by Slattery and Rayner (2010). While admittedly ad hoc, an explanation is that the activation produced by the words with the omitted accent (e.g., carcel) induces some extra uncertainty that may require re-inspection (see Bicknell & Levy, 2010)—keep in mind that the omission of the accent mark in Spanish constitutes a spelling error in writing. As indicated earlier, participants were not informed that some words did not have the normative accent marks, and some participants could have noticed the missing accent marks and re-inspected the words. What we should note here is that, when using a semantic categorization task, Labusch et al. (2021) found similar response times to Spanish words like cárcel and carcel—participants were asked not to pay attention to whether the normative accent mark was present or omitted. They did find, however, a small advantage for cárcel-type items for the long responses. Thus, this pattern again suggests that accent marks could play a small role at late stages of lexical access in Spanish.

As indicated in the Introduction, lexical stress falls on in the second-to-last position on nearly 80% of Spanish words (Quilis, 1993). Thus, the effect of omitting the accent marks in Spanish may be less in the canonical position (second-to-last position) than in the non-canonical positions. Indeed, in the above-presented exploratory analyses on the total times on the target word, we found a smaller cost when the accent fell on the canonical position (11 ms: cárcel vs. carcel) than in the non-canonical positions (e.g., 35 ms: brújula vs. brujula; 28 ms: corazón vs. corazón). While one needs to be cautious at the results of exploratory analyses, our data suggest that accent marks could play a smaller role in the canonical second-to-last position. One possible reason for this pattern is that the penultimate is the position that skilled readers of Spanish expect lexical stress.

To sum up, we examined whether there is a reading cost during sentence reading in Spanish when the word's accent mark is omitted (e.g., cárcel vs. carcel). While we did find a reading cost of omitting the accent mark, this cost did not occur in the initial contact on the target word (first-pass eye fixation measures). Instead, it only appeared in eye movement measures that are associated to post-access lexical processing (total time, including re-reading). At an applied level, our findings offer some clues on future simplifications on the rules of Spanish accent marks—as indicated earlier, other Romance languages (e.g., Italian, Romanian) use accent marks much more sparingly. In light of the extant rules of accentuation in Spanish (Real Academia Española, 2010), which reduced the instances in which accent marks were required (e.g., sólo→solo), our findings suggest that these rules can be simplified with little cost.[3] Furthermore, the decrease in the number of rules would save some valuable time during language instruction with both developing readers in Spanish-speaking countries or with learners of Spanish as L2.

Author note

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Data accessibility statement

The data and materials from the present experiment are publicly available at the Open Science Framework website: https://osf.io/z95eb

Declaration of conflicting interests

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Supplementary material

The supplementary material is available at qjep.sagepub.com.

Notes

1. We acknowledge that this may not be the case in languages where accent marks may indicate vowel quality (e.g., é /e/ vs. è /ɛ/ in French). For instance, Trifonova and Adelman (2019) found a different effect of repeated letters on word recognition in French depending on whether the accented vowels were encoded with or without accent marks in the analyses. This dissociative pattern suggests that, in French, accented and non-accented vowels are represented as separate entries (see Chetail & Boursain, 2019, for evidence with the masked priming technique).
2. These analyses were conducted to shed light on the nature of the effect on total time (see von der Malsburg & Angele, 2017, for a cautionary note on multiples tests on eye movement measures).
3. As a Reviewer suggested, accent marks may help during language learning and literacy development, in particular for those words that are not stressed in the canonical last-but-one syllable. A developmental study comparing the effect of present vs. omitted accents would shed light on this issue—indeed, one could compare high- vs. low-frequency words in tasks that require pronunciation (e.g., naming task) and that do not require pronunciation (e.g., semantic categorization task).

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