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The contrastive value of lexical stress in visual word recognition: Evidence from Spanish

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Abstract

Background: Many pairs of words in Spanish, in particular many verbal forms, differ only in the syllable stressed, such as aNImo (I encourage) and aniMÓ (he encouraged). Consequently, word stress may acquire a lexical contrastive value that has been confirmed by Dupoux, Pallier, Sebastian, and Mehler (1997) for Spanish speakers though not for French speakers in auditory perception. **Method:** This study contrasts the priming effect produced by pairs of written words that differ only in their stress pattern with the priming effect in repetition priming, stress only priming (with no orthographic relation), and morphological priming, in visual word recognition. **Results:** The results, using short and masked prime presentation, showed facilitation for different stress (orthographically identical) pairs (rasGÓ/RASgo) compared to totally unrelated pairs (dorMÍ/RASgo) but no facilitation compared to orthographically unrelated (but stress related) pairs (PERsa/RASgo). However, identity pairs (RASgo-RASgo) produced facilitation compared to both orthographically unrelated conditions. At long SOA, orthographically related (stress unrelated) pairs produced significant facilitation, as occurred with morphologically related pairs (RASga/RASgo), on the orthographically unrelated words (PERsa/RASgo). **Conclusion:** These results confirm the early and prelexical importance of word stress for lexical selection in Spanish, as is the case with orthographic and phonological features.

Keywords: Lexical stress, accent, repetition priming, form priming, morphological priming, visual word recognition, prelexical processing.

Resumen

El valor contrastivo del acento léxico en el reconocimiento visual de palabras: evidencia del español. **Antecedentes:** muchos pares de palabras en español, en particular muchas formas verbales, difieren solo en la sílaba acentuada, tal como aNImo y aniMÓ. Así el acento puede adquirir un valor contrastivo que fue confirmado por Dupoux, Pallier, Sebastian y Mehler (1997) en español, pero no en francés, en percepción auditiva. **Método:** este estudio contrasta el efecto de primado en pares de palabras que difieren en su patrón de acentuación con el efecto de repetición, el primado solo de acento (sin relación ortográfica) y el primado morfológico en reconocimiento visual de palabras. **Resultados:** usando priming enmascarado se obtuvo facilitación para los pares con diferente acento (rasGÓ/RASgo) comparando con los pares sin relación (dorMÍ/RASgo), pero no se produjo comparando con los no relacionados de igual acento (PERsa/RASgo). Sin embargo, los pares idénticos (RASgo-RASgo) produjeron facilitación comparando con ambas condiciones ortográficamente relacionadas. Con un SOA largo los pares con diferente acento (ortográficamente iguales) produjeron una facilitación significativa, como ocurrió con los pares relacionados morfológicos (RASga/RASgo), sobre los pares ortográficamente diferentes (PERsa/RASgo). **Conclusión:** estos resultados confirman la importancia del procesamiento temprano y preléxico del acento para la selección léxica en español, como ocurre con las características ortográficas y fonológicas de las palabras.

Palabras clave: acento léxico, primado de repetición, primado formal, primado morfológico, reconocimiento visual de palabras, procesamiento preléxico.

One particular word differs from others by one or more letters in the alphabetical languages. Some words differ in a single letter such as, in Spanish, *casa (house)* and *cama (bed)*, or in the order of letters and/or syllables, such as *bolo* (*skittle)* and *lobo (wolf)*. Sometimes a single letter becomes a critical property of contrast between different morphemes, as it happens with *cas-o (case)* and *cas-a (house)*, or different genders of the same stem morpheme, such as in *niñ-o (boy)* and *niñ-a (girl)*. However, a minimal contrasting feature can also govern the difference between words: the stress. This is the case for words such as *Ánimo (courage)*, *aNImo (I encourage)* and *aniMÓ (he encouraged)*.

Pairs of words differing only in one specific contrastive feature, such as *casa* and *cama* are more difficult to recognize than those differing in many features, such as *perro (dog)* and *cadena (chain)*. In the two last decades many studies on word recognition have focused on the psychological mechanisms allowing the selection of one lexical representation among a variable number of partially similar words (Andrews, 1997; Grainger, 1992; Marcet & Perea, 2017; Perea & Rosa, 2000). According to seminal studies such as Segui and Grainger (1990) we know that excitatory and inhibitory processes are important mechanisms of lexical selection and the letters become determinant features that make it possible to distinguish words. The goal of this article is to decide whether

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or not, in reading in Spanish, stress plays a similar role in lexical access as letters do. In fact, many words in Spanish can only be differentiated by the syllable that is stressed (e.g. *BEbe [he/she drinks]* and *beBÉ [baby]).*

Most studies of lexical stress have been carried out on the perception of speech (although things and changing, e.g., Sulpizio, Spinelli, & Burani, 2015) and have progressed in two directions (Cutler, 1986). *Lexical stress* theories are centered on the contribution of stress to lexical access as a prelexical cue, while *metrical stress* theories focus on the problem of listener use of strong and weak syllable alternation to identify word boundaries in speech (Cutler, 1986; Cutler & Clifton, 1985). English stress is lexical, associated with each word and can fall on any syllable of the word. In French, in contrast, the stress is not variable and always falls on the final syllable (Arciuli & Slowiaczek, 2007). The lexical contrastive function of English stress is, however, restricted to a small group of pairs of words. The majority of the most commonly used words (between 80% and 90%) have a pattern of strong-weak (Sw) syllables. The remaining words, weak-strong (Ws), are generally verbs. When stress is the only phonological cue that distinguishes a pair of words, one of them, the Sw word, is usually a noun and the Ws word a verb (Cutler & Carter, 1987). Members of the same grammatical category are not usually contrasted by the stress. Only this minimal feature contrasts some exceptions, such as FORbear and forBEAR.

The contrastive role of Spanish stress

Spanish stress may fall on any of the last three syllables of a word. The most frequent pattern is penult stress on vowel-final words (CAsa "house"). Consonant-final words stressed on the final syllable are considered regulars (carTEL "poster") while antepenult stress is always irregular (PÍcaro "villainous"; Pensado, 1999). According to Morales-Front (2014), about 64% of the Spanish words have the stress on the penult syllable, 28% on the last syllable and only 8% on the antepenult syllable. Eddintong (2000) carried out a stress classification of the 4829 most frequent polysyllabic words selected from the Alameda and Cuetos frequency dictionary of Spanish (1995) supporting this linguistic distinction: from the total of words ending in a vowel, 178 are stressed on the final syllable, 2494 on the penult syllable, and 178 on the antepenult syllable; from the total of consonant-final words (except plural words ending in the suffix –s) 778 are stressed on the final syllable, 176 on the penult syllable and 2 on the antepenult syllable. This lexical distribution of stress shows a more complex panorama than the simply predominant regularity of the Sw words in English. However, some English authors have developed models that consider stress as an important cue to search in the lexicon, even in visual word recognition. The model of Black and Byng (1986) predicts that search for a word in the lexicon begins with those having the most regular stress pattern. Gutiérrez, Palma, and Santiago (1998) tried to verify this prediction in Spanish using regular words (Sw) and irregular words (Ws) but only the number of errors and not the reaction times seems to favor the Black and Byng's model.

Perhaps the most important difference between Spanish and English is the capacity of Spanish stress to distinguish between words. Each word in Spanish has a defined and invariable stress pattern. Thus stress is, sometimes, the only feature that resolves the ambiguity derived from the existence of different words made up of the same phoneme strings (Á*nimo, aNImo, aniMÓ [the courage, I encourage, he encouraged]*). In written language this ambiguity is resolved by the presence or absence of a punctuation mark: the accent (´), indicating the syllable receiving the stress. The accent marks those stress patterns which, in Spanish, are most irregular (Á*nimo, animÓ*) and is not used for regular patterns, such as a*NImo*, stressed on the penult syllable or *carTEL*, stressed on the final syllable. In speech perception, Dupoux, Pallier, Sebastian, and Mehler (1997) demonstrated the capacity of Spanish listeners to distinguish, with an ABX paradigm, between pseudowords stressed on different syllables (A/ BOpelo, B/ boPElo, X) boPElo). French listeners, however, were unable to distinguish between the stimuli. Also, Soto, Cutler, and Sebastián (2001) found some results in favor of stress as a pre-lexical cue in Spanish. Gutiérrez-Palma and Palma-Reyes (2008) primed a word with correctly and incorrectly stressed words (e.g., técla-TECLA vs. teclá-TECLA) at short and long SOAs (33, 66, 100, and 143 ms) founding only facilitation at the longest SOA and inhibition at the incongruent priming also at 100 and 143 ms SOA. They suggest that stress affects lexical access at a late stage of lexical access processing. Against this late influence of the accent marks in Spanish, Perea, Abu Mallouh, Mohamed, Khalifa and Carreiras (2018) find a very early influence of the diacritic marks that differentiate Arabic letters. In a masked priming experiment, with a prime duration of 50 ms., they found an orthographic priming effect which was independent of whether the letter changed in its form or in the number and position of its diacritical marks with respect to the target. Also, both, form orthographic priming and diacritic priming produced similar and longer times than repetition priming. The participants in this experiment were children, but previously they had been obtained with adults (Perea, Abu Mallouh, Mohamed, Khalifa and Carreiras, 2016).

The aim of the present study is to contrast the priming effects produced by pairs of written words that differ only in their stress pattern, with the priming effect in several other experimental manipulations such as repetition priming, stress only priming, (without orthographic relation) and morphological priming, in visual word recognition. Deferring to the previous described study of Gutiérrez-Palma and Palma-Reyes (2008) all primes and targets were legal and existing words in Spanish. The general aim, given the contrastive role of stress in Spanish, is to know whether or not stress is a relevant feature for early and pre-lexical processing of the word, as seems to occur with other orthographic and phonological features and also, with diacritical points in Arabic.

Experiment 1

This experiment attempts to compare different stress repetition priming (prime and target with total orthographic overlap but different stress pattern [*rasGÓ/RASgo, he tore- I tear or feature*]) with repetition priming (*RASgo/RASgo I tear/I tear*). This contrast aims to discover whether stress disagreement (with total orthographic overlap) is able to modify the facilitation produced by the total orthographic overlap. Repetition priming produces consistent facilitation according to many experimental studies (see the seminal articles of Forbach, Stanners, & Hochhaus, 1974; Forster & Davis, 1984; Perea & Rosa, 2000; and Scarborough, Cortese, & Scarborough, 1977, for a comparison of repetition and form priming). Different stress repetition priming and repetition priming will be compared with orthographically unrelated but stress related priming (*PERsa/RASgo, Persian/I tear or feature*).

Short exposition of the prime word (32 ms.), preceded by a mask will prevent conscious identification of the word and, therefore, predictive biases. This short SOA may also provide a picture of early stages in lexical processing. Our hypothesis is that the amount of facilitation will be as great as the number of features shared by prime and target. Repetition pairs have perfect orthographic and stress matching. However, different stress pairs match only orthographically and therefore, if stress is processed early, less facilitation is expected.

Method

Participants

Thirty psychology undergraduates at La Laguna University, Spain, participated in the experiment for course credit. All were Spanish native speakers with normal or corrected to normal vision.

Instruments

The stimuli were presented in the center of the screen of a PC with a 70 Hz refresh rate. The letters, in courier font, appeared as white characters on a dark background. The primes were presented in upper-case letters while the targets appeared in lower case. Each character covered approximately 0.38" of visual angle from a distance of 60 cm. These display characteristics were maintained in all experiments. Sixty target stimuli were each paired with an orthographically identical but different stress word (rasGÓ/RASgo), the same word (RASgo/RASgo) and an orthographically unrelated word (PERsa/RASgo). Prime and target had the same syllabic structure and length in number of letters. Twenty prime-target pairs were presented in each of the three conditions to each participant in such a way that they saw each prime and target once during the experiment. The prime words had a lower lexical printed frequency than the target. This frequency relation was constrained pair by pair. A list of fillers, word-word unrelated pairs and word-nonword related and unrelated pairs, were introduced to reduce the percentage of orthographically related word-word pairs to 44 %. The percentage of related word-nonword pairs was 17 %. Nineteen experimental targets were words of four letters and forty-one were five letters long. Some fillers were four, five, six or seven letters long to approximate the characteristics of the stimuli to normal Spanish distribution. All targets were grammatically ambiguous as they could be categorized either as verbs or as nouns. The primes for the orthographic category were unambiguous verbal forms, whereas for repetition pairs they were, obviously, ambiguous. The category of unrelated pairs was made up of a random selection of grammatically ambiguous and non-ambiguous lexical items.

Procedure

The masking procedure was similar to that used by Forster and Davis (1984) and by Grainger, Colé and Segui (1991). The sequence of events that occurred in each trial was: firstly, a mask of hash marks (#), that exactly covered the number of spaces of the prime stimulus was presented for 500 ms. Second, the prime was exposed in the same place for 32 ms. and was immediately followed by the target stimulus, which remained on the screen until participant response. Participants were not informed of the prime presence. They were told that one stimulus would appear in the center of the screen and their task consisted of pressing a key as rapidly and as accurately as possible, "YES" if a word and "NO" if a nonword appeared. The computer recorded response keys and latencies.

Data analysis

A main factor, Type of Priming, with three levels was introduced: orthographic priming, repetition and unrelated priming.

Results

Mean reaction times (RTs) for correct responses in each condition excluding errors (2.78 %) are presented in Table 1. ANOVAs were carried out by participants (F1) and by items (F2). Latencies exceeding 1200 ms. or not reaching 200 ms. were excluded from the analysis (2.94%) of the data). These two cut-off points were maintained in all the experiments.

The factor Type of Priming produced significant effects on the RTs. ($F1(2,58)=12.82$, $p<0.001$, $Mse=1169.11$; $F2(2,118)=12.96$, $p<0.001$) as a result of the shorter times for repetition priming. Separate ANOVAs were carried out to establish paired comparisons between conditions. The 39 ms difference between repetition priming and different stress priming was statistically significant ($F1(1,29)=19.13$, $p<0.001$, $Mse=1141.30$; $F2(1,59)=17.12$, $p<0.001$, $Mse=2426,80$). Both types of pairs overlap in all letters. The only difference is that the orthographic pairs were stressed on a different syllable. Also, repetition pairs produced a significant difference of 40 ms. with the unrelated pairs ($F1(1,29)=21.03$, $p<0.001$, $Mse=1099.62$; $F2(1,59)=23.19$, $p<0.001$, $Mse=2629,90$) which do not share any letter in the same position but were stressed on the same syllable. However, different stress priming did not produce any significant effect on the unrelated pairs ($F1(1,29)=0.01$, $p=0.90$, $Mse=1266.39$; $F2(1,59)=0.62$, $p<0.435$, $Mse=3000,31$).

Experiment 2

The null facilitation of the different stress pairs in Experiment 1 was interpreted as the incapacity of two words, although sharing

Table 1
Mean reaction times (and percentage of errors) in experiment 1

Type of priming			Differences		
Different Stress rasGÓ/RASgo	**Repetition RASgo/RASgo**	**Unrelated PERsa/RASgo**	**D1**	**D2**	**D3**
695 (3.33)	656 (1.33)	696 (3.66)	1	40	39

Note: D1 is the difference between Different Stress and Unrelated pairs, D2 is the difference between Repetition and Unrelated pairs and D3 is the difference between Different Stress and Repetition pairs

all letters, to produce facilitation because of non-matching in their stress pattern (*rasGÓ*/*RASgo*). The 32 ms of prime exposition was sufficient to produce orthographic processing as was suggested by the effectiveness of the repetition priming. If orthographic and stress computation occur independently during the early milliseconds of processing, it is possible to interpret the null effect of the orthographic pairs as being due to the fact that the non-related items did not constitute an adequate base line. In fact, the orthographically unrelated items used in Experiment 1, such as *PERsa*/*RASgo*, are stress related words because the stress falls on the penult syllable in both words. It is not unlikely, then, that this orthographically unrelated condition was producing an stress facilitation. Experiment 2 attempts to clarify this question by introducing a more adequate unrelated condition. Orthographically and stress unrelated pairs, such as *dorMÍ*/*RASgo,* were introduced to compare with the different stress repetition words (*rasGÓ*/*RASgo*) and orthographically unrelated words (*PERsa*/*RASgo*) used in the previous experiments. It was expected that, maintaining the 32 ms. SOA of experiment 1, *rasGÓ*/*RASgo* would produce some facilitation with respect to the new base line because of the orthographic overlapping. Also, the orthographically unrelated pairs of experiment 1 (*PERsa*/*RASgo*) would produce facilitation on the really unrelated pairs because of the stress relationship.

Method

Participants

Thirty psychology undergraduates at La Laguna University, in Spain, participated in the experiment for course credit. All were Spanish native speakers with normal or corrected to normal vision.

Instruments

The primes of the morphological category of experiment 1 were removed and replaced by another verbal form that changes the position of the stress to the final syllable. If the target was the first person of the present *RASgo*, the prime was the third person of the past *dorMÍ*. All the other stimuli remained as in the first and second experiment. The percentage of orthographically related word-word pairs was 22 % and of word-nonword pairs was 17%.

Procedure

The same as in experiment 1 (SOA of 32 ms.)

Data analysis

A main factor, Type of Priming, with three levels was introduced: different stress repetition priming (rasGÓ/RASgo), orthographically unrelated priming (PERsa/RASgo) and totally unrelated priming (*dorMÍ*/RASgo).

Results

Mean reaction times (RTs) for correct responses in each condition excluding errors (1.9 %) are presented in Table 3. ANOVAs were carried out by participants (F1) and by items (F2). Latencies exceeding 1200 ms. or not reaching 200 ms. were excluded from the analysis (2.5 % of the data).

The main factor, Type of Priming, produced significant effects by participants ($F1(2,58)=4.79$, $p<0.05$, $Mse=803.78$; $F2(2,118)=2.74$, $p=0.06$) as a result of the facilitation of stress different related targets and orthographically unrelated targets on the totally unrelated targets. Separate ANOVAs were carried out to establish paired comparisons between conditions. The 20 ms difference between stress different repetition priming and the totally unrelated condition was statistically significant by participants and items ($F1(1,29)=8.01$, $p<0.01$, $Mse=717.97$; $F2(1,59)=4.62$, $p<0.05$, $Mse=1747,83$). Also the orthographically unrelated pairs produced a similar significant difference of 20 ms. with the totally unrelated pairs ($F1(1,29)=7.93$, $p<0.01$, $Mse=729.92$; $F2(1,59)=4.33$, $p<0.05$, $Mse=2867,35$). However, no difference between stress different related and orthographically unrelated pairs was obtained, as occurred in Experiment 1.

The results of Experiment 1 were replicated in this experiment because no differences were found between the *rasGÓ*/*RASgo* pairs and *PERsa*/*RASgo* pairs. Both conditions produced in Experiment 2 significant differences with the totally unrelated pairs (*dorMÍ*/*RASgo*). However, the facilitation of these two types of pairs was produced by different factors. Stress different related pairs produced facilitation because of the orthographic overlap, whereas orthographically unrelated pairs produced facilitation because of stress overlap.

Experiment 3

There remains one more contrast to be carried out. The different stress repetition condition in experiments 1 and 2 is also a condition of morphologically related words. Primes and targets such as *rasGÓ* and *RASgo* are inflections of the same verbal stem *rasg-*: *rasGÓ* is the third person of the past form of the verb, whereas *RASgo* is the first person of the present. Some studies have shown facilitation for prime and target that differ only in their gender or number forms (Alvarez, Urrutia, Dominguez & Sanchez-Casas, 2011; Dominguez, Segui & Cuetos, 2002; Dominguez, De Vega & Barber, 2004; Drews & Zwitserlood, 1995; see also Amenta & Crepaldi, 2012, for a revision of morphological processing). The

Table 2
Mean reaction times (and percentage of errors) in Experiment 2

Type of priming			Differences		
Different Stress rasGÓ/RASgo	**Orth.Unrelated PERsa/RASgo**	**Totally Unrelated dorMÍ/RASgo**	**D1**	**D2**	**D3**
650 (2.33)	650 (3.00)	670 (2.00)	20	20	0

Note: D1 is the difference between Different Stress and Totally Unrelated pairs, D2 is the difference between Orthographically Unrelated and Totally Unrelated pairs and D3 is the difference between Different Stress and Orthographically Unrelated pairs

third experiment, then, focuses on the comparison of different stress repetition priming with morphological priming while using a longer SOA of 224 ms. The purpose of this experiment is to contrast stress different pairs and the unrelated pairs of experiment 1 (PERsa-RASgo) at a longer SOA. Given the morphological and semantic relation between words of this category (rasGÓ-RASgo), we expect reliable facilitation of the orthographically unrelated pairs (stress related) at 224 ms. SOA. This facilitation, if produced, will be compared with morphological priming using words sharing the stem of the verb and changing their suffix, in this case, the last letter: *RASg-a/RASg-o*.

Method

Participants

Thirty psychology undergraduates at La Laguna University, in Spain, participated in the experiment for course credit. All were Spanish native speakers with normal or corrected to normal vision.

Instruments

The primes of the repetition category of the previous experiment were removed and replaced by another verbal form that changes the suffix of person to obtain the morphological priming category. If the target was the first person of the present *RASgo*, the prime was the third person of the present *RASga*. All the other stimuli remained as in experiment 1. The percentage of orthographically related and unrelated pairs of stimuli was similar to experiment 1.

Procedure

The same as the previous experiment, except for the time of exposition of the prime, which, in this experiment was of 224 ms.

Data analysis

A main factor, Type of Priming with three levels was introduced: different stress repetition priming (rasGÓ/RASgo), morphological priming (RASga/RASgo) and unrelated priming (PERsa/RASgo).

Results

Mean reaction times (RTs) for correct responses in each condition excluding errors (3.56 %) are presented in Table 2. ANOVAs were carried out by participants (F1) and by items (F2). Latencies exceeding 1200 ms. or not reaching 200 ms. were excluded from the analysis (7,44 % of the data).

The main factor, Type of priming, produced significant effects on RTs (F1(2,58)=9.96, p<0.001, Mse=2255.64; F2(2,118)=16.80, p<0.001) as a result of the facilitation of different stress orthographically related targets and morphologically related targets on the unrelated targets. Separate ANOVAs were carried out to establish paired comparisons between conditions. The 35 ms difference between different stress priming and the unrelated condition were statistically significant (F1(1,29)=8.04, p<0.01, Mse=2190.70; F2(1,59)=16.75, p<0.001, Mse=2804,65). Also the morphological pairs produced a significant difference of 55 ms. with the unrelated pairs (F1(1,29)=26.52, p<0.001, Mse=1654.44; F2(1,59)=28.36, p<0.001, Mse=3335,35). However, the difference between different stress priming and morphological priming (20 ms.) did not reach significant facilitation (F1(1,29)=2.02, p=0.166, Mse=2921.76; F2(1,59)=2.97, p=0.09, Mse=2777,72).

Experiment 1 used a very short prime exposition of 32 ms., which was seen to be insufficient to influence morphologically the target in the stress different pairs. The 224 ms prime exposition in this experiment did allow morphological processing. In this respect, the 55 ms. facilitation effect of morphological relatives (RASga/RASgo) supports this assumption of the need for longer prime exposition to allow morphological processing.

Discussion

A series of three experiments was carried out to study the contrastive value of the stress and accent marks in Spanish. The results, with the masked priming procedure, allow supporting an early processing of lexical stress. Experiment 1 showed that repeating a word as prime and target is not sufficient to obtain facilitation, if the stress pattern is not identical in both words. If the stress falls on different syllables (*rasGÓ-RASgo*), no facilitation is obtained with respect to the unrelated condition. In contrast, the same stress pattern (repetition priming) produces facilitation (*RASgo-RAS-go*). The absence of facilitation with a very short SOA (32 ms.) for stress different pairs could be interpreted as the balance between facilitation due to orthographic overlap and inhibition due to the lack of stress agreement leading to competing lexical representations. Experiment 1 allows us to infer the importance of stress in lexical access, based on the null facilitation for different stress orthographically identical pairs in relation to repetition priming. However, a verification of this effect was necessary at short SOA. Experiment 2 introduced a new control condition without orthographic or stress relation (*dorMÍ-*

Table 3
Mean reaction times (and percentage of errors) in Experiment 3

Type of priming			Differences		
Different Stress rasGÓ/RASgo	**Morphological RASga/RASgo**	**Unrelated PERsa/RASgo**	**D1**	**D2**	**D3**
722 (2.99)	702 (2.55)	757 (5.16)	35	55	20

Note: D1 is the difference between Different Stress and Unrelated pairs, D2 is the difference between Morphological and Unrelated pairs and D3 is the difference between Different Stress and Morphological pairs

RASgo). The goal was to compare this condition with the control condition of the previous experiment (PERsa-RASgo) to obtain, as in fact occurred, a net facilitation due only to stress overlap without orthographic relation. The orthographic condition (*rasGÓ-RASgo*) also produced significant facilitation on the totally unrelated pairs (*dorMÍ-RASgo*). Stress computation and orthographic processing seem to work in a parallel and independent way because orthographic priming without stress overlap produced facilitation but stress priming without orthographic relation also produced similar facilitation.

Because prime and target in the different stress repetition condition are also morphological relatives, Experiment 3 used a longer time window (SOA 224 ms.) to recover the morpho-semantic processing. Pairs such as *rasGÓ-RASgo* are inflectional forms of the same verbal stem. It was expected that the early inhibition produced by a different stress pattern would be substituted by late morphological and semantic facilitation. The results confirmed the initial prediction. The orthographic pairs produced, in this experiment, significant facilitation. Even though this facilitation was 20 ms. smaller than that obtained for morphological pairs (*RASga-RASgo*), the difference was not statistically significant and might point to a lesser importance of letters in lexical discrimination as compared to stress.

In summary, stress could be considered a prelexical element that the visual word recognition system uses to arrive at the lexicon as also Gutiérrez-Palma and Palma-Reyes (2008) point-out, but in contrast with their results, the contrastive value of stress in our experiments has a very early effect, perhaps due to the illegal pattern of the orthographic marks used in the primes of their experiments, that slow the recognition of the target. Our results are in agreement with those of Perea et al. (2016, 2018) supporting early processing of diacritical marks in Arabic language. These diacritical marks are points situated, in different number and position, on the letters that change the lexical value of the word. Many Arabic words differ physically only in the presence and/or location of the diacritical points. The accent in Spanish seems to fulfill this early contrastive function.

If phonemes, syllables or letters are considered prelexical units in recognizing a word, it is logical that lexical stress is also a prelexical unit that restricts, by means of recognition of the stressed syllable, the lexical field of search or the amount of activated units in the lexicon. This lexical function of stress appears to be especially active in Spanish, a language which, in contrast with English, uses stress on many occasions as the minimal feature that distinguishes pairs of words within the same grammatical category or between categories (Soto, Cutler, & Sebastián, 2001). Spanish verbs constitute a special group of words that use stress to distinguish some of their forms.

Two points, at least, remain unresolved. Firstly, with reference to the nature of stress processing, we do not know whether this is a visual or a phonological operation during reading. Spanish stress is orthographically marked with an accent (´) on the vowel of the stressed syllable and is governed by specific rules familiar to readers and writers. The presence or absence of the accent and the consonantal or vocalic end of the words indicates which is the stressed syllable of written words. These rules allow the reader to access correctly the stress pattern of known or unknown words. Therefore stress, a prosodic and phonological cue, is inferred in reading using only visual and prelexical information. Our data do not allow to know whether or not this visual feature is transformed into a phonological pattern that permits lexical activation or search to occur in a phonological lexicon, as may occur with letters into phonemes using grapheme to phoneme rules (Coltheart, 1978).

The second problem is more technical but no less important. The targets used in the experiments are grammatically ambiguous. *RASgo* as an individual word is a noun or a verbal form (first person present of the verb *rasGAR).* This aspect might be considered a problem because some linguists consider that stress assignment is governed by different rules for verbs and nouns (Roca, 1988), but this opinion is not free of controversy (Eddington, 2000; Harris, 1989). Another question that might be important in our stimuli is that some of these are not only grammatically ambiguous but also semantically ambiguous. *RASgo* means *feature* as a noun and *to tear* as a verb. Some other targets are only grammatically ambiguous. For example, *RObo* as a verb, means *to steal* and, as a noun, means *robbery*. This is a very interesting aspect in relation to stress assignment that should be considered for future research but it was not, for the moment, the focus of this research.

Essentially, our conclusion is that the stress pattern of a word is prelexically computed. Stress seems to have, in Spanish, a crucial function in comparison to other languages, such as English, because the number of pairs of words differing only in this characteristic is abundant. English stress does not have, perhaps, this lexical function but it has, rather, a metrical utility to define the boundaries of words in speech perception, such as has been attributed by Cutler. It is not likely, then, in English, to obtain a result such as that found in Spanish, as in visual word recognition the words appear segmented on the paper.

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