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The role of syllables in intermediate-depth stress-timed languages: masked priming evidence in European Portuguese

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Abstract The role of syllables as a sublexical unit in visual word recognition and reading is well established in deep and shallow syllable-timed languages such as French and Spanish, respectively. However, its role in intermediate stress-timed languages remains unclear. This paper aims to overcome this gap by studying for the first time the role of syllables at early stages of visual word recognition in Portuguese (European), a language where the spelling-sound correspondences are less transparent than Spanish but less opaque than French, and also with fuzzier syllabic boundaries than both languages. To that purpose, 36 native speakers of Portuguese performed a lexical decision task combined with a masked priming paradigm. Ninety-six dissyllabic Portuguese target words, and 96 nonwords, half of which with a CV (*ru.mor* [rumor]) and the other half with a CVC first-syllable structure (*forno* [oven]), were preceded by a briefly presented nonword prime (50 ms) that could be syllable congruent (e.g., ru.mis-RU.MOR, for.pa-FOR.NO), syllable incongruent (e.g., rum.pa-RU.MOR, fo.rou-FOR.NO), or unrelated (e.g., ca.fas-RU.MOR, pou.me-FOR.NO) with the targets. Results were clear-cut and showed a facilitative syllabic priming effect in Portuguese, as target words preceded by syllable congruent primes were recognized faster and more accurately than when preceded either by incongruent or unrelated primes, although the effect was restricted to CV words. For nonwords there were no signs of syllabic effects. The findings are discussed attending to the characteristics of the Portuguese language and to current models of visual word recognition.

Keywords Syllable · Visual word recognition · Priming · Sublexical unit

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Introduction

Although reading is a fast and virtually an effortless activity for skilled readers, recognizing words is a tremendously complex process (e.g., Coltheart, Rastle, Perry, Langdon, & Ziegler, 2001; Perry, Ziegler, & Zorzi, 2010; Plaut, McClelland, Seidenberg, & Patterson, 1996; Seidenberg & McClelland, 1989; Ziegler, Perry, & Coltheart, 2000; Zorzi, Houghton, & Butterworth, 1998). Identifying the factors that affect its recognition has been a main focus of research in cognitive sciences since its early beginnings (e.g., Huey, 1908; Taft & Forster, 1976). However, most of the models developed so far can only account for the visual word recognition effects of monosyllabic words (e.g., Coltheart et al., 2001; Plaut et al., 1996; Seidenberg & McClelland, 1989; Ziegler et al., 2000). This is an important limitation since polysyllabic words are much more common than monosyllabic words in the majority of languages. For instance, in European Portuguese (EP), Soares et al. (2014) highlighted that only 641 words (0.3%) of the Procura-PALavras (P-PAL) wordform corpus (a printed corpus of approximately 227 million words) corresponded to monosyllables (see also Soares et al., 2015 for additional evidence in a subtitle corpus). The same is also observed in other languages such as English (e.g., Baayen, Piepenbrock, & van Rijn, 1993), or Spanish (e.g., Vitevitch & Rodriguez, 2005). Therefore, understanding the processes and mechanisms that underlie the visual word recognition for words beyond one syllable long is imperative in the current visual word recognition literature (e.g., Brand, Rey, & Peereman, 2003; Davis, 2010; Norris & Kinoshita, 2012; Perry et al., 2010; Yap, Tse, & Balota 2009). What is known about the lexical and sublexical factors impacting the visual word recognition of monosyllables might not be directly generalized to polysyllables whose processing introduces additional questions such as stress assignment, vowel reduction and syllabic parsing. These phenomena can significantly change the way the majority of words in a language (polysyllables) are processed and recognized.

Syllable as a unit of visual word recognition of polysyllabic words

Although several units such as letters, phonemes (e.g., Pelli, Farell, & Moore, 2003; Rastle & Brysbaert, 2006; Seidenberg, 1988), bigrams (e.g., Conrad, Carreiras, Tamm, & Jacobs, 2009; Doignon & Zagar, 2005; Seidenberg, 1987; Seidenberg & McClelland, 1989) and morphemes (e.g., Rastle, Davis, & New, 2004; Schilling, Rayner, & Chumbley 1989), have been proposed as sublexical components that mediate processing between letter input and lexical representations, most authors agree that above letter features processing, the syllable plays a functional role in reading, due primarily to its importance in speech production and perception (e.g., Mehler, Dommergues, Frauenfelder, & Segui, 1981; Morais, Content, Cary, Mehler, & Seguí, 1989; Sebastián-Gallés, Dupoux, Segui, & Mehler, 1992). Indeed, although syllables are considered phonological units in word processing, many studies support the idea that phonological representations are activated during reading (e.g., Frost, 1998; Newman, Jared, & Haigh, 2012).

Therefore, it is not surprising that many studies conducted in different languages such as Spanish (e.g., Álvarez et al., 2001, 2004; Álvarez, de Vega, & Carreiras, 1998; Álvarez, Taft, & Hernández-Cabrera, 2016; Carreiras et al., 1993; Carreiras & Perea, 2002; Carreiras, Vergara, & Barber, 2005; Perea & Carreiras, 1998), French (e.g., Chetail & Mathey, 2009; Conrad et al., 2007; Marín & Carreiras, 2002; Mathey & Zagar, 2002), German (e.g., Conrad et al., 2008; Conrad & Jacobs, 2004; Conrad, Stenneken, & Jacobs, 2006; Hutzler, Conrad, & Jacobs, 2004; Stenneken, Conrad, & Jacobs, 2007), and English (e.g., Ferrand, Segui, & Humphreys, 1997; Macizo & Van Petten, 2007; Prinzmetal, Treiman, & Rho, 1986; Rapp, 1992; Schiller, 1999, 2000; Taft, 2001, 2002), have analysed the role of syllables in the recognition of printed words. This has been done mainly through the manipulation of the frequency of occurrence of the (first) syllables within words (e.g., Álvarez, Carreiras, & de Vega, 2000; Álvarez et al., 2001; Carreiras et al., 1993; Conrad et al., 2006, 2007, 2008; Macizo & Van Petten, 2007; Perea & Carreiras, 1998; Stenneken et al., 2007), and/or by exploring the (in)congruency of the syllables (first) shared between primes and targets in priming paradigms (e.g., Álvarez et al., 2004; Carreiras & Perea, 2002, 2011; Chetail & Mathey, 2009; Ferrand et al., 1997).

Syllable frequency studies

The rationale of the studies manipulating first-syllable frequency relies on the idea that, if readers parse printed words into syllables then the number of times a syllable occurs in a language (i.e., its frequency of occurrence) should impact word recognition. Carreiras et al. (1993), in one of the first studies conducted to explore the role of the syllable in the visual word recognition of Spanish, manipulated the frequency of the first syllable. Thus, two groups of words were created, words with a high versus low first-syllable frequency. The results demonstrated that high-frequent syllable words elicited longer response times and higher error rates than low-frequent syllables words. This inhibitory effect, observed in subsequent studies conducted in Spanish (see Álvarez et al., 2000, 2001; Carreiras & Perea, 2002; Perea & Carreiras, 1998) and also in other languages (e.g., French: Mathey & Zagar, 2002; German: Conrad & Jacobs, 2004), and using other techniques (e.g., eye tracking: Hutzler et al., 2004; Event Related Potentials [ERPs]: Barber, Vergara, & Carreiras, 2004; Goslin, Grainger, & Holcomb, 2006), was explained by the fact that words beginning with high-frequent syllables activate more lexical candidates than words beginning with low-frequent syllables, thus delaying word recognition for words from larger syllabic neighbourhoods that compete strongly for word selection (see Conrad, Tamm, Carreiras, & Jacobs, 2010 for a recent computational implementation of this mechanism, to account for the syllable frequency inhibitory effect in Spanish).

For English, however, there is much less evidence supporting the role of syllables in visual word recognition (e.g., Macizo & Van Petten, 2007; Prinzmetal et al., 1986; Rapp, 1992; Taft, 2001, 2002; see however the naming study by Ferrand, Segui, & Humphreys, 1997, that showed evidence towards the syllable as a sublexical unit, for words with clear syllable boundaries). The fact that English is a language in which the mapping between orthography and phonology is much more opaque than in other languages (such as Spanish that exhibits a shallow orthography) and also the fact that it presents less clear syllabic boundaries than Spanish, French, or German, have been advanced as the potential explanations for the absence of reliable syllabic effects in English. Moreover, syllables seem to have less perceptual relevance in stress-timed languages, as English, than in syllable-timed languages, like Spanish or French (e.g., Bradley, Sanchez-Casas, & Garcia-Albea, 1993; Cutler, Mehler, Norris, & Segui, 1983, 1986). In syllable-timed languages the duration of each syllable is fairly equal, whereas in stress-timed languages syllables may last different amounts of time. Note that in these languages the duration of unstressed syllables varies considerably in order to make stress syllables occur at roughly equal intervals of time (see Nespor, Shukla, & Mehler, 2011 for details), which could also contribute to attenuate the role of syllables as a perceptual unit for word recognition. Furthermore, as pointed out by Mattys and Melhorn (2005), stress-timed languages are also characterized by exhibiting more syllabic complexity (in number and variety of syllable types), and other phonological characteristics. Specifically, phenomena such as vowel reduction (i.e., in the spoken language, many vowels are not pronounced, causing a mismatch between the syllable division observed in speech and in print) and ambisyllabicity (i.e., the fact that a given consonant could both the coda of one syllable and the onset of the following syllable). These features contribute to make syllabic boundaries fuzzier and the syllable a less likely candidate for lexical access. In these languages, other units can assume a major role in word recognition. For instance, Taft (1979, 1992) proposed that English words are parsed according to the Basic Orthographic Syllabic Structure (BOSS), in which the coda of the first printed syllable is maximized without violating English orthographic rules (for instance the word *radio* would be syllabified as *rad-io* and not as *ra-dio*).

Syllable congruency studies

The role of the syllable in reading has also been investigated with masked priming paradigms that explored the congruency of the syllable structure shared between prime and target (e.g., Álvarez et al., 2004; Brand et al., 2003; Carreiras & Perea, 2002, 2011; Chetail & Mathey, 2009; Ferrand et al., 1997; Schiller, 1999, 2000). The masked priming paradigm, developed by Forster and Davis (1984), is a widely used paradigm to explore sublexical effects (such as syllabic effects) during the first stages of visual word recognition. Indeed, as it involves the brief presentation of a prime (virtually invisible), the information about the prime is (almost) inaccessible to consciousness (Forster, 1988). Yet, strong effects of the prime on the processing of the target were systematically observed in the cognitive literature (for reviews, see Kinoshita & Lupker, 2003; or Van Den Bussche, Van Den Noortgate, & Reynvoet, 2009). Therefore, it is considered the standard paradigm to study early and automatic effects of visual word recognition, as it minimizes the potential influence of other (strategic) effects during lexical access (see Forster 1988 for more details).

Following this paradigm, Álvarez et al. (2004) conducted a LDT with Spanish skilled readers in which disyllabic target words beginning either with a CV (e.g., *ju.nio* [june]) or a CVC first-syllable structure (e.g., *mon.ja* [nun]) (note that C stands for consonant and V for vowel), were preceded by a brief (64 ms) nonword prime that could share the first three letters and the first syllable with the target (prime congruent condition, e.g., ju.nas-JU.NIO; mon.di-MON.JA), or the first three letters but not the first syllable with the target (prime incongruent condition, e.g., jun.tu-JU.NIO; mo.nis-MON.JA). Results showed that participants were significantly faster recognizing words preceded by a syllable congruent than a syllable incongruent prime, though surprisingly the effect was restricted to CV words. The authors attempted to explain this syllable structure effect (i.e., advantage of CV over CVC words) based on the idea that the CV is the most common syllabic structure in Spanish (e.g., in the Spanish lexicon there are three times more words starting with a CV syllable than with a CVC syllable), which might cause the parser to syllabify Spanish words by using a CV first-syllable structure by default. Because CVC words are much less frequent, it is possible that CVC syllables might not produce enough activation, and/or the activation produced is not fast enough as to elicit syllabic congruency effects for CVC words in a masked priming paradigm. Indeed, recent studies using event related potentials (ERPs), have studied the syllable frequency effect with CV and CVC words (see Goslin et al., 2006 for more details) using ERPs. The results showed that words with high frequent first syllables, produced more positive potentials in the time window between 300 and 600 ms, than word with low frequent first syllables. This was obtained for CV and CVC words alike. Therefore, it is possible that masked priming paradigms are not the most adequate to capture syllabic effects in CVC words, perhaps because the prime duration is too brief (note however that Carreiras & Perea, 2011, used longer prime durations and still the syllable congruency effect remained restricted to CV words).

Evidence for syllable effects from masked priming paradigms has also been observed in other languages. For instance, Chetail and Mathey (2009), conducted a LDT using the same procedure as Álvarez et al. (2004), with a 67 ms (Experiment 1) and a 43 ms (Experiment 3) prime durations with French participants, and additionally a naming study (Experiment 2) to analyse if syllable congruency effects could be observed both in visual and spoken modalities using the same materials. An “extra” unrelated condition was also included to test whether the syllable congruency effects could arise from any orthographic overlap between primes and targets. Results showed that when primes were displayed for 67 ms, similar results were found both in the LDT and in the naming tasks. Specifically, the results showed that words preceded by syllable congruent primes produced faster recognition/naming responses than when preceded by syllable incongruent and unrelated primes, but again only for CV words (e.g., *ba.lance* [balance]). For CVC words (e.g., *bal.con* [balcony]), congruent primes produced response times as faster as incongruent primes, both differing significantly only from the unrelated condition, that presented longer latencies. In Experiment 3, no significant priming effect was observed, neither for CV nor for CVC words. These findings not only replicate the results previously observed for Spanish, but also extend them as they show that the syllable congruency effect for CV words was of facilitation as syllable congruent condition differentiated both from the syllable incongruent and the unrelated conditions. However, for CVC words there was no sign of a genuine syllabic effect as, in this case, syllable congruent and syllable incongruent primes eased recognition (note that both conditions differentiated from the unrelated condition but not between each other). In line with the explanation advanced by Álvarez et al. (2004) and Chetail and Mathey (2009) suggested that the advantage of the CV over the CVC words could also arise from the fact that in French, as in Spanish, the CV is also considered the canonical syllable structure, which might make the parser to use a CV syllabification by default.

Although syllable effects in visual word recognition have been widely investigated in French and Spanish, for EP, as far as we know, the only study exploring syllable effects in word recognition was conducted by Morais et al. (1989) in speech perception. In this study, EP participants (illiterates and literates) were asked to detect a given segment (e.g., /*ga*/ or /*gar*/) within a CV (e.g., *ga.ragem* [garage]) or a CVC (e.g., *gar.ganta* [throat]) first-syllable structure word. Results showed that both groups made fewer mistakes when the segment to identify corresponded to the first syllable (e.g., /*ga*/ in *ga.ragem* [garage] and /*gar*/ in *garganta* [throat]) than when it did not (e.g., /*gar*/ in *ga.ragem* [garage] and /*ga*/ in *gar.ganta* [throat]), thus showing that the syllable plays a role in the recognition of EP spoken words. However, to the best of our knowledge, no previous studies were conducted in the written modality, thus remaining unanswered whether the syllable also assumes a functional role during the visual word recognition of EP words.

The present study

In this paper we aimed to study for the first time the role of the syllable at the early stages of visual word recognition, in EP. Studying syllabic effects during the word recognition of EP printed words is relevant not only because it would extend syllable effects in reading to another language, but importantly because EP presents several phonological and orthographic characteristics that place it in-between languages in which syllable effects has been systematically observed (Spanish, French) and not observed (at least so consistently, English). Like Spanish and French, EP is a Romance language, but contrarily to them exhibits a set of rules that govern the grapheme-phoneme correspondences that are more opaque than Spanish but more transparent than French, thus, being considered an intermediate-depth language (see Lima & Castro, 2010 for details). Moreover, it presents a pattern of syllabification that brings it closer to English than to Spanish or French. As with English, EP presents syllabic boundaries blurred by phenomena of ambisyllabicity and vowel reduction. Unstressed syllables, notably at the end of words, are reduced in speech (e.g., see Delgado-Martins, 2002; Mateus & Andrade, 2000), thus causing mismatches between syllable divisions in speech and print (for instance the final letter *e* in the EP word *leite* [milk] is supressed in speech, hence giving rise to a monosyllable in speech, *lˈɐjt*, and a dissyllable in print, *lei-te*). All these features contribute for EP being considered a stress-timed language, just like English (Frota & Vigário, 2001). Moreover, EP is also considered one of the Romance languages with one of the greatest syllabic complexity. For example, when considering disyllabic words, EP presents 25 permissible syllables at first position (data obtained from the P-PAL lexical database; Soares et al., 2014), whilst Spanish presents only 16 (data obtained from EsPal lexical database; Duhon, Perea, Sebastián-Gallés, Martí, & Carreiras, 2013), and French 15 (Adda-Decker, Mareuil, Adda, & Lori, 2005). Thus, the study of the syllable in a language such as EP can shed light into the linguistic characteristics that could contribute to the emergence of the syllabic effect across-languages.

Critically, if syllabic effects in visual word recognition are driven by the suprasegmental characteristics of speech, we expect that syllabic effects observed in EP might not be as strong as those observed for Spanish and French. However, if the syllabic effects are driven by the transparency of the orthography, and/or by and by the clarity of the syllabic boundaries, we expect to observe syllabic effects in EP similar to those observed in Spanish or French. Nonetheless, it is also important to note that if syllable effects would be observed in the recognition of EP printed words, we also expect that they will be observed both for CV and CVC words conversely to what has been observed in Spanish or French languages. Indeed, if we consider that EP presents greater syllabic type diversity, as mentioned, and also that the differences between the number of CV and CVC words are not as pronounced as in Spanish or French (accordingly to the information provided by P-PAL database, in EP, 38% of the words present a CV syllabic structure while 30.2% present a CVC syllabic structure), syllabic structure effects are not expected. This prediction is also in line with the previous results observed by Morais et al. (1989) for spoken word recognition. Finally, we also expect that the locus of the syllabic effects in print will be lexical in nature, since past studies failed to find syllable length effects in nonwords (see Ferrand & New, 2003; Muncer & Knight, 2012).

Research design

To test these hypotheses, we conducted an experimental study involving the use of a lexical decision task (LDT) combined with a masked priming paradigm. This paradigm was chosen because, as mentioned, it is well suited to study early and automatic effects in visual word recognition, and also because it allowed us to directly compare the results obtained here with the ones previously obtained in other studies (e.g., Álvarez et al., 2004; Carreiras & Perea, 2011; Chetail & Mathey, 2009). Nevertheless, we aimed to analyse syllabic effects in this new language with a better control over the pool of CV and CVC stimuli used in previous studies. It is worth mentioning that Álvarez et al. (2004) and Carreiras and Perea (2011) only matched the CV and CVC words used in their studies in length, word frequency and number of orthographic neighbours, and only Chetail and Mathey (2009) matched them on the number of more frequent neighbours. This lack of stimuli control cannot rule out other potential explanations for the syllabic effects observed, nor does it allow researchers to safely state that the syllable structure effect observed in these languages (e.g., syllable advantage restricted to CV words) was due to the differences in the number of occurrences between CV and CVC syllables in the language (e.g., Álvarez et al., 2004; Carreiras & Perea, 2011; Chetail & Mathey, 2009).

Participants (undergraduate students) were recruited from the University of Minho, via an invitation sent to the e-mail addresses of the students who were attending different courses of that university. Students who were willing to participate in the study were asked to complete an online questionnaire aimed to collect socio-demographic and language background information (e.g., sex, age, place of birth, native language, language and reading history). Inclusion criteria involved being an undergraduate student with EP as a native language, and not revealing history of reading problems or learning disabilities. Data were collected individually at the facilities of the Human Cognition Lab from the Centre of Psychology (CIPsi), University of Minho. Written informed consent was obtained from each of the participants that took part in the experiment.

In the experiment the type of target (i.e., word such as *rumor* [rumour] or nonword such as *berzo*), the structure of the first-syllable of the target (i.e., CV as –*ru-mor* [rumour], or CVC as *for-no*[oven]), and the type of prime (i.e., nonwords that could be either syllable congruent (e.g., ru.mis-RU.MOR), syllable incongruent (e.g., rum.pa-RU.MOR), or orthographically unrelated with the target (e.g., ca.fas-RU.MOR, to the target) were manipulated. Three versions of the same task were developed to counterbalance stimuli across prime conditions in a Latin-square design. Participants were assigned randomly to each of the versions of the task, though assuring the same number of participants *per* version ($n = 12$). Reaction times (RTs, in milliseconds, ms) and accuracy (Acc) rates (i.e., the number of errors committed in the task) were collected from all participants.

Method

Participants

Thirty-six undergraduate students ($M_{\text{age}} = 19.4$; $SD_{\text{age}} = 3.57$; 32 female) took part in the experiment in exchange of course credits. All of them were native speakers of EP and had normal or corrected-to-normal vision. None of the participants reported history of reading related disorder, therefore all were considered normal skilled readers of EP.

Materials

A total of 96 disyllabic Portuguese words were selected from the P-PAL lexical database (Soares et al., 2014) as target words. Of these, 48 presented a CV (e.g., *ru.mor* [rumor]) and the other 48 a CVC (e.g., *for.no* [oven]) first-syllable structure accordingly both to the written and to the phonological syllabification information provided by the P-PAL database.[1] Two-hundred and eighty-eight legal nonword primes were also created and assigned to three different prime conditions: (1) 96 nonwords that shared the first three letters and the first syllable with the target (e.g., ru.mis-RU.MOR [rumour], for.pa-FOR.NO [oven]); (2) 96 nonwords that shared the first three letters but not the first syllable with the target (e.g., rum.pa-RU.MOR [rumour], fo.rou-FOR.NO [oven]); and (3) 96 nonwords that did not share any letters or syllables with the target, though they had the same syllabic structure (e.g., ca.fas RU.MOR [rumour], pou.me-FOR.NO [oven]).

CV and CVC words were matched (all $ps > .270$) in number of letters ($M_{\mathrm{CV}} = 5.00$, $M_{\mathrm{CVC}} = 5.02$), per million word frequency ($M_{\mathrm{CV}} = 2.39$, $M_{\mathrm{CVC}} = 2.99$), neighbourhood size (N; $M_{\mathrm{CV}} = 6.44$, $M_{\mathrm{CVC}} = 6.71$), Levenshtein Distance (OLD_{20}; $M_{\mathrm{CV}} = 1.59$, $M_{\mathrm{CVC}} = 1.53$), number of high-frequent neighbours ($M_{\mathrm{CV}} = 2.19$, $M_{\mathrm{CVC}} = 2.21$), and the mean frequency of the most frequent neighbours ($M_{\mathrm{CV}} = 65.52$, $M_{\mathrm{CVC}} = 76.75$) as taken from P-PAL database (Soares et al., 2014). Furthermore, CV and CVC target words were also matched (all $ps > .149$) on several sublexical variables as the number of words with the same number of letters sharing the same bigrams in the same positions ($M_{\mathrm{CV}} = 367.90$, $M_{\mathrm{CVC}} = 326.67$), the summed logarithms (Log10) of the bigram frequencies (SLBF; $M_{\mathrm{CV}} = 11.03$, $M_{\mathrm{CVC}} = 11.50$); and, importantly, in other syllabic measures as the number of disyllabic words containing the same syllables in the same positions ($M_{\mathrm{CV}} = 106.85$, $M_{\mathrm{CVC}} = 120.71$), the summed frequency (Log10) of the disyllabic words that share the first syllable with the targets irrespective of the position ($M_{\mathrm{CV}} = 2.90$, $M_{\mathrm{CVC}} = 2.78$), the mean number of orthographic ($M_{\mathrm{CV}} = 3.04$; $\mathrm{M}_{\mathrm{CVC}} = 2.60$) and phonological neighbours ($M_{\mathrm{CV}} = 2.94$; $\mathrm{M}_{\mathrm{CVC}} = 2.46$) that share the first syllable with the target in the same position, and the number of words that are simultaneously orthographic and phonological neighbours and share the first syllable with the target in the same position ($\mathrm{MCV} = 2.06$; $\mathrm{MCVC} = 2.06$).

Additionally, a set of 96 legal nonword targets and 288 nonword primes were also created for the purpose of the LDT. Nonword targets were created by replacing one or two letters in the medial and final positions in other Portuguese words with similar characteristics to the experimental words (e.g., *berço* [crib] became *berzo* by replacing the *ç* with a *z*). Nonword primes were created by using the same manipulation as the target words (96 per prime condition).

Procedure

The experiment was run individually in a soundproof booth. Presentation of the stimuli and recording of responses (RTs and Acc) were controlled by DMDX software (Forster & Forster, 2003). Participants performed a LDT combined with a masked priming technique. The LDT was composed of 192 trials (96 words and 96 nonwords) that were randomly presented to the participants. Each trial consisted of

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[1] In the P-PAL lexical database the syllabification information was based on a two-step process: (1) automatic syllabification of the words using a CPAN module (http://search.cpan.org/dist/Lingua-PT-PLN/PLN.pm), and (2) manual verification and correction (when necessary) of the output. The syllabification criteria were adopted from the Portuguese Language Orthographic Agreement of 1990, as detailed at http://www.portaldalinguaportuguesa.org/main.html?action=acordo&version=1990.

a sequence of three visual events presented at the centre of the computer screen: (1) a forward mask (#####), presented for 500 ms, (2) the prime, presented in lowercase for 50 ms, and (3) the target, presented immediately after the prime, in uppercase. Targets remained on the screen until participants' response or until 2500 ms had elapsed. Participants were asked to decide as quickly and accurately as possible if the string of letters presented in uppercase (targets) was or was not a real EP word. If participants considered that the string of letters was a real EP word they should press the *M* key on the keyboard ("*sim*" [yes] response). Conversely, if they considered that it was not a real EP word they should press the *Z* key on the keyboard ("*não*" [no] response). Both speed and accuracy were stressed in the instructions. Participants were not informed about the presence of lowercase stimuli (primes). Prior to the experimental trials, participants received 24 practice trials (12 words—six with a CV structure and six with a CVC structure—and 12 nonwords) with the same manipulation as in the experimental trials to familiarize them with the task. The whole session lasted approximately 15 min per participant.

Results

Incorrect responses for target words (4.8%) and nonwords (5.7%) were excluded from the data analyses. Words with an error rate above 33% were also excluded (it occurred for 10 words in total, and comprised words such as *cerne* [core], *nesga* [crumb], *babel* [babel] and *foral* [foral], which present a very low raw frequency in Portuguese, ranging from 0.0098 to 10.8601 *per* million words as obtained from the P-PAL database; and for six nonwords, such as *satio* and *sonce*). In addition, RTs that were below 300 ms and above 1500 ms were also excluded. In a second step we also eliminated RTs below and above 3.0 standard deviations from the mean performance of each participant. The mean of the RTs for the correct responses and the percentage of errors committed for the CV and CVC target words and nonwords in each prime condition are presented in Table 1.

Repeated-measures of variance (ANOVAs) considering participants (F_1) and items (F_2) were conducted based on a 3 (type of prime: syllabic congruent, syllabic incongruent and unrelated) × 2 (syllabic structure of the target: CV vs. CVC) × 3 (list: 1, 2, and 3) mixed design, both on RT and Acc data for word and nonword

Table 1 Mean of lexical decision times (in ms) and of the errors (%) on target words and nonwords by experimental condition

Target first-syllable structure	Prime first-syllable structure		
	CV	CVC	Unrelated
Words			
CV words	762 (5.7)	812 (7.0)	813 (6.4)
CVC words	826 (7.1)	818 (7.4)	828 (7.2)
Nonwords			
CV nonwords	926 (16.4)	929 (14.4)	941 (13.8)
CVC nonwords	934 (14.8)	954 (16.9)	983 (16.9)

targets. In the F_1 analyses, type of prime and syllabic structure of the target were considered as within-subject factors and list as a between-group factor, while in the F_2 analyses type of prime was considered a within-subject factor, and syllabic structure of the target and list as between-group factors. List was included in the analyses to remove the error of variance due to the three counterbalancing lists (Pollatsek & Well, 1995).

Word targets

The ANOVA on the RTs data showed a significant main effect of the type of prime, $F_1(2, 66) = 7.499$, $MSE = 5741.150$, $p < .001$, $\eta_p^2 = .185$; $F_2(2, 160) = 7.585$, $MSE = 3987.950$, $p < .001$, $\eta_p^2 = .087$. This effect showed that participants were faster (31 ms) recognizing words preceded by a syllable congruent prime than by an unrelated prime ($p < .001$), though the differences between the syllable incongruent and the unrelated conditions did not reach statistical significance (a 2 ms difference). Moreover, the effect revealed that participants were also significantly faster (29 ms), recognizing words preceded by a syllable congruent prime than by a syllable incongruent prime ($p = .004$), thus establishing a genuine syllable effect during early stages of visual word recognition of EP disyllabic words.

The ANOVA also showed a significant main effect of syllabic structure of the target, $F_1(1, 33) = 15.193$, $MSE = 2798.441$, $p < .001$, $\eta_p^2 = .315$; $F_2(1, 80) = 1.138$, $MSE = 22{,}613.125$, $p = .148$, $\eta_p^2 = .026$, though restricted to the participant data. This effect showed that participants were faster (28 ms) when the target presented a CV than a CVC first-syllable structure. Importantly, the interaction between the syllabic structure of the target and the type of prime reached statistical significance, $F_1(2, 66) = 3.210$, $MSE = 6561.351$, $p = .047$, $\eta_p^2 = .089$; $F_2(2, 160) = 3.771$, $MSE = 3987.950$, $p = .025$, $\eta_p^2 = .045$. The pairwise comparisons with Bonferroni correction revealed that the facilitative syllabic effect reported above (i.e., faster RTs for the target words preceded by a syllable congruent prime than both an unrelated and a syllable incongruent primes), was restricted to the EP words with a CV first-syllable structure ($p < .001$). For the EP words with a CVC first-syllable structure, there were no signs of priming as both syllable congruent and syllable incongruent primes did not differentiate significantly from the unrelated primes, and additionally from each other (ps = 1.000).

On the Acc data, the results of the ANOVA showed a significant main effect of syllabic structure of the target, $F_1(1, 33) = 4.462$, $MSE = .020$, $p = .042$, $\eta_p^2 = .119$; $F_2(1, 80) = 1.408$, $MSE = 0.017$, $p = .239$, $\eta_p^2 = .017$, though restricted to the participant data. This effect indicated, in line with the RTs results, that participants committed fewer errors when words presented a CV (6.3%) than a CVC first-syllable structure (8.8%). Neither the effect of type of prime nor the interaction between the two factors reached statistical significance on the accuracy data.

Nonword targets

The ANOVA on the RTs data showed a significant main effect of the type of prime, $F_1(2, 66) = 5.322$, $MSE = 17{,}470.\ 196$, $p = .007$, $\eta_p^2 = .139$; $F_2(2, 172) = 3.684$,

$MSE = 15{,}500.373$, $p = .027$, $\eta_p^2 = .041$. This effect showed that participants were significantly faster (30 ms) recognizing nonwords preceded by syllable incongruent primes than by unrelated primes ($p = .014$). They were also faster (22 ms) recognizing nonwords preceded by syllable congruent primes, than by an unrelated primes ($p = .119$), although the differences were only approach significance. Furthermore, the differences between the syllable congruent and the syllable incongruent conditions (8 ms) did not reach statistical significance. Thus, for nonwords there was no signs of syllabic priming effects.

Moreover, the RT results revealed a main effect of the syllabic structure of the target $F_1(1, 33) = 9.560$, $MSE = 33{,}771.841$, $p = .004$, $\eta_p^2 = .225$; $F_2(1, 86) = .334$, $MSE = 5180.632$, $p = .565$, $\eta_p^2 = .004$, restricted to the participant data. This effect showed that participants were significantly faster (25 ms) responding to CV words than CVC nonwords ($p = .004$). On the Acc data, the ANOVAs did not show statistical significant effects.

Discussion

Although previous studies conducted in deep and shallow syllable-timed languages, such as French and Spanish respectively, have provided evidence for the relevance of the syllable as a sublexical unit at early stages of visual word recognition (e.g., Álvarez et al., 2004; Carreiras & Perea, 2002, 2011; Chetail & Mathey, 2009), in EP its role has been unexplored. Our study was developed to directly address this issue by using a LDT combined with a masked priming paradigm, as used in previous studies (e.g., Álvarez et al., 2004; Carreiras & Perea, 2011; Chetail & Mathey, 2009). As stated in the introduction, EP is a pivotal language to study syllabic effects in visual word recognition, since it presents phonological and orthographic characteristics that put it between languages in which syllabic effects were systematically observed (e.g., Spanish, French) or not observed (e.g., English). Thus, studying syllabic effects in EP will shed light on the language features that could contribute to the emergence of syllable effects during visual word recognition, in a given language.

The results obtained here clearly demonstrate that, at initial stages of visual word recognition, the syllable functions as a sublexical unit in the recognition of EP printed words. Indeed, the brief presentation (50 ms) of a nonword prime that not only shared the first three letters, but importantly the same syllable boundary with the target, eased the visual word recognition of EP dissyllabic words (note that the use of unrelated primes allows us to conclude that this effect was of facilitation), tough only for CV words. CV words were also recognized faster and more accurately than CVC words. Finally, the results obtained also demonstrated that the locus of the syllabic effect was lexical in nature, since for nonwords targets the presentation of a nonword prime that shared the first-syllable seems to have no impact on the speed and accuracy with which EP nonwords were recognized.

These results partially support our hypotheses. Indeed, as expected, a reliable syllabic congruency effect was observed in EP, which extends previous findings observed by Álvarez et al. (2004), Carreiras and Perea (2011), and Chetail and

Mathey (2009), to another Romance language. These findings are interesting and showed with an improved methodological design that even though EP is a stress-timed language, which led us to hypothesize that the role of the syllable as a functional unit in the visual word recognition of EP words might be attenuated, as in English, these suprasegmental characteristics were not relevant enough as to prevent the syllable congruency effect from emerging in EP. The fact that EP is also a Romance language exhibiting clearer syllable boundaries than English (though less than Spanish and French), might explain why presenting a nonword prime that not only shared the first three letters but, importantly, the first-syllable boundary eased the visual word recognition of EP words. Evidence supporting this potential interpretation comes from the naming study of Ferrand et al. (1997) with English native-speakers. Using the masked priming paradigm, the authors found an advantage of the syllable congruent condition over the syllable incongruent and unrelated conditions but only for English words with clear syllabic boundaries (e.g., *bal-cony*; the *l* can only belong to the first syllable because *lc* cannot constitute a permissible syllable), and not for ambisyllabic words (e.g., *ba-lance*; the *l* can form both the syllable *bal* and the syllable *lan*). Although these results were found in a naming study, they clearly suggest that the unambiguousness of the syllabic boundaries within words in a given language seems to drive the emergence of syllabic effects at early stages of visual word recognition.

Moreover, it is also important to stress here that, although to date no computational model of visual word recognition has attempted to account for the syllable congruency effect observed in different languages (note that the MROM-S model was developed to account for the syllable frequency effects observed in the Spanish language), we can anticipate, however, within an interactive model of activation, that when a nonword syllable prime is presented (e.g., *ru.mis*), it is syllabified on a syllabic layer, as proposed by the MROM-S model (Conrad et al., 2010), thus spreading activation to all of the words in the lexicon that present that syllable in the same position (e.g., *ru.mor* [rumour], ru.blo [ruble], *ru.bro* [red], *ru.bra* [red]). Consequently, when a target word that shares that syllable is presented (e.g., *ru.mor* [rumour]), less activation is necessary for that word to be recognized, hence explaining the syllable congruency effect observed. Note that when nonwords were used as primes (as in our case) facilitative and not inhibitory syllabic effects were obtained. This was firstly observed by Carreiras and Perea (2002) in a masked priming study where target words were preceded either by word and nonword primes sharing the first syllable. The findings showed a different pattern of results for each of the two types of primes. When word primes were used, an inhibition syllable effect was observed. Conversely, when nonword primes were used a facilitation syllable effect was observed instead. The authors argued that, because nonwords do not compete directly with the target words for activation, its effect was of facilitation, since the threshold of activation necessary to a “YES” response would be reached quickly when a prime containing the same syllable as the target, in the same position, is presented. This is also consistent with the fast-guess mechanism proposed by the original MROM model (Grainger & Jacobs, 1996) and by the DRC model (Coltheart, Rastle, Perry, Langdon, & Ziegler, 2001), to explain why words that showed a higher level of similitude with other words in the lexicon were recognized faster and more accurately than words that showed less similitude (see Coltheart et al., 2001; Grainger & Jacobs, 1996 for details).

However, if this mechanism could account for the syllabic congruency effect observed in our data, it does not explain how syllabification is achieved during early stages of visual word recognition. The only model that has, to date, attempted to include a syllabic level of word processing has been the MROM-S model (Conrad et al., 2010). Yet, it still does not describe how the syllabification process takes place. Nevertheless, it is possible to anticipate that as in the CDP++ model (Perry et al., 2010) there might be a graphemic buffer that syllabifies words according to the maximal onset principal (MOP), in a syllabic layer that mediates between the letter lever of processing that the lexical level of representation. Specifically, after the letter level, word processing might proceed by extracting information regarding the nucleus of the syllable (vowel), followed by the onset of the first syllable. At this stage, the processing might end, with the syllable being activated, or it might have to continue, if this syllable contains a coda unit. Still, although this mechanism might explain the syllabification process, it does not account for the syllable structure effect observed in our data.

Indeed, contrary to our predictions, and to the results previously observed by Morais et al. (1989) in spoken word recognition, in EP the syllable congruency effect was restricted to CV words, as previously observed for Spanish (e.g., Álvarez et al., 2004; Carreiras & Perea, 2011) and French (e.g., Chetail & Mathey, 2009). So, even though EP is a language with one of the richest collection of syllable structures across all Romance languages and, in addition, a language where the differences between the number of occurrences of CV and CVC first-syllable words are less pronounced than in other languages, reliable syllable congruent effects were still restricted to CV words. Note, however, that for CVC words, syllable congruent primes also produced faster reaction times than both syllable incongruent and unrelated primes, as for CV EP words, though the differences across-prime condition were not large enough to reach statistical significance. One could argue that perhaps because CVC syllables are longer, participants would not have to process the prime until the fourth letter, in order to activate the CVC syllable. Thus, a 50 ms prime might not be sufficient time for the participants to process the CVC syllables, and this could be the cause of the syllable structure effect. However, other behavioral studies have provided evidence favoring an early activation of the phonological information presented in a nonword primes beyond the first letters of the string, as the vast amount of studies with transposition letter effect have demonstrated (e.g., Comesaña, Soares, Marcet, & Perea, 2016; Lupker, Perea, & Davis, 2008; Perea & Acha, 2009; Perea & Lupker, 2004). Taken together, these results suggest that a 50 ms nonword prime duration might indeed be sufficient to allow the syllabification process to occur for both syllabic structures. Moreover, these studies and our results suggest that at early stages of visual word recognition both syllable structures seem to be processed, although the level of activation generated by CVC nonword primes seems not to be strong enough as to allow the syllable congruency effect to emerge for this syllable structure. Furthermore, it is also worth noting here that evidence supporting that both syllables structures are activated at first stages of visual word recognition has also been obtained from recent ERPs studies. These studies have shown not only that syllable frequency effects were modulated in early (P200) ERP components (e.g., Barber et al., 2004), but, importantly, that CV and CVC syllables activate the same neural correlates (e.g., Goslin et al., 2006). Nevertheless, it is also important to consider that, since the CVC syllable structure is more complex than the CV syllable structure, particularly because it presents an extra element (coda) that has been shown to be the hardest syllabic element to process (see Treiman & Danis, 1988 for more details), it is also possible to anticipate that CVC nonword primes might be more difficult to syllabify than CV nonword primes. This might explain the absence of reliable syllable congruency effects for CVC words in our study and in many other studies conducted in other languages (e.g., Álvarez et al., 2004; Carreiras & Perea, 2011; Chetail & Mathey, 2009).

In these studies, the syllable structure effect was explained relying on the idea that the CV is the most common (canonical) syllabic structure in these languages, which might cause the parser to syllabify words by using a CV strategy by default. Nevertheless, since these studies lack a strict control of the stimuli used, as mentioned, it is possible that other variables might explain the results. To overcome these limitations, the CV and CVC stimuli used in our study were matched on a wide range of lexical and sublexical variables, including several type and token positional and non-positional syllable statistics (see the Materials section). However, and despite this highly strict control, syllable priming effects were still only observed for the CV words. In a tentative to further explain the factors that might underlie the advantage of the CV over the CVC syllabic structure, we reanalysed our CV and CVC word stimuli attending only to the composition of first-syllable. This reanalysis showed that, when we disregard the composition of the second syllable, the CV words used in our study revealed a higher type ($M_{\mathrm{CV}} = 74.5$, $M_{\mathrm{CVC}} = 29.9$, $p = .002$) and token ($M_{\mathrm{CV}} = 2.70$, $M_{\mathrm{CVC}} = 2.22$; $p = .001$) first syllable frequency than the CVC words used, which might explain the syllabic advantage observed. Indeed, since the CV words present both a higher number of words that share the same syllable at the same position, and also words that are more frequent in the EP language, this could have allowed the system to generate a higher level of activation for a ‘yes’ response when CV words were preceded by a CV congruent nonword prime than when CVC words were preceded by a CVC congruent nonword prime, as proposed by the original MROM (Grainger & Jacobs, 1996) and the DRC (Coltheart et al., 2001) models. Therefore, the levels of activation generated by CVC nonword primes might not have been strong enough as to significantly impact the ‘yes’ response when CVC target words were presented, at least in the behavioural masked priming paradigm used in our study. Subsequent studies should further investigate the syllable congruency effect with more sensitive on-line techniques, such as ERPs. Moreover, future studies should also attempt to investigate if giving the prime more time to be processed, the syllable congruency effect might emerge for CVC words.

To conclude, it is worth noting that the results presented in this paper clearly demonstrate, with a set of stimuli much more controlled than the ones used in previous studies, that the syllable plays indeed a functional role at early stages of visual recognition of EP words, at least for those beginning with a CV syllable, as captured by a masked priming paradigm. These results not only add to the current literature, because they extend the syllabic effects previously observed in Spanish, French, and German to another language with distinct orthographic and phonological characteristics, but importantly because they shed light into the mechanisms/ language characteristics that can better account for the syllabic effects observed in different languages. It is imperative that the current models of visual word recognition are amended to include, not only a syllabic layer, as in the MROM-S model (Conrad et al., 2010), that could account for the syllable structure effects observed in different languages, but additionally that could specify the principles/ mechanisms by which the syllabification process takes place as in the CDP++ model (Perry et al., 2010). Moreover, it is also important to highlight that, from an applied point of view, these results also draw attention to the importance of using syllabic based methods when teaching EP children how to read and write, an issue that has been attracting a growing interest in the literature (e.g., Chetail, Colin, & Content, 2012; Doignon-Camus et al., 2013; Ecalle, Kleinsz, & Magnan, 2013; Zhang & Wang, 2014).

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Appendix

The items are arranged in triplets in the following order: syllable-congruent prime, syllable-incongruent prime, and unrelated prime for the word and nonword targets.

Words

babur; babpa; dudot; BABEL; bagra; bagmo; dopur; BAGOS; batur; batco; debro; BATOM; bazum; bazco; vefra; BAZAR; bifur; bifto; gatra; BIFES; bocor; bocte; dupre; BOCAL; cabel; cabco; netro; CABRA; cetar; cetpo; mujis; CETIM; curir; curnu; mazem; CURAS; dicre; dicta; pijer; DICAS; dunir; dunve; bivel; DUNAS; facur; facte; lovre; FACAS; farot; farfu; dixor; FAROL; febum; febco; colur; FEBRA; fedum; fedno; lefor; FEDOR; fezom; fezco; gevra; FEZES; figor; figna; lapra; FIGAS; forur; forlo; buzit; FORAL; funat; funti; lenar; FUNIL; furim; furne; toviz; FUROR; gater; gatpe; vaber; GATIL; jejar; jejco; delom; JEJUM; latre; latca; facri; LATIM; licem; licta; gotro; LICOR; luver; luvco; baver; LUVAS; murer; murze; namor; MURAL; natre; natco; zales; NATAS; nudam; nudco; velis; NUDEZ; nuvro; nuvca; vuvis; NUVEM; pirir; pirva; rusco; PIRES; polum; polno; jadro; POLAR; pudur; pudca; tefas; PUDIM; pudas; pudno; febos; PUDOR; pulis; pulzo; fande; PULOS; remer; rembe; vonar; REMOS; robir; robta; zorlo; ROBES; ruble; rubco; nitus; RUBRA; rumum; rumpi; niver; RUMOR; sinai; sinra; nacro; SINOS; sobur; sobpu; befro; SOBRA; tiqro; tiqta; lapos; TIQUE; tirer; tirjo; larel; TIRAS; tutro; tutca; fazir; TUTOR; vapel; vapca; nejus; VAPOR; varom; vardo;

norei; VARIZ; visim; visca; nunva; VISOR; vogur; vogma; pazer; VOGAL; zebor; zebno; dalim; ZEBRA; barto; barel; lerto; BARBA; berno; beram; losvo; BERMA; casra; casim; veiza; CACO; calba; catle; nebta; CALDO; cenza; cenur; raica; CENSO; cerma; ceros; mosce; CERNE; cinle; cinor; zerda; CINTO; cinvo; cinum; vismo; CINZA; corbe; corim; surbo; CORDA; corzo; corum; zasna; CORVO; cosna; cosai; sesna; COSMO; dergo; deros; lasno; DERME; farne; farer; lerzo; FARSA; forve; foris; tunzo; FORCA; forza; forau; tusge; FORNO; funja;funer; tespa; FUNGO; gampe; gamor; fesdo; GAMBA; garda; garel; prela; GARFO; genfa; genom; jarce; GENRO; gosvo; gosim; pinzo; GOSMA; lasve; lasom; benve; LASCA; lesro; lesum; tarco; LESMA; manvo; manul; vormo; MANGA; morza; morum; craze; MORNO; mosro; moser; ninzo; MOSCA; nesco; nesur; vrapo; NESGA; ninte; ninel; mirlo; NINFA; percor; parost; grobot; PARDAL; parme; parus; gerpa; PARGO; parbe; parim; gonfe; PARTO; pasna; pasem; genza; PASMO; perme; peram; foszo; PERSA; porma; porus; jesva; PORCO; rambe; ramei; drojo; RAMPA; rusmo; rusil; varpe; RUSGA; sarge; sarim; zesgo; SARJA; surbe; surer; crala; SURTO; talna; talum; bilva; TALCO; tambe; tamou; fesgo; TAMPO; tanju; tanes; larxa; TANGO; tarbo; tarer; bonfo; TARTE; tesbo; tesur; larfe; TESTA; tosdo; toclo; forfe; TOSTA; turde; turom; disda; TURBO; vervo; verer; creco; VERME; verma; veris; masva; VERSO; vesda; vesam; zesje; VESGO; vesmo; vesou; crago; VESPA;

Nonwords

bager; bagma; dajul; BAGIL; begul; begno; jonha; BEGRA; bepui; bepco; lanus; BEPRA; bevur; bevda; magur; BEVOL; bicel; bicte; fopra; BICRA; bodus; bodpo; terol; BODIO; bubra; bubpo; lapta; BUBIM; budei; budco; ravra; BUDIA; bupei; bupco; sigue; BUPLA; cadul; cadpo; rogul; CADRE; conel; conve; ficro; CONUL; dapul; dapco; bujro; DAPIL; datur; datca; tibro; DATRO; facum; facta; mucra; FACIZ; fanur; fanvo; defar; FANOL; fetra; fetco; bidro; FETOM; fonem; fonve; denus; FONUS; foter; fotco; gonua; FOTAI; gedum; gedmo; pisor; GEDRA; gomua; gompo; tucre; GOMER; gotre; gotce; pegro; GOTAM; jedem; jedca; panir; JEDUR; letro; letca; puler; LETOM; lezum; luzco; vernu; LUZAR; nefer; nafte; zejro; NAFEM; nager; nagmo; capra; NAGAM; nagum; nagco; zaqua; NAGIA; nague; nagma; nomui; NAGOU; natei; natpa; cogra; NATUO; necal; necte; xuzre; NECRU; pabpa; pabre; tomul; PABRO; pafum; pafca; vezul; PAFIR; paner; panjo; jacro; PANOL; pebut; pebpa; gafus; PEBIL; pogro; pogme; zapau; POGUA; ridre; ridmo; xadal; RIDAR; sabar; sadca; reces; SADRIL; satas; satpa; pofir; SATIO; tagre; tagma; verpo; TAGIO; tezil; tezca; zada; TEZUE; timis; timbo; fenus; TIMAO; vatra; vatpo; somus; VATAU; venil; venfe; lagro; VENOI; zebim; zebpa; nigua; ZEBIO; zenos; zenja; xixas; ZENAL; zevar; zevga; mefro; ZEVOU; zilom; zilxe; cocra; ZILAM; zunim; zunxa; rozou; ZUNUR; barxa; barum; fosma; BARMO; basda; basur; rilfo; BASFO; biscu; bisom; tosxo; BISZA; bolfa; bolus; palna; BOLDA; bolxe; bolil; dosgo; BOLPA; carmi; carum; xenco; CARCA; dande; damum; brifo; DAMBU; dempo; demul; bofus; DEMPA; desfe; desum; valca; DESPO; dolza; dolui; xalca; DOLCO; fapco; fapre; brapo; FAPSA; fesxu; fesim; derxo; FESMO; forpe; forer; lanja; FORGO; fosje; fosel; dorpe; FOSGO;

galba; galui; palne; GALFA; gasfu; gasul; proce; GASPO; ginva; ginus; palso; GINCA; gonfo; gonal; jenel; GONTA; gunsa; gunis; zasne; GUNZO; jorxa; jorum; nesfa; JORZA; josdo; josir; feica; JOSCE; julza; juler; valro; JULTE; larne; larom; venco; LARFA; mulxo; mulir; goute; MULSA; nasto; nasil; xonim; NASTRE; nolbu; nolai; nalfa; NOLTE; palfo; palil; loilo; PALDE; pesfu; pesis; jarca; PESMO; pesza; pesoi; vospe; PESTAR; pisja; pisau; jisca; PISMO; porja; porul; ponja; PORPO; permo; peril; dalba; PURNA; rolxo; rolus; reica; ROLRO; sanvre; sanaol; frana; SANTRA; segmo; seguo; lisvo; SEGNA; sonza; sonis; roumo; SONCE; texva; texol; busbo; TEXFO; tinzo; tiner; bulma; TINDA; tornu; torui; falno; TORMA; valta; valus; fengo; VALBO; vanza; vaner; nouma; VANCE; vaszu; vasum; verzo; VASMO; verjo; velor; junro; VERFA; vigmo; viguo; grofo; VIGNA; vosfe; vosur; xerla; VOSMA; zalva; zalum; crofo; ZALCO; zalne; zaler; rispo; ZALMO; zermu; zerar; lasba; ZERCE;

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