

When orthography is not enough: The effect of lexical stress
in lexical decision.

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| Journal: | Memory & Cognition |
| Manuscript ID: | MC-ORIG-14-029.R3 |
| Manuscript Type: | Original Manuscript |
| Date Submitted by the Author: | n/a |
| Complete List of Authors: | Colombo, Lucia; University of Padua, Dipartimento di Psicologia Generale Sulpizio, Simone; University of Trento, |
| Keywords: | word recognition, prosody, lexical processing |
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7 When orthography is not enough: The effect of lexical stress in lexical decision. !
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Abstract !

Three lexical decision experiments were carried out in Italian, in order to verify if stress dominance (the most frequent stress type) and consistency (the proportion and number of existent words sharing orthographic ending and stress pattern) had an effect on polysyllabic word recognition. Two factors were manipulated: whether the target word carried stress on the penultimate (dominant; graNIta, seNIle 'slush, senile') or on the antepenultimate (non-dominant) syllable (MISsile, BIbita 'missile, drink'), and whether the stress neighborhood was consistent (graNIta, MISsile) or inconsistent (seNIle, BIbita) with the word's stress pattern. In Experiment 1 words were mixed with nonwords sharing the word endings, which made words and nonwords more similar to each other. In Experiment 2 words and nonwords were presented in lists blocked for stress pattern. In Experiment 3 we used a new set of nonwords, which included endings with (stress) ambiguous neighborhoods and/or with low number of neighbors, and which were overall less similar to words. In all three experiments there was an advantage for words with penultimate (dominant) stress, and no main effect of stress neighborhood. However, the dominant stress advantage decreased in Experiments 2 and 3. Finally, in Experiment 4 the same materials used in Experiment 1 were also used in a reading aloud task, showing a significant consistency effect, but no dominant stress advantage. The influence of stress information in Italian word recognition is discussed. !

Keywords: lexical stress, lexical decision, stress dominance, stress consistency !

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3 There has been increasing interest in the role that lexical stress plays in the pronunciation of a word
4 from its orthography. The issue is particularly relevant for free-stress languages such as English or
5 Italian, in which readers must assign stress before articulation may start (e.g., Colombo, 1992;
6 Colombo, Deguchi, Boureux, 2013; Colombo & Zevin, 2009; Perry, Ziegler, & Zorzi, 2010;
7 Sulpizio, Arduino, Paizi, & Burani, 2013; Sulpizio, Spinelli, & Burani, in press). Important factors
8 related to lexical stress that have been investigated, in tasks such as reading aloud and lexical
9 decision are: Dominance (the most frequent stress pattern in a language: Colombo & Zevin, 2009;
10 also known as regularity or typicality: Arciuli & Cupples, 2006; Jouravlev & Lupker, 2014; Kelly
11 & Bock, 1988; Rastle & Coltheart, 2000; see below); orthographic correlates of stress (e.g., affixes;
12 Rastle & Coltheart, 2000), stress neighborhood consistency (that is, the more or less constant
13 correspondence between spelling patterns and stress, Arciuli & Cupples, 2006; Burani & Arduino,
14 2004; Burani, Paizi, & Sulpizio, 2014; Colombo, 1992; Jouravlev & Lupker, 2014; Pagliuca &
15 Monaghan, 2010; Paizi, Zoccolotti, & Burani, 2011; Seva, Monaghan & Arciuli, 2009; Sulpizio &
16 Colombo, 2013), and grammatical class (typical stress differs for nouns and verbs in English:
17 Arciuli & Cupples, 2006; for different grammatical classes in Russian: Jouravlev & Lupker; 2014;
18 for a review of all the above issues, see Sulpizio, Burani, & Colombo, 2015). Among these factors,
19 the most relevant for the present study is dominance.

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22 The first studies focusing on the effect of the most frequent stress pattern in reading aloud
23 showed that the emergence of this effect is influenced by word frequency. Both Monsell, Doyle and
24 Haggard (1989) and Brown, Lupker and Colombo (1994) found evidence for a stress effect in
25 naming English words, and an interaction with frequency. The same pattern was also established in
26 naming Italian words by Colombo (1992), who found that low-frequency words with the most
27 frequent stress pattern (on the penultimate syllable of polysyllabic words, as in bamBI no, child)
28 showed an advantage compared to low-frequency words with antepenultimate stress (e.g., TAvo lo,
29 table), which is much less frequent (with a proportion of about 0.2 to 0.8). However, Rastle and
30 Coltheart (2000) found a stress effect in English only when the word contained affixes, which cued

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3 the correct stress pattern. Yet again, Burani and Arduino (2004) found no evidence for an advantage
4 of the dominant stress in Italian, arguing that participants use only stress neighborhood consistency
5 in reading aloud, that is, the association between certain orthographic patterns and stress (see below
6 for a more detailed description). Finally, Colombo and Zevin (2009) also found no clear evidence
7 for an advantage of words with dominant stress over those with non-dominant stress in a priming
8 paradigm with a naming task.
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11 While the majority of studies have been based on tasks involving production (reading aloud
12 and naming) the investigation of lexical stress has been further extended to the lexical decision
13 process. Specifically, Arciuli and Cupples (2006) investigated the effect of frequency of stress
14 (which they called typicality) in English with naming and lexical decision, manipulating both
15 typicality of stress and grammatical class (nouns vs. verbs). In fact, they did not explore the most
16 frequent stress pattern in the language overall, but the most frequent/typical pattern within each
17 grammatical class. They found an advantage for typically stressed words (i.e., second syllable stress
18 for verbs, first syllable stress for nouns) in both tasks, but only in the pattern of errors. They argued
19 that because the same pattern was obtained in both naming and lexical decision, and since lexical
20 decision can be carried out based on orthography alone, these results suggest that stress may be
21 cued directly by orthography. Further, through an analysis of the distribution of word endings and
22 their correlation with stress pattern, they found that word endings were able to predict both
23 grammatical class and lexical stress. Mundy and Carroll (2013), on the other hand, only found
24 evidence for an effect of the consistency between orthographic endings and stress in a lexical
25 decision task. Kelly, Morris, and Verrekia (1998) investigated the role of particular spellings in
26 word endings, which, in their hypothesis, might signal a specific stress pattern (e.g., “-et” associated
27 to first syllable stress, as in comet, and “-ette” associated to second syllable stress, as in roulette).
28 They found supporting evidence in both latencies and error rates, in naming and lexical decision. !
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32 Further evidence for an effect of stress in lexical decision comes from a study on Russian
33 (Jouravlev & Lupker, 2014). In Russian disyllabic words there is no overall dominant pattern, but
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3 initial and final stress are present in different proportions in each grammatical category. Nouns and
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5 verbs have a similar proportion of initial and final stress, while adjectives are more frequently
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7 stressed on the initial syllable. Using disyllabic stimuli, Jouravlev and Lupker (2014) found a
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9 significant interaction of stress type with grammatical class: No stress type effect was found in
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11 either naming or lexical decision for nouns and verbs, while a significant advantage for initial
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13 compared to final stress adjectives was found in both naming and lexical decision.
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17 The aim of the present study was to investigate the role of lexical stress in word recognition,
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19 and whether this role depends on stress neighborhood consistency, that is, the correspondence, or
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21 lack of correspondence, between orthography and stress. These issues were investigated in Italian, a
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23 transparent language in spelling-sound correspondence, but not in lexical stress. Considering stress
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25 types in Italian, penultimate syllable stress is the most frequent pattern (bamBIⁿo, child), since
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27 around 80% of Italian polysyllables bear such stress (Thornton, Iacobini, & Burani, 1997). One of
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29 the first proposals about Italian stress representation and processing in reading (Colombo, 1992)
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31 claimed that stress can be represented both at the lexical level, as part of the phonological
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33 representation of lexical entries, and at the sublexical level, with spelling patterns of word endings
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35 directly cueing stress. Moreover, in agreement with models of production (Levelt, Roelofs & Meyer,
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37 1999) stress can be abstractly represented within a metrical frame specifying the stressed syllable
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39 position. This is an abstract representation because it is independent of segmental information and
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41 can be derived by statistical distributional information about the most frequent stress type, or, in
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43 some frameworks, by rule (Levelt et al., 1999). !
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51 This view is partially consistent with that proposed in a computational model, the CDP++
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53 model for polysyllabic word reading in Italian (Perry, Ziegler, & Zorzi, 2014). In the computational
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55 perspective provided by Perry et al. (2014) prosodic information is abstractly coded in a stress
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57 buffer, connected with both the lexical and the sublexical pathways. While the lexical route would
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59 activate the correct stress pattern within the stress output nodes, the sublexical route likely reflects
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consistency effects. Using this framework which includes an abstract representation of stress (the

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3 “stress nodes”), Perry et al. (2014) simulated the results of several studies on stress carried out in
4 Italian with the reading aloud task (e.g., Burani & Arduino, 2004; Colombo, 1992; Colombo &
5 Zevin, 2009). In particular, they simulated the dominant stress advantage, the stress type by word
6 frequency interaction and the stress type by stress neighborhood consistency interaction found in
7 Colombo (1992). But they were also able to find the same pattern as Burani and Arduino (2004),
8 with a significant stress neighborhood consistency effect independent of main stress. Being able to
9 simulate most, even contrasting results, they concluded that the divergences in the different studies
10 were due to the particular nature of the experimental materials. They also claimed that stress and
11 consistency effects likely reflect an interaction between lexical and sublexical pathways. In fact,
12 simulations carried out by alternatively removing lexical and sublexical phonology clearly showed
13 that both are required to simulate the main effects in Italian. Note, however, that Perry and
14 colleagues did not simulate lexical decision, and a prediction based on this model would be highly
15 speculative, particularly because a clear pattern of behavioral data in lexical decision is missing.
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34 While at least one study has found an effect of the most frequent stress in English lexical
35 decision (Arciuli & Cupples, 2006) two studies in Italian showed conflicting results. One study
36 (Colombo, 1992) found an effect of stress dominance on low frequency words in the pattern of
37 errors; the other (Burani & Arduino, 2004) did not find any effect at all. There might be different
38 reasons for this inconsistency in results, probably grounded on the nature of the experimental
39 stimuli (see discussion in Burani & Arduino, 2004). However, clearly it is important to further
40 investigate this issue and verify if a robust pattern can be established in lexical decision. !
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50 Some studies show that access to the phonological information of the stimulus may be fast
51 and automatic (Ashby, Sanders, & Kingston, 2009; Wheat, Cornelissen, Frost, & Hansen, 2010; see
52 Frost, 1998, for a review). Moreover, phonological variables can sometimes affect decision
53 (Halderman, Ashby, & Perfetti, 2012), as phonological information may help word recognition by
54 enhancing orthography-to-phonology mapping. As noted, Italian is very regular in spelling-sound
55 correspondences, with the only exception of stress pattern, and phonological assembly may be very
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3 fast: Thus, in recognizing a word readers are very likely to use both phonological recoding
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5 procedures and whole word lexical processing. Supporting evidence comes from a study by Burani
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7 and Cafiero (1991) who manipulated subsyllabic and consonant-vowel structure of Italian words in
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9 lexical decision. They found that lexical decision on words with consonant-vowel structure
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11 controlled were faster and less error-prone when they contained simpler and more frequent
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13 subsyllabic units, like for example single consonant onsets and codas, which are more frequent in
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15 Italian compared to complex (CC) onsets and codas, suggesting a role for these phonological units
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17 in lexical access. !
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22 Concurrent evidence from other types of effects supports the idea that both lexical and
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24 sublexical phonology are equally used in Italian. Peressotti and Colombo (2010) found a
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26 pseudohomophone advantage in reading aloud compared to control nonwords. Since
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28 pseudohomophone effects are considered markers of phonological involvement (Jacobs & Grainger,
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30 1994) they interpreted this result as evidence of an interaction in the phonemic buffer between
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32 output lexical phonology activated directly from orthography and sublexical processing. Given the
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34 evidence for Italian suggesting that phonology is automatically activated, an effect of the most
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36 frequent stress type might be expected in lexical decision. Such an effect might be driven from
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38 lexical and/or sublexical phonology, consistently with what is predicted in Perry et al. (2014). In
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40 particular, it might reflect faster access to lexical representations in the phonological lexicon, faster
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42 activation of sublexical phonology, or both. !
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49 Naming a word can be helped by its ending, as shown by the literature on neighborhood
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51 consistency effects in English. Note, however, that in such literature, the term ending was defined in
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53 different ways. First, it was used to refer to consistency between orthography and segmental
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55 phonology (in particular, rhymes) mostly in the English language and for monosyllabic words
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57 (Jared, McRae, & Seidenberg, 1990; Seidenberg & McClelland, 1989; Treiman, Mullennix,
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59 Bijelac-Babic, & Richmond-Welty, 1995) on one hand, and, on the other hand, to consistency
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between orthography and stress, in Italian and Russian (Burani & Arduino, 2004; Colombo, 1992;

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3 Jouravlev & Lupker, 2014). Second, it has been defined at different levels of granularity, with the
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5 extreme case of the study by Monaghan, Arciuli and Seva (2013) who investigated the relation to
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7 stress of initial and ending units of different sizes, from one to five letters. !
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10 A particular relevance in the investigation of consistency effects has been given to the rhyme.
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12 Many studies indeed show that rhyme is an important unit in reading (e.g., Ziegler & Goswami,
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14 2005). The nature of endings assumed to be relevant for Italian reading was defined by Colombo
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16 (1992) as the sequence formed by the nucleus of the penultimate syllable and the last syllable: the
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18 rhyme. For examples, in the word “la-VO-ro” the rhyme is “-oro”, formed by the nucleus of the
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20 penultimate syllable plus the last syllable. Italian words with many stress consistent neighbors
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22 (words sharing orthographic ending and stress pattern, also called stress friends) are named faster
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24 than words with many stress inconsistent neighbors (words sharing orthographic ending, but with a
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26 different stress pattern, also called stress enemies; Arciuli & Cupples, 2006; Burani & Arduino,
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28 2004; Colombo, 1992). For example, TRAgica (tragic) and forMIca (ant) share the orthographic
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30 ending -ica, which is mostly included in words with initial stress: TRAgica is consistent with the
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32 stress neighborhood of -ica, whereas forMIca is stress inconsistent. Note that in some studies
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34 (Colombo, 1992; Colombo & Zevin, 2009) stress neighborhood consistency effects interacted with
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36 stress dominance, and were only apparent for non-dominant stress words. This result was confirmed
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38 by simulations in the connectionist computational model of Italian reading by Pagliuca and
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40 Monaghan (2010), which also showed this interaction. !
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48 The effect of word endings might extend to lexical decision, with faster latencies and more
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50 accurate responses for stress consistent than stress inconsistent words. Word endings might exert
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52 their effect at the orthographic level. Support for the idea that endings may provide orthographic
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54 cues to stress comes from the connectionist computational model implemented by Arciuli,
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56 Monaghan and Seva (2010), which did not include a phonological component, and showed
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58 sensitivity to the statistical properties of the orthography. The network was trained to learn from
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60 the orthography, and was required to assign initial or second syllable stress to the disyllabic words.

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3 By identifying orthographic regularities in word endings, the network was able to assign stress to
4 disyllabic stimuli. The authors concluded that stress information is orthographically represented. !
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8 In the present study we manipulated lexical stress and stress neighborhood consistency in
9 lexical decision and reading aloud. We ran three lexical decision experiments in which word stimuli
10 were maintained constant, while contextual variations were introduced. Specifically, in Experiment
11 1 words were presented mixed together with nonwords, most of which had a final sequence strongly
12 associated either with dominant or non-dominant stress. In Experiment 2 we presented the same
13 stimuli as in Experiment 1, but in two separate blocks, where stress was held constant. In
14 Experiment 3 we again adopted the mixed stress presentation of Experiment 1, but with a new set of
15 nonwords, which were built with weak final sequences in terms of orthography-to-stress association.
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17 The idea underlying the introduction of contextual variations in Experiments 2 and 3 was to
18 decrease the tendency to rely on lexical consultation because of the pure lists (only one stress type;
19 Experiment 2), and because of the greater word/nonword dissimilarity on the basis of endings
20 (Experiment 3). !
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36 In all the experiments, two variables were manipulated: type of stress (dominant vs. non-
37 dominant), and stress neighborhood consistency (consistent and inconsistent; see Table 1 for
38 examples). !
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44 - Table 1 - !
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46 If word recognition benefits from phonological activation, and if the frequency of the stress
47 type is important in discriminating words and nonwords, we might expect an advantage for
48 dominant stress words (graNIta 'slush' and seNIle 'senile', compared to BIbita 'drink' and MISSile
49 'missile'), independently of the type of ending. If, instead, the consistency of endings is important
50 and affects word recognition at an orthographic level, as much as it affects word naming, we might
51 expect an advantage for consistent compared to inconsistent endings independently of stress type
52 (graNIta and MISSile better than seNIle and BIbita).
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Moreover, we might also expect an effect of the endings on nonwords. In particular, given that nonwords with ambiguous endings or from small neighborhoods are less word-like, it might be easier to classify them as nonwords, compared to nonwords with larger and more consistent neighborhoods. !

Former studies using the lexical decision task found stress dominance effects mostly in the pattern of errors (Arciuli and Cupples, 2006; Colombo, 1992), but the error rate is usually very low in lexical decision. Thus, in the present study we carried out speeded lexical decision, with a 600 ms deadline for a response. This procedure has been found to increase the number of errors without changing the nature of the effects or processes involved (Colombo & Tabossi, 1992; Parkin, 1982).

Finally, Experiment 4 was carried out with a reading aloud task, as a comparison to lexical decision, and to replicate former effects found in the literature. !

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Experiment 1 !

Method !

Participants !

Thirty-four students (12 males; mean age: 23.03, sd: 1.09) from the University of Padua took part in the experiment. They were all native Italian speakers with normal or corrected-to-normal vision. !

Materials !

Four sets each with 30 three-syllabic low-frequency words were selected from the CoLFIS database (Bertinetto et al., 2005) and were used as stimuli. The four sets were obtained by combining two experimental factors: stress dominance (words bearing dominant vs non-dominant stress) and stress neighborhood consistency (stress consistent neighborhood vs. stress inconsistent neighborhood). Stimuli were matched on: Frequency, length in letters, orthographic neighborhood size, and summed frequency of orthographic neighbors (see Table 2). Familiarity ratings, on a five-point scale, were also collected by a group of 15 participants who did not participate in any of the lexical decision experiments. We did not match stimuli on bigram frequency, since this choice

possible, whether each letter string was a real word or not: The response was given by pressing either key 1 or key 5 of a five-keys response-box. Key selection was counterbalanced across participants. A set of 60 practice trials preceded the experiment. !

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Results!

Because the task required a binary decision, only data from participants with mean accuracy above 60% were kept. Thus, three participants were excluded from the analyses because of their low level of accuracy (48%, 52% and 54% of accuracy, respectively). Nonwords were analysed separately from words. !

Reaction times and errors for the word and nonword data were both analysed using mixed-effects models (Baayen, Davidson, & Bates, 2008). The models were fitted using the lmer function (lme4 package) in R software (version 2.11); p values were calculated using the MCMC procedure, sampling 10,000 times (Baayen et al., 2008). Participants and items were treated as random factors. Results are reported in Table 3. !

-Table 3- !

Words. !

Reaction times. Results are reported in Table 3. Only correct responses were analyzed. RTs were log transformed to reduce skewness of data. A mixed-effects model was performed with RTs as dependent variable and stress type (dominant vs. non-dominant) and stress neighborhood consistency (consistent vs inconsistent neighbors) as fixed factors. Bigram frequency was also entered as predictor. The same analysis was also adopted in Experiments 2 and 3. !

The model showed a significant effect of stress type ($t = 2.92$, $\beta = 0.038$, $st. err. = 0.013$, $p_{MCMC} = .004$): Participants were faster to identify the target stimulus as a word when it had dominant stress, than when it had non-dominant stress. No further effect reached significance (stress neighborhood consistency: $t = -1.8$, $p > .05$; stress type by stress neighborhood consistency interaction: $t < 1$; bigram frequency: $t < 1$. !

Response accuracy. A mixed-effects model was performed with response accuracy as the dependent variable and stress type (dominant vs. non-dominant) and stress neighborhood consistency (stress consistent vs. stress inconsistent) as fixed factors. Bigram frequency was also entered as a fixed factor. The same analysis was also adopted in Experiments 2 and 3. !

Overall error rate was 18.46% of all data points. A main effect of stress type was found ($z = -4.46$, $\beta = -1.987$, st. err. = 0.445, $p < .001$): Participants were less accurate in categorizing stimuli as words when they had non-dominant stress, than when they had dominant stress. No further effect reached significance (stress neighborhood consistency: $z < 1$; stress type x stress neighborhood consistency interaction: $z < 1$; bigram frequency: $z < 1$).

Nonwords. !

Reaction times. Only correct responses were analyzed. RTs were log transformed to reduce skewness of data. A mixed-effects model was performed with RTs as dependent variable and type of ending (dominant vs. non-dominant vs. neutral) as fixed factor. Orthographic neighborhood size and bigram frequency were also entered as predictors to control for their effect on response latencies. !

Latencies were shorter for nonwords with ambiguous (462 ms) and dominant (474 ms) stress endings compared to nonwords with non-dominant stress endings (485 ms; $t = 4.18$, $\beta = 0.040$, st. err. = 0.009, $p < .001$; and $t = 2.85$, $\beta = 0.025$, st. err. = 0.008, $p = .005$, respectively). The difference between dominant stress and ambiguous nonwords was not significant ($t = 1.53$, $p > .13$). Among the control predictors, only bigram frequency was significant ($t = 3.19$, $\beta = 0.032$, st. err. = 0.01, $p = .001$; orthographic neighborhood size: $t < 1$, $p > .4$). !

Response accuracy. Overall error rate was 16.27%. Nonwords with ambiguous (91%) and dominant (86%) stress endings were more accurate than nonwords with non-dominant stress endings (76%; $z = -4.951$, $\beta = -1.262$, st. err. = 0.255, $p < .001$; and $z = -3.898$, $\beta = -0.859$, st. err. = 0.220, $p < .001$, respectively). The difference between dominant stress and ambiguous nonwords was not significant

($z = 1.49$, $p > .13$). Among the control predictors, both orthographic neighborhood size and bigram frequency were significant ($z = -3.02$, $\beta = -0.227$, st. err. = 0.075, $p = .002$; and $z = -2.04$, $\beta = -0.529$, st. err. = 0.259, $p = .04$, respectively).!

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Discussion!

The data of Experiment 1 show that target words with dominant stress were recognized faster and more accurately than non-dominant stress targets and there was no effect of stress neighborhood consistency. Possibly, participants activated lexical phonology, because of the different stress patterns in the stimuli, and dominant stress words, as more typical or familiar stimuli, were facilitated. Moreover, nonwords most likely associated with non-dominant stress were slower and more error prone than both words with dominant and with ambiguous stress. These effects were significant although orthographic variables were included in the model to control for confounding factors. Thus, the disadvantage of nonwords with non-dominant stress suggests the involvement of phonology in nonword lexical decision. !

In Experiment 2 we investigated if different processing might occur when words were presented in lists blocked by stress. The idea was as follows: processing in Experiment 1 may have compelled lexical phonological contribution because of the simultaneous presence of stimuli with different stress, and of the resulting tendency to activate the phonological lexicon in order to discriminate words from nonwords. When all stimuli in a block have the same stress, the tendency to activate lexical phonology might be less strong, because in principle stress might be assigned following the list suggestion: if all the stimuli in a list have dominant stress, participants might be inclined to be consistent with the list and apply dominant stress. Thus, the stress dominance effect should diminish. If, in contrast, the tendency to activate lexical phonology is not subject to strategic adjustments, the dominant stress advantage should still occur. !

We used the same stimuli as in Experiment 1. In each block words either had dominant or non-dominant stress. Nonwords in each block were selected on the basis of the probability of being

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3 named with dominant or non-dominant stress, and were included so as to be congruent with the
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5 word list. Thus, within each block words and nonwords with the same stress pattern were presented. !
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8 9 10 Experiment 2 !

11 12 Method !

13 14 Participants. !

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16 Twenty-nine participants (7 males; mean age: 23.06, sd: 2.61) from the University of Padua took
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18 part in the experiment. They were all native Italian speakers with normal or corrected-to-normal
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20 vision. None had participated in the previous experiments. !
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24 Materials & Design. Words and nonwords were the same as in Experiment 1. Stimuli were
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26 presented in two blocks: Each block was composed of half words and half nonwords. All stimuli
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28 within a block had the same stress. !
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31 32 Procedure. !

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34 The same procedure as in Experiment 1 was adopted, except that the whole set of stimuli was
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36 divided into two blocks. Each participant was presented with two blocks, one with dominant stress
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38 words and nonwords, one with non-dominant stress words and nonwords. Stimuli were randomized
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40 within each block and block order was counterbalanced across participants. !
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43 44 Results!

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46 Five participants were excluded from the analyses because of a very low level of accuracy (40%,
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48 50%, 51%, 53%, and 45% of accuracy, respectively). Words and nonwords were separately
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50 analysed. !
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53 Reaction times and errors were both analysed using mixed-effects models (Baayen et al., 2008).
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56 Participants and items were treated as random factors. Results are reported in Table 4. !
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59 -Table 4- !
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Words. !

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3 Reaction times. The mixed-effects model on log RTs showed that the main effect of stress type was
4 significant ($t = 4.12$, $\beta = 0.04$, st. err. = 0.009, pMCMC <.001): Participants were slower when
5 categorizing word stimuli with non-dominant than with dominant stress. No further effect reached
6 significance (stress neighborhood consistency: $t < 1$; stress type x stress neighborhood consistency:
7 $t = -1.3$, $p > .1 < 1$; bigram frequency: $t < 1$). !

8
9
10 Response accuracy. Overall error rate was 22.89%. No effect reached significance (stress type: $z < 1$;
11 stress neighborhood consistency: $z < 1$; stress type x stress neighborhood consistency: $z < 1$; bigram
12 frequency: $z = 1.5$, $p > .1$).
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24 Nonwords.

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26
27 Reaction times. Latencies were shorter for nonwords with ambiguous (455 ms) and dominant stress
28 endings (458 ms) compared to nonwords with non-dominant stress endings (471 ms; $t = 3.16$, $\beta =$
29 0.028 , st. err. = 0.008, $p = .002$; and $t = 3.37$, $\beta = 0.027$, st. err. = 0.008, $p < .001$, respectively). The
30 difference between dominant stress and ambiguous nonwords was not significant ($t < 1$). Of the
31 other predictors, only orthographic neighborhood size was significant ($t = 2.20$, $\beta = 0.006$, st. err. =
32 0.028 , $p = .02$). !
33
34

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36
37 Response accuracy. Overall error rate was 22.7%. Nonwords with ambiguous (83%) and dominant
38 stress endings (79%) were more accurate than nonwords with non-dominant stress endings (71%; z
39 $= -3.506$, $\beta = -0.638$, st. err. = 0.182, $p < .001$; and $z = -3.563$, $\beta = -0.574$, st. err. = 0.161, $p < .001$,
40 respectively). The difference between dominant stress and ambiguous nonwords was not significant
41 ($z < 1$). Of the other predictors, only orthographic neighborhood size was significant ($z = -4.52$, β
42 $= -0.245$, st. err. = 0.054, $p < .001$). !
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55 Discussion !

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57 The results of Experiment 2 replicated those of Experiment 1: there was again an advantage
58 for dominant stress words compared to non-dominant stress words. Although overall the pattern
59 was the same as in Experiment 1, the size of the effect showed a tendency to decrease, at least in the
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2
3 analysis of response accuracy. Words with dominant stress showed an increase in error rate
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5 compared to Experiment 1, although there was a slight reduction in latencies. Apparently, then,
6
7 participants were able to take some advantage of the constant stress within a list, at least with non-
8
9 dominant words. As to nonwords, the same pattern was found as in Experiment 1, with nonwords
10
11 having dominant or ambiguous endings easier and more accurate than nonwords with non-dominant
12
13 endings. The nonwords types also differed in bigram frequency and proportion of words with
14
15 dominant stress sharing the same endings. However, the bigram frequency of nonwords with
16
17 ambiguous (11.3) and non-dominant (11.4) endings did not differ, while there was a significant
18
19 difference in latencies and accuracy between the two nonwords types. Thus, although we cannot
20
21 unambiguously determine the cause of the difference, possibly it was due to the nature of endings in
22
23 the two nonword types. !
24
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28

29 In Experiment 1 and 2 endings of words and nonwords partially overlapped (39%).
30
31 Moreover, endings of all stimuli in the first two experiments belonged to large-sized neighborhoods,
32
33 and were strongly biased toward one or the other stress pattern. Thus, endings could not help
34
35 participants in discriminating words from nonwords. !
36
37
38

39 In Experiment 3 we examined the possibility that the results of the two experiments were
40
41 mainly determined by the difficulty to discriminate words from similar nonwords because of the
42
43 overlapping endings, and by the consequent tendency to activate the lexical phonological
44
45 representation of words. It is well known that lexical decision is affected by strategic manipulations
46
47 depending, for example, on the type of nonword included (James, 1975; Shulman & Davison, 1977;
48
49 Stone & Van Orden, 1993; Yap, Balota, Cortese & Watson, 2006). Thus in Experiment 3 we
50
51 presented nonwords that were more dissimilar to words, compared to Experiment 1 and 2. We
52
53 created a new set of nonwords, which did not share endings with words. These nonword endings
54
55 belonged to small or to stress ambiguous neighborhoods that would not provide robust cues to stress
56
57 (Colombo, et al., 2013; Sulpizio et al., 2013). These nonwords were also lower in bigram frequency,
58
59 orthographic neighborhood size and orthographic neighborhood frequency (see Table 5), which
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1
2
3 increased their dissimilarity to words. If lexical decision can be affected by contextual effects of
4
5 word endings, smaller or no effects of word stress would be expected in Experiment 3. !

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10 Experiment 3!

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12 Method!

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15 Participants. Twenty-four participants (4 males; mean age: 21.41, SD: 0.82) from the University of
16
17 Padua took part in the experiment. They were all Italian native speakers with normal or corrected-
18
19 to-normal vision. None had participated in the previous experiments. !

20
21
22 Materials & Design. !

23
24
25 The same words as in Experiment 1 were used. A new set of 120 filler nonwords was included by
26
27 using mainly final sequences belonging to small or ambiguous neighborhoods, neither biased
28
29 toward dominant nor toward non-dominant stress (e.g., -odo), as verified in former studies
30
31 (Colombo et al., 2013). The new set of nonwords differed from that used in Experiments 1 and 2
32
33 on the following dimensions: bigram frequency, orthographic neighborhood size, and orthographic
34
35 neighborhood Frequency (see Table 5). The same design as in Experiment 1 was adopted. !

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38
39 - Table 5 - !

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41 Procedure. !

42
43 The same procedure as in Experiment 1 was adopted. !

44
45 Results!

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48 Two participants were excluded from the analyses because of a very low level of accuracy (46%
49
50 and 53% of accuracy, respectively). Nonwords were only used as fillers and were not analysed
51
52 (mean RTs: 477 ms; mean error rate 31.1%). For words, reaction times and errors – 22.89% of all
53
54 data points – were both analysed using mixed-effects models (Baayen et al., 2008). Participants and
55
56 items were treated as random factors. Results are reported in Table 6. !

57
58
59
60 -Table 6- !

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2
3 Reaction times. The model on log RTs showed a main effect of stress type ($t = 3.27$, $\beta = 0.047$, st.
4 err. = 0.014, $p_{\text{MCMC}} < .001$): Participants were slower with non-dominant than with dominant
5 stress words. No further effect reached significance (stress neighborhood consistency: $t < 1$; stress
6 type x stress neighborhood consistency : $t < 1$; bigram frequency: $t = 1.73$, $p > .05$).!

7
8 Response accuracy. The mixed-effects model on response accuracy showed a main effect of stress
9 type ($z = -3.1$, $\beta = -0.680$, st. err. = 0.219, $p < .001$), with participants being less accurate when
10 categorizing words with non-dominant than with dominant stress. No further effect reached
11 significance (stress neighborhood consistency: $z < 1$; stress type x stress neighborhood consistency:
12 $z = 1.4$, $p > .1$; bigram frequency: $z < 1$). !

26 Discussion !

27
28 The results of Experiment 3 show that changing the nonword context did not greatly affect the
29 pattern of data: Words with dominant stress were again recognized faster and more accurately than
30 words with non-dominant stress. Although the general pattern remained the same in the three
31 experiments, the size of the effects was reduced in Experiment 3, compared to Experiment 1, in
32 both latencies and error rate. This reduction in effect size was supported in the joint analysis of the
33 two experiments on both errors and latencies. In the RTs' analysis, stress ($t = 3.25$, $\beta = 0.038$, st. err.
34 = 0.011, $p = .001$); experiment ($t = -3.36$, $\beta = -0.043$, st. err. = 0.012, $p = .001$) and consistency x
35 experiment were significant ($t = -3.20$, $\beta = 0.031$, st. err. = 0.009, $p = .001$). The experiment and
36 stress factors indicated that latencies were faster in Experiment 3 than in Experiment 1, and for
37 dominant than non-dominant stress words. The interaction showed that the effect of consistency
38 was different in the two experiments, with slower latencies for consistent over inconsistent words in
39 Experiment 1 ($t = -2.071$, $\beta = -0.0204$, st. err. = 0.009, $p = .04$) but no effect in Experiment 3 ($t < 1$).!

40
41 In the analysis of errors, there were more errors in Experiment 3 than in Experiment 1 ($z = -$
42 5.03 , $\beta = -1.175$, st. err. = 0.233, $p < .001$), and the stress effect was significant ($z = -5.70$, $\beta = -$
43 1.628 , st. err. = 0.285, $p < .001$), but smaller in size in Experiment 3 than in Experiment 1 (stress x
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3 experiment; $z = 4.45$, $\beta = 0.837$, st. err. = 0.187, $p < .001$). Consistency x experiment ($z = -3.49$, $\beta =$
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5
6 -0.759 , st. err. = 0.217, $p < .001$) and the three-way interaction stress x consistency x experiment
7
8 were also significant ($z = 2.54$, $\beta = 0.704$, st. err. = 0.276, $p = .01$). The three-way interaction
9
10 showed that the dominant stress advantage was reliable in Experiment 3 for consistent words
11
12 (dominant stress advantage: 13.48%; $z = -3.345$, $p < .001$), while substantially decreasing for
13
14 inconsistent words (dominant stress advantage: 3.86%; $z = -1.06$, $p > .2$). This reduction however
15
16 was not apparent in Experiment 1 (dominant stress advantage for consistent words: 22.2%; $z = -$
17
18 4.178 , $p < .001$; dominant stress advantage for inconsistent words: 20.7%; $z = -7.33$, $p < .001$). !

21
22 The comparison between experiments also showed a trade off in Experiment 3, with a
23
24 decrease in latencies, but an increase in error percentage, compared to Experiment 1. This trade off
25
26 suggests that the change in the nonword context affected processing, with participants tending to
27
28 give a fast response, that often was mistaken, and with a reduction of the dominant stress advantage
29
30 in Experiment 3. Exactly which characteristics of nonwords produced this reduction is not clear,
31
32 given that the three nonword types were significantly different for bigram frequency, orthographic
33
34 neighborhood size and proportion of words with dominant stress sharing their endings. These
35
36 aspects were not controlled.
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41 The lack of a clear consistency effect in the present study, where lexical decision was used,
42
43 stands in strong contrast with the results obtained in former studies with a reading aloud task. In our
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45 view, this depends on processing differences due to the task, but it might also be that our results
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47 were strongly affected by the stimuli we used. To rule out such possibility we ran a control reading
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49 aloud experiment, in which the same stimuli as in Experiment 1 were used. We tested whether the
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51 same words would produce the typical stress neighborhood effect often reported in the literature on
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53 reading aloud. !
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60 Experiment 4 !

Method!

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Participants. !

Twenty-eight participants (15 males; mean age: 23.28, sd: 3.12) from the University of Trento took part in the experiment. They were all native Italian speakers with normal or corrected-to-normal vision. None had participated in the previous experiments. !

Materials & Design. !

The same as in Experiment 1 !

Procedure. !

Participants were tested individually. They were instructed to read the targets as quickly and accurately as possible. !

Stimuli were displayed in black upper-case letters, centered on the computer screen. Before the presentation of each stimulus, a fixation cross was displayed for 500 ms. Each stimulus disappeared at pronunciation or after 1500 ms. There was an inter-stimulus interval of 1500 ms. The experiment was preceded by a practice session with stimuli not included in the experimental trials. The experimenter noted the naming errors. The participants' responses were also recorded to allow further analyses of errors and control of stress pronunciations. !

!

Results and discussion!

Analyses were run only on naming errors (8.67% of all data points), which included mispronunciation errors, phonemic errors, and stress errors (see Table 8 for the relative proportion of error types). Reaction times were not analyzed since stimuli in different conditions were not matched on initial phonemes, which are well known to affect naming times (e.g., Kessler, Treiman, & Mullenix, 2002). Pseudowords were only used as fillers and were not analyzed. Results are reported in Table 7. !

!

-Table 7 and Table 8- !

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3 Statistical analyses, based on mixed-effects models (Baayen et al., 2008), were carried out
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5 combining all error types (but the analyses carried out for each type of error separately were
6
7 consistent). Accuracy was entered as the dependent variable and stress type (dominant vs. non-
8
9 dominant) and stress neighborhood consistency (stress consistent vs. stress inconsistent) as fixed
10
11 factors. Words bigram frequency was also entered as fixed factor. Participants and items were
12
13 treated as random factors. The model showed a main effect of stress neighborhood consistency ($z =$
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15 -2.67 , $\beta = -1.212$, st. err. = 0.453, $p = .007$), with participants being less accurate when reading
16
17 stress inconsistent than stress consistent words. No further effect reached significance (stress type: z
18
19 < 1 ; stress type x stress neighborhood consistency: $z < 1$; bigram frequency: $z < 1$).!

20
21 The data of the naming experiment confirmed the results of former studies (e.g., Burani &
22
23 Arduino, 2004; Burani et al., 2014; Paizi et al., 2011), with an advantage for consistent over
24
25 inconsistent stress neighbors, and no stress dominance effect, thus suggesting that the results
26
27 obtained in our lexical decision experiments were not due to the particular nature of the stimuli.!

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34 35 36 General Discussion !

37
38 The present study aimed to investigate the role of lexical stress and stress neighborhood
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40 consistency in word recognition in a transparent orthography. To summarize, Experiments 1-3
41
42 showed an advantage for dominant stress over non-dominant stress words, despite changes in
43
44 nonword context and list composition. This stress effect was significant in each lexical decision
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46 experiment, but tended to decrease with the change in nonword context. When nonwords became
47
48 less similar to experimental words, latencies became shorter but error rates increased. Finally, the
49
50 dominant stress advantage was no longer apparent in the reading aloud task.

51
52 The stress effect we found partially replicates Colombo (1992) who also found an advantage
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54 for dominant stress, although only in the measurement of errors. In contrast, Burani and Arduino
55
56 (2004) did not find it. Several factors may be responsible for this difference, probably the most
57
58 important of which is that in the latter study selected materials had a higher number of stress friends
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3 for non-dominant than for dominant stress words. We note, however, that Burani and Arduino
4 (2004) did not find any effect of stress neighborhood consistency in lexical decision. Other factors
5
6 may include the nonword type, as the present experiments show that changes in nonword context
7
8 may provide slight differences in the results. !
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15 Phonology and the dominant stress advantage.

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17 In the introduction we expected an effect of the dominant stress because overall activation within
18 the phonological lexicon would be greater for word types with the dominant pattern and the
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20 decision process would be able to monitor this activity and produce an advantage for words with
21
22 dominant stress. !
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27 Although in principle the dominant stress advantage might be driven just by faster access to the
28
29 lexical phonological representations, it is also possible that the sublexical level also contributes to
30
31 the computation of phonology. Segmental phonology would be activated very fast in Italian and is
32
33 not error prone, and its output, maintained in the buffer, would feed the phonological lexicon in
34
35 addition to the activation from orthography. Words with dominant stress would receive more
36
37 feedback activation from the phonological lexicon, and therefore would be recognized faster than
38
39 words with non-dominant stress. This view is consistent with simulations of the reading process in
40
41 the computational model of Italian by Perry et al. (2014). Moreover, the model includes two
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43 pathways, for lexical and sublexical phonology, and easily lends itself to the possibility of relatively
44
45 independent manipulations of either pathway to explain nonword context effects, as shown by the
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47 authors.
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53 As apparent from the analyses, the change of nonword context in the three lexical decision
54
55 experiments slightly but significantly affected the results. Latencies were significantly faster in
56
57 Experiment 3, where words and nonwords were more dissimilar, than in Experiment 1. The
58
59 inclusion of nonwords with rare or ambiguous endings in Experiment 3 produced a higher error rate
60
and the overall dominant stress advantage decreased in the pattern of errors from 21% to 9%. This

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3 result may have been due to differences in the nonword types, (in bigram frequency, for example).
4
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6 However, considering the three-way interaction experiment by stress by consistency in the joint
7
8 analysis of Experiments 1 and 3, it seems likely that word endings were at least in part responsible
9
10 for the differences. Possibly, they were indeed processed by our participants and, to some extent,
11
12 affected the way they performed lexical decision, thus supporting the idea that both sublexical and
13
14 lexical processes were involved in the experiments. Also supportive of this interpretation is the
15
16 difference between nonword types in the analyses of both latencies and errors. !
17
18

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20 Our results are partially consistent with findings reported by Jouravlev and Lupker (2014)
21
22 who manipulated stress type and neighborhood consistency in lexical decision. For Russian
23
24 adjectives, the only grammatical category with strong asymmetries in the relative proportion of
25
26 initial vs final syllables, the authors reported an advantage for initial syllables stress (the most
27
28 frequent stress type), no effect of consistency, and, in the pattern of errors only, an effect of
29
30 consistency affecting just the less common stress pattern. Our results overall confirmed the
31
32 advantage for the dominant stress pattern. !
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39 Context effects and task differences.

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41 The results of Experiment 4 showed that the same stimuli that produced a clear dominant stress
42
43 advantage and no effect of stress neighborhood consistency in lexical decision (Experiment 1),
44
45 showed exactly the reverse pattern (a stress neighborhood consistency effect, but no stress
46
47 dominance effect) in reading aloud. The dissociation suggests that different mechanisms were at
48
49 work in the two tasks. Therefore, we are confident that the effects we reported in lexical decision
50
51 are due to how the system recognizes the stimuli and not to the nature of stimuli. !
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55
56 The different involvement of processes in reading aloud and lexical decision has been
57
58 thoroughly investigated, and accounted for in different ways. Balota and collaborators (Balota &
59
60 Chumbley, 1984; Balota & Spieler, 1999; Colombo, Pasini & Balota, 2006; Yap et al., 2006)
claimed that word-nonword discrimination involves two different processes, a familiarity evaluation

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3 that may drive responses in addition to lexical activation rate, and an attentional process, required
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5 when nonwords are very similar to words. According to the two-process model, when words and
6
7 nonwords are very different, an accurate orthographic-phonological check is bypassed, and familiar
8
9 stimuli may be easily accepted as words. However, when nonwords are similar to words, differing
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11 for example by one letter, their discrimination from words, in particular low frequency and less
12
13 familiar words, requires an in-depth processing before a response is given. !

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17 In the present study nonwords were more similar to words in Experiments 1 and 2, than in
18
19 Experiment 3. In the latter, the greater dissimilarity may have induced participants to avoid an
20
21 accurate check, and to give a fast, but often inaccurate response, thus explaining the 12% increase
22
23 in overall error rate. The much greater frequency of the penultimate syllable stress over all words in
24
25 Italian makes this type of stress more familiar. However, when these words have inconsistent
26
27 endings, this makes them comparatively less familiar, and this might explain the greater error rate
28
29 increase (23.14%) in Experiment 3 compared to Experiment 1 for words with dominant stress but
30
31 inconsistent endings (seNlle). This is less of a problem when a relatively fuller processing of the
32
33 words is carried out, as in Experiment 1, but induces more errors when processing is made faster by
34
35 the dissimilarity of nonwords. This interpretation rests on the idea that words were distinguished
36
37 from nonwords on the basis of the familiarity of their phonological representation, and that words
38
39 with dominant stress have a more familiar representation because dominant stress is more frequent.
40
41 This interpretation is more suitable to account for the results, compared to one purely in terms of
42
43 orthography, which would not be able to account for the presence of the stress effect in Experiment
44
45 3, suggesting that phonology was active. !

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48 The present results might be explained in a slightly different framework. Stone and Van
49
50 Orden (1993; see also Yap et al., 2006) used a random walk model to account for the variation in
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52 the size of the frequency effect as a function of nonword type. Specifically, they found that the size
53
54 of the frequency effect (a marker of lexical involvement) increased with the increase in
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56 word/nonword similarity (e.g., going from illegal strings, to legal nonwords, and to
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3 pseudohomophones). In contrast to the two-process model, this framework assumes that only signal
4 strength, an evidence accumulating process, is responsible for the effects. Within this process, high
5 frequency words have a stronger signal than low frequency words, since signal strength is greater
6 for stimuli that are processed more efficiently. When nonwords are very similar to words (for
7 example, with pseudohomophones, or with shared endings), signal strength decreases for both high
8 and low frequency words, increasing overall latencies. The frequency effect increases as well, with
9 the relation between signal strength and the time to give a response following a non linear-concave
10 function (Stone & Van Orden, 1993). This means that the same change in the rate of evidence
11 accumulation for a signal has a greater impact on processing times of stimuli that are processed less
12 efficiently (e.g., low frequency words).!

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27 To extend this interpretation to the present data, we might assume that dominant stress words
28 would have higher signal strength because they are more frequent as a type, compared to words
29 with non-dominant stress. According to the random walk model changes in the nonword context
30 produce changes in the response criterion, which is the distance of the decision boundary (i.e.,
31 word/nonword) from the start point and indicates how easy it is to take a decision in terms of
32 processing involvement. With a decrease in word/nonword similarity, response boundaries become
33 less conservative, producing faster responses but more error prone. Thus, with the decrease in
34 word/nonword similarity from Experiment 1 to Experiment 3, response boundaries became less
35 conservative, and responses were faster, but more prone to errors. As a result, the size of the stress
36 effect was larger (significantly for accuracy and numerically for RTs) in Experiment 1 than in
37 Experiment 3. Moreover, error rates increased with the decrease in word/nonword similarity. Our
38 overall pattern is similar to that reported by Stone and Van Orden's model. Note that the model
39 predicts that the nonword manipulation should impact more on stimuli with lower signal strength
40 (i.e., low-frequency words in Stone and Van Orden's study). This being the case, we would have
41 expected the manipulation to have a stronger impact on non-dominant stress words, which should
42 be, *prima facie*, the stimuli with lower signal strength. Differently, in Experiment 3, there was a
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3 larger decrease in accuracy for words with dominant stress, in particular for those with inconsistent
4 endings (see Table). In contrast, the nonword manipulation in Experiments 1-3 had a smaller impact on
5 those stimuli, that showed the lowest performance overall. Thus neither the two-process model nor
6 the random walk model can completely explain the whole set of results of the present study. To
7 summarize, the process of word recognition produced a pattern of results quite different from those
8 exhibited in reading aloud, suggesting that the nature of processes involved in lexical decision are
9 quite dissimilar from those involved in reading aloud, where perhaps production mechanisms are
10 more relevant.
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22 Overall, the present results show an effect of stress in lexical decision that supports the idea of
23 automatic phonological activation. The decrease in the stress effect in Experiment 3 may have been
24 related to a decrease in lexical effects, and a simultaneous increase in sublexical effects, as in Stone
25 and Van Orden's study. This is not to say that phonological effects cannot vanish, under the
26 appropriate conditions: for example, in Peressotti and Colombo (2010; Experiment 4) no effect of
27 pseudohomophones was found in lexical decision, since, because of the type of nonwords included,
28 participants were able to perform the task based solely on orthography.
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39 To conclude, our study investigated processing of the same stimuli, requiring the same
40 response, under different processing conditions, determined by either a different context
41 (Experiments 1 and 3) or a blocking of stimuli (Experiment 2), and a further comparison with a
42 different task (Experiment 4). The results showed a robust effect of prosodic manipulation, showing
43 that stress information may play an important role during word recognition. !
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3 Appendix !
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6 Words used in all experiments !
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8 Stimuli with dominant stress and consistent stress neighborhood: arcana, avaro, balena, canora,
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10 carota, castoro, cicuta, decoro, dimora, fachiro, forati, fulgore, granita, icona, mulino, papiro, pedine,
11
12 pepita, pulcino, querela, ristoro, scolaro, silicio, sirena, sonoro, sottane, spremuta, tapiro, vaccino,
13
14 vampiro. !
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17 Stimuli with dominant stress and inconsistent stress neighborhood: alfiere, asilo, barile, baule,
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19 concime, cratere, cupido, enzima, fienile, indiano, infido, intrico, macaco, mangime, metano,
20
21 monile, moviola, ortica, ostile, paiolo, pianola, raviolo, senile, sultano, tagliola, tritolo, tucano,
22
23 tutela, vaiolo, vescica. !
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26
27 Stimuli with non-dominant stress and consistent stress neighborhood: bilico, bolide, buttero, cantico,
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29 capsule, celtico, colica, cresima, distico, duttile, esule, flebile, fodero, fossile, futile, infimo, ionico,
30
31 labile, lacero, ludico, missile, porfido, raffica, sciatica, sferica, spasimo, tattile, tunica, vigile,
32
33 zenzero. !
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36
37 Stimuli with non-dominant stress and inconsistent stress neighborhood: afona, alluce, anfore, argine,
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39 barbaro, bibita, canfora, concavo, darsena, despota, diafana, domino, folgore, fosforo, fradicio,
40
41 lapponi, logoro, mescita, orbita, orfane, porpora, recluta, redini, ruggine, satiro, suddito, timpani,
42
43 zattera, zefiro, zingaro. !
44
45

46 Nonwords used in Experiments 1, 2, and 4. !
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48 adimo, aldume, astola, astone, ballido, bedule, begano, berino, bettuce, bildese, biluta, birume,
49
50 bistone, bodune, bollice, bovero, camoni, castubo, ceberi, celido, ceraso, chiroga, cobota, comilo,
51
52 corafo, dediro, denora, derule, dirloni, dirtola, dolame, dorreta, ellate, empomi, eperi, etuce, faboga,
53
54 facero, faride, feluge, fiocimi, fispuce, fraboro, gambura, ganoci, gecana, ginido, gofano, gospilo,
55
56 govato, gramulo, gurafo, iruta, lagule, lemana, leneri, licero, lidame, lighena, linata, lirdane, mavena,
57
58 mepela, mepuce, mulica, nalafo, necile, ninoro, nosela, nostubo, oddimo, ofide, onese, paghite,
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60 paroga, piedomi, pirtubo, pitano, pivida, polaso, pudela, rastole, reluge, remoni, rincolo, rolide,

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rudomi, saccubo, saloci, sbaccole, scelate, settame, sintura, sorato, sperilo, spisida, stipimi, stoleta,
strimole, tenuge, terpico, tevone, tolebre, trofulo, tugile, umbica, urfina, valona, vepela, visima,
vistena, voberi, zaloci, zefomi, zelido, zifilo, zilota, ziltica, zipero, zircona. !

Nonwords used in Experiment 3. !

badusa, balusa, batila, bicopa, bidaro, bilango, bofengo, bogada, bostuda, bunesi, burnado,
cambupo, catrofa, celango, cevaro, cimpofe, copifa, cudige, dabefo, dabengo, dalise, darila,
delaco, dereto, dibipa, dorango, duntesi, fazubo, fenula, fenzada, fonnira, funzaca, gafodo,
galifo, galova, galtodo, gampesi, ganeca, gatala, gavira, grenofo, gulefo, gurife, labofo, lebifo,
lenubo, lintaro, lofada, lopirop, lubego, madife, mefaca, midefa, midego, midesa, mindofe, motipa,
muntifo, nabice, nafeno, naltige, naltipe, nelluco, neltofe, nerise, nesupo, nizzeto, paduco, paltefa,
pecila, peviro, pirtefa, pivaco, purofe, ragifa, ravesa, rilofa, rimpaca, rinzapo, ronise, rucodo, rufipe,
saveca, sefoma, selapo, sevipo, sicova, simbego, soveto, supala, tadrofa, tefopa, tellusa, tobefo,
tolado, tolice, tolipe, tozife, truvapo, turiipo, tuveno, vamige, vedoma, vibala, vibofe, vintado,
vopesa, vostife, vusteca, vutopa, zartipa, zatula, zavuda, zecife, zelaco, zibofo, zolubo, !
zonupo, zufice. !

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Table 1. Examples of word stimuli for each experimental condition.!

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| Stress neighborhood! | Stress type! | |
|----------------------|------------------|----------------------|
| ! | Dominant stress! | Non-dominant stress! |
| Consistent ! | graNIta (slush)! | MISsile (missile)! |
| Inconsistent ! | seNIle (senile)! | BIbita (drink)! |

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Table 2. Summary statistics: means (and standard deviations) for the words used in the experiments: Words with Dominant stress and consistent (GraNIta, slush), and inconsistent (seNIle, senile) stress neighborhood; words with non-dominant stress and consistent (MISsile, missile), and inconsistent (BIbita, drink) stress neighborhood. Examples of target words are in parentheses. !

| Item Variables! | Dominant stress | | Non-Dominant stress ! | |
|---|--|--|---|--|
| | Consistent stress neighborhood! (graNIIta)! | Inconsistent stress neighborhood! (seNIle)! | Consistent stress neighborhood! (MISsile)! | Inconsistent stress neighborhood! (BIbita)! |
| Frequency! | 9.43! (11.31)! | 12.2! (21.88)! | 8.13! (12.54)! | 7.4! (5.72)! |
| Length in letters! | 6.4! (0.67)! | 6.43! (0.67)! | 6.6! (0.62)! | 6.6! (0.62)! |
| Number of orthographic neighbors (N)! | 3.1! (1.58)! | 2.33! (1.58)! | 2.9! (1.97)! | 2.8! (1.58)! |
| Mean Neighbors' frequency! | 5.6! (5.44)! | 8.36! (13.76)! | 5.73! (6.68)! | 4.63! (5.97)! |
| Mean Familiarity! | 2.41! (0.61)! | 2.14! (0.6)! | 2.26! (0.47)! | 2.16! (0.6)! |
| S-Neighborhood size (total number)*! | 289! (78.09)! | 299! (48.99)! | 452! (39.6)! | 593! (134.2)! |
| Proportion of stress consistent words+! | 0,68! (.04)! | 0,15! (.03)! | 0,86! (.02)! | 0,16! (.01)! |

* Total number of words in each stress neighborhood defined by endings (e.g., neighbors in -Ita)!

+ Proportion of words with the same ending as a target word, and congruent stress (e.g., graNIIta, Gita, adiBIIta, conDIIta, but not BIbita, etc.)!

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Table 3. Mean RTs for correct responses and percentage of errors by condition (with standard deviations), in Experiment 1 (Mixed block).

| Stress type | Stress neighborhood consistency | | | |
|---------------------|---------------------------------|------------------|--------------|------------------|
| | Consistent | | Inconsistent | |
| | Mean RTs | %E | Mean RTs | %E |
| Dominant stress | 462 (13) | 12.16 (9.25) | 454 (14) | 7.17 (9.6) |
| Non-dominant stress | 478 (18) | 34.34 (12.14) | 474 (20) | 27.85 (10.83) |
| Stress effect | 16 | 22.2 | 20 | 20.7 |

Table 4. Mean RTs for correct responses and percentage of errors by condition (with standard deviations) in Experiment 2 (Pure blocks).

| Stress type! | Stress neighborhood consistency! | | | |
|----------------------|----------------------------------|----------|---------------|----------|
| | Consistent | | Inconsistent! | |
| ! | Mean RTs! | %E! | Mean RTs! | %E! |
| Dominant stress! | 445! | 21.13! | 447! | 18.87! |
| | (27)! | (13.72)! | (27)! | (16.75)! |
| Non-dominant stress! | 465! | 26.87! | 459! | 25.29! |
| | (27)! | (13.41)! | (31)! | (12.48)! |
| Stress effect! | 20! | 5.74! | 12! | 6.42! |

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Table 5. Comparison of the mean values of the variables for the nonwords in Experiments 1-2, and 3.

| Variables: | Experiment 1-2: | Experiment 3: | t test: |
|-------------------|-----------------|---------------|--------------------|
| Bigram frequency: | 11.53: | 11.26: | 7.03, $p < .001$: |
| N size: | 1.13: | 0.78: | 7.8, $p < .001$: |
| N Frequency: | 18.02: | 0.16: | 1.9, $p = .05$: |

Table 6. Mean RTs for correct responses and percentage of errors by condition (with standard deviations) in Experiment 3. !

| Stress type! | Stress neighborhood consistency ! | | | |
|----------------------|-----------------------------------|--------------------|----------------|--------------------|
| | Consistent | | Inconsistent ! | |
| ! | Mean RTs! | %E! | Mean RTs! | %E! |
| Dominant stress! | 447! (23)! | 26.49! (13.84)! | 452! (24)! | 30.31! (15.94)! |
| Non-dominant stress! | 469! (31)! | 39.97! (17.73)! | 461! (23)! | 34.17! (14.15)! |
| Stress effect ! | 22! | 13.48! | 9! | 3.86! |

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Table 7. Percentage of errors by condition (with standard deviations), in Experiment 4 (Reading aloud).!

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| Stress type! | Stress neighborhood consistency ! | |
|----------------------|-----------------------------------|-------------------|
| | Consistent ! | Inconsistent ! |
| Dominant stress! | 4.54! (4.90)! | 13.93! (4.89)! |
| Non-dominant stress! | 4.17! (4.12)! | 12.03! (6.37)! |

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