Feet are parametric—even in languages with stress

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In this paper, we compare English and Brazilian Portuguese (BP), and argue that, despite similarities in their stress patterns, these languages are fundamentally different: while English builds feet, BP does not.

Background: In languages where prominence is characterized as 'stress', it is computed in the phonological word (PWd) and realized in the foot (Selkirk 1984, Nespor and Vogel 1986). English is representative of this type of language: in nouns and adjectives, left-headed weight-sensitive binary feet (moraic trochees) are built from the right edge of the PWd, coupled with final syllable extrametricality (Hayes 1982); see (1a). Binary feet also play a role in regulating minimal word size in English: no sub-minimal (CV_μ) lexical words exist in the language, and truncation, including hypocorization, never results in monomoraic forms (1b).

(1) **English**
(a) $[ə_\mu(\widehat{dʒ}\acute{ɛ}_\mu n_\mu)_{Ft}\langle də_\mu\rangle]_{PWd}$ 'agenda'
$[(k\acute{æ}_\mu nə_\mu)_{Ft}\langle də_\mu\rangle]_{PWd}$ 'Canada'
(b) chemistry → [kɛm], *[kɛ]
Elizabeth → [lɪz], *[lɪ]

French contrasts with English. The only obligatory position of prominence is the right edge of the phrase, not the word (Dell 1984) (2a), sub-minimal lexical words are freely tolerated (2b), and truncation/hypocorization can yield sub-minimal forms (Weeda 1992, Scullen 1997) (2c). Since lexical words must contain a binary foot to be well-formed (McCarthy and Prince 1986), this, coupled with the absence of word-level stress, has led some scholars to propose that French is footless (Jun and Fougeron 2000).

(2) **French**
(a) [lə ɡʀɑ̃ ɡaʀsɔ́], *[lə ɡʀɑ̃́ ɡaʀsɔ́]
'the big boy'
(b) [li] 'bed'
[fɛ] 'done'
(c) *chimie* → [ki]
Dominique → [do]

At first glance, BP looks just like English, aside from final extrametricality: in nouns and adjectives, left-headed weight-sensitive binary feet are built from the right word edge (3a).

(3) **BP**
(a) $[pa_\mu(p\acute{ɛ}_\mu l_\mu)_{Ft}]_{PWd}$ 'paper'
$[sa_\mu(p\acute{a}_\mu tʊ_\mu)_{Ft}]_{PWd}$ 'shoe'
(b) [pa] 'shovel'
[fɛ] 'faith'
(c) *dou* → [do] '(I) give'
Fernanda → [fe]

Once we compare the languages more carefully, however, we notice important differences between them. First, BP—like French and unlike English—has a high number of sub-minimal words (3b) and word-minimality can be violated in vowel fusion and hypocorization (3c). Second, when metrical patterns beyond those in (3a) are factored in, the range of patterns attested cannot be captured by a single foot type. Indeed, foot-based analyses of BP have employed trochees (Bisol 1992), iambs (Lee 2007), and/or dactyls (Wetzels 1992), with no single analysis emerging as optimal. Interestingly, the same holds for French. Scholars who propose that French has feet cannot agree on what type of foot it has: trochees (Selkirk 1978, Montreuil 2002), iambs (Charette 1991), or unbounded feet (Dresher and Kaye 1990). In English, by contrast, there is general consensus that the language builds moraic trochees. Exceptions to regular stress do not cast doubt on foot type; instead, they involve the presence or absence of extrametricality: $[(k\acute{æ}_\mu nə_\mu)_{Ft}\langle də_\mu\rangle]$ 'Canada' vs. $[bə_\mu(n\acute{æ}_\mu nə_\mu)_{Ft}]$ 'banana'.

Proposal: We have seen that indeterminacy in foot type, along with free violations of word minimality, casts doubt on the existence of the foot in BP, thus making it more parallel to French than to English. Below, we show that a third difference between BP and English—weight effects in antepenultimate position—seals the fate against the foot in BP but further motivates it for English.

Weight effects in antepenultimate position: In contrast to (3a), 12% of BP nouns and adjectives display antepenultimate stress, which, under a footing analysis, suggests that the language has exceptional final syllable extrametricality: $[pa_\mu(t\acute{ɛ}_\mu ti_\mu)\langle ko_\mu\rangle]$ 'pathetic'. Crucially, if BP builds feet, then two logical possibilities are predicted for weight-sensitivity: (a) weight effects are *not active* in antepenultimate syllables, i.e., a LLL word is just as likely to bear antepenultimate stress as a HLL word (ĹLL ∼ ĤLL); or (b) weight effects are *negative*, i.e., LLL words are more likely to bear antepenultimate stress than HLL words (ĹLL ≻ ĤLL). If, however, BP does not build feet, then we predict that *positive* weight effects should be found in antepenultimate position: ĤLL ≻ ĹLL. Weight effects in antepenultimate position are problematic for footing because foot typology can't capture this, as a marked metrical structure cannot be avoided: (H)L⟨L⟩ contains a medial unfooted syllable, while (ĤL)⟨L⟩ contains a highly marked uneven trochee (cf. ĹLL, which is perfectly parsed as (ĹL)⟨L⟩, as in $[pa_\mu(t\acute{ɛ}_\mu ti_\mu)\langle ko_\mu\rangle]$). Thus, if BP lacks feet, we predict ĤLL ≻ ĹLL; if English has feet, we predict either ĤLL ∼ ĹLL or ĹLL ≻ ĤLL.

Experiment: Native speakers of BP ($n = 27$) and English ($n = 13$) listened to pairs of nonce words that differed only in stress location. The stimuli in both experiments (n = 240 (Pt); n = 180 (En)) were generated by a script in R (R Core Team 2018), then manually checked for phonotactic naturalness in each of the languages. The stimuli were categorized into three weight profiles: HLL, LHL and LLL. Heavy syllables contained a coda consonant; for the English experiment, all final syllables were of the shape CəC, given that the profile of final CV syllables is highly skewed in the language. Representative examples are provided in (4) below. Vowel quality was later examined to rule out a possible effect of inherent duration.

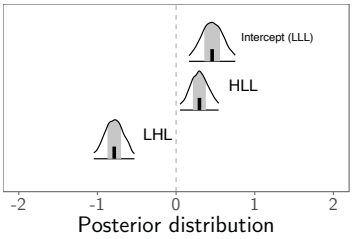
(4) BP stimuli: gu.pla.ɾo (LLL) bɾon.da.le (HLL) bo.gɾen.da (LHL)
English stimuli: kɪ.mɛ.sər (LLL) lɪn.sɛ.kəf (HLL) tɛ.prɪŋ.kəl (LHL)

The BP and English stimuli were recorded by a female native speaker of BP and a male native speaker of English, respectively—both with training in phonetics. Participants were asked to choose which version of each minimal pair sounded more natural to them. Stimuli and order of presentation were randomized. The data were modelled with Bayesian hierarchical logistic regressions, which included by-speaker random intercepts and slopes, as well as by-item random intercepts.

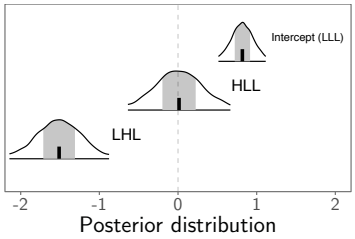
Results and analysis: Fig. 1 plots the results. Not surprisingly, LHL words disfavor antepenultimate stress in both languages. Speakers of BP preferred ĤLL to ĹLL: the entire posterior distribution of HLL is above zero, as seen in Fig. 1a. Speakers of English, however, showed no statistically credible difference between ĤLL and ĹLL—indicated in Fig. 1b by the posterior distribution of HLL, which is centered around zero. The experimental results for BP expand on the data in (3a): heavy syllables are more likely to be stressed in *all* positions in the stress domain. The results are also consistent with the word-minimality violations in (3b-c), in that the weight effect in antepenultimate syllables is unexpected if feet play a role in the language. If BP does *not* build feet, however, we not only predict the presence of sub-minimal words, but also the weight effect in question. In contrast, the results for English are consistent with (1a-b): feet capture the (lack of) weight effects in antepenultimate position as well as the word-minimality restriction in the language.

Figure 1: Posterior distributions of effect sizes. Distributions > 0 favor antepenultimate stress (rel. to LLL).

(a) BP ($n = 27$): ĤLL $>$ ĹLL



(b) English ($n = 13$): ĹLL $\sim$ ĤLL



Outstanding questions: One common argument for the foot in BP is that antepenultimate stress is not productive because it involves exceptional extrametricality. On our account, if there are no feet, we predict that antepenultimate stress should be productive. Support for this comes from borrowings such as *messenger*, *caravan* and *marketing*, which are produced with antepenultimate stress in BP. This cannot be explained simply as preservation of the source language's stress pattern as words like *hamburger* and *cinema* have penultimate stress. Likewise, words such as *nylon* and *paddle* ([náj.loŋ], [pá.dew]), which would also require exceptional extrametricality because of the final heavy syllable, are never repaired.

Another common argument is that feet are needed to account for secondary stress in BP. Surprisingly, though, the location of secondary stress in the language can vary, suggesting that syllables are not necessarily iteratively parsed into moraic trochees from the right edge of the word: initial stress, e.g., dèsodoránte *vs.* a rhythmic right-to-left pattern, e.g., desòdoránte 'deodorant'. Further, it is unlikely that the latter involves feet because no weight effects are observed: compare *bordó* 'maroon', which does not have secondary stress on the first syllable even though it is heavy and could therefore form a moraic trochee (*[(bò$_\mu$r$_\mu$)(dó$_\mu$)]), in contrast to the same syllable in *bòrboléta* 'butterfly'. This contrasts with English, where a word like [(bæ̀$_\mu$n$_\mu$)(dǽ$_\mu$)⟨nə⟩] 'bandana' has secondary stress on the initial heavy syllable (cf. *banána*), indicating that moraic trochees also regulate secondary stress.

In sum, there is more evidence against the foot than for it in BP. Counter to first appearances, this makes BP look more like French, another Romance language, than like English.